Discussion Papers

Determinants of interest rate spread for new household loans in Slovenia

Some preliminary observations

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Table of contents

Abstract

This discussion paper outlines some preliminary results regarding the determinants of interest rate spread on new housing and consumer loans in Slovenia. Using a representative sample of housing and consumer loans approved by Slovenian banks between October 2018 and March 2022, we examine the impact of loan-specific and time-varying bank factors on the interest rate spread of new loans. We find that loan-specific variables (loan amount, maturity, interest rate type, presence of loan security, DSTI ratio, etc.) play an important role in determining the spread. They are statistically and generally also economically significant. This suggests that Slovenian banks take account of loan characteristics when pricing new loans. We also find that certain bank-specific, time-varying characteristics (market share, total capital ratio and NPE ratio) are statistically significant and have a non-negligible impact on spreads. We observe that loans deviating from macroprudential measures introduced by the Banka Slovenije (DSTI, maturity and LTV cap) generally have higher spreads. Nevertheless, this impact is economically small and likely imperceptible to borrowers who are creditworthy.

Povzetek

V tem prispevku predstavljamo preliminarno analizo dejavnikov, ki vplivajo na obrestne marže novih stanovanjskih in potrošniških posojil v Sloveniji. Na reprezentativnem vzorcu stanovanjskih in potrošniških posojil, ki so jih slovenske banke odobrile med oktobrom 2018 in marcem 2022, smo proučili vpliv karakteristik posojil in časovno spremenljivih bančnih karakteristik na obrestne marže novih posojil. Ugotavljamo, da imajo karakteristike posojil (znesek posojila, ročnost, vrsta obrestne mere, prisotnost zavarovanja, razmerje DSTI itd.) pomembno vlogo pri določanju obrestne marže. Njihovi učinki so statistično značilni in v večini primerov tudi ekonomsko nezanemarljivi. To nakazuje, da slovenske banke pri oblikovanju cen novih posojil upoštevajo njihove značilnosti. Ugotavljamo tudi, da so bančne karakteristike, ki se spreminjajo skozi čas (tržni delež, količnik celotnega kapitala, razmerje NPE), statistično značilne, njihov učinek pa je prav tako ekonomsko pomemben. Posojila, ki odstopajo od makrobonitetnih ukrepov Banke Slovenije (omejitev razmerja DSTI, ročnosti in LTV), imajo praviloma višje obrestne marže. Razlike so sicer nizke in verjetno neopazne za posojilojemalce, ki so kreditno sposobni.

1 Introduction

For bank regulators, it is important to understand what factors banks consider when pricing new loans. This information is useful in several areas, including for the analysis of financial stability and for conducting macroprudential policy. The aim of this discussion paper is to analyse the determinants of interest rate spreads for new loans issued by Slovenian banks. We hope that this information can inform the activities of financial regulators in Slovenia.

There is a rich literature attempting to identify the factors affecting interest rate spreads of banks. A seminal paper in the field was written by Ho and Saunders (1981) (later extended by Maudos and Fernandez de Guevara (2004) and others), who developed a theoretical model that explains the interest rate margins of banks by assuming banks are dealers faced with uncertain deposit supply and loan demand. In the model, the bank interest rate spread is explained by macroeconomic characteristics (e.g. reference interest rate volatility), bank-specific characteristics (e.g. capital adequacy ratio) and market structure characteristics.

Rather than considering the interest rate margins at the bank level, some papers focus on determining factors that affect interest rate spreads for new loans. In addition to macroeconomic and bank factors, those studies (e.g. Hubbardm Kuttner and Palia (2002)) also consider the effects of loan characteristics on interest rate spreads. In this discussion paper, we follow this approach when analysing the determinants of interest rate spreads for new bank loans to households in Slovenia.

We analyse the interest rate spread determinants for new housing and consumer loans approved by Slovenian banks between October 2018 and March 2022. Our sample covers about 97 % of loan volume approved over the period and includes information on the characteristics of individual loans. We regress individual loan characteristics and the time-varying bank variables against the interest rate spreads of new loans to identify their effect on the spread. We also consider the compliance of individual loans with macroprudential measures introduced by the Banka Slovenije to estimate whether compliance (or lack thereof) affects the interest rate spreads of new loans. We estimate the model coefficients using the least squares dummy variables (LSDV) model, which allows us to control for bank-and time-fixed effects.

To the best of our knowledge, this is the first study that uses loan-level data to analyse the determinants of interest rate spreads of new loans in Slovenia. Our objective is to identify the relevant factors for determining the interest rate spreads. We place special importance on determining the effect of compliance with the Banka Slovenije's borrower-based measures on the interest rate spread. This work was motivated by a financial podcast where it was suggested that Slovenian banks do not adjust the interest rates based on the loan characteristics, but may adjust them based on the strength of the business relationship (measured by the number of products the customer has at a particular bank). This hypothesis cannot be tested directly, but if it holds true, we would expect that the impact of loan characteristics on loan spread should be either economically small, statistically insignificant or both. The other motivation to conduct this study was to examine whether compliance with borrower-based measures affects the spread.

2 A brief literature review

There is a rich literature attempting to explain the loan interest rate spreads of banks. The seminal paper on the topic was written by Ho and Saunders (1981), who modelled banks as liquidity dealers faced with uncertain deposit supply and loan demand. This uncertainty regarding the future liquidity needs gives rise to a spread between deposit and loan interest rates. It is assumed that the observed interest rate spreads of banks have two components – the residual spread and the pure spread. The residual spread is driven by bank-specific factors, for example efficiency, bank-specific credit risk and other bank-specific factors (Männasoo, 2013). The pure spread is assumed to vary with time but is the same across banks. Ho and Saunders argued that pure spread is affected by four factors: the volatility of interest rates, banks' risk appetite, transaction size (of loans and deposits) and the market power of individual banks (i.e. market structure), all the factors being positively related to the spread. Since then this model has been extended by Allen (1988), Angbanzo (1997), Maudos and Fernandez de Guevara (2004), and others, who have proposed new factors affecting the pure spread.

One way to estimate the determinants of interest rate spreads is to run two-stage regressions. The advantage of this approach is that it allows us to separate the drivers of bank interest rate spread between the banking system and the individual bank. When this approach is used, one first regresses the observed bank spreads for each period against bank-specific covariates and time dummies. The intercept and the time-fixed effects from the regression are interpreted as the pure spread. In the second stage, the pure spread is regressed against theoretical determinants of interest rate spread. Two-stage regressions are popular in the literature. For instance, Saunders and Schumacher (2000) used this approach to examine the determinants of bank spreads on a sample of European and US banks. Likewise, Männasoo (2013) used this model to explain the factor contributing to higher interest rate spreads of Estonian banks after the global financial crisis.

An alternative way of estimating the spreads is to run a single-stage regression which includes all the factors affecting the spread. This approach does not allow us to distinguish between the pure and residual spread. Nevertheless, it is popular (see McShane and Sharpe (1985), Angbanzo (1997), Fungačova and Poghosyan (2009), etc.). For instance, Hubbard, Kuttner and Palia (2002) used one-stage regressions when analysing whether the health of banks impacts on the cost of loans for US firms. Similarly, Haugwout, Mayer and Tracy (2009) used single-stage regressions when analysing the impact of demographic factors on the pricing of US subprime loans.

The use of single-stage regressions is especially popular in cases where loan characteristics (e.g. loan amount, loan maturity, etc.) are available at the loan level. For example, Dietrich and Wernli (2016) used this method to study the impact of used borrower/loan-based characteristics on interest rates of peer-to-peer (P2P) loans in Switzerland. Similarly, Santoso, Trinugroho and Risfandy (2020) conducted single-stage regressions to examine the determinants of interest rate for new P2P loans in Indonesia.

Generally speaking, the use of loan characteristics in regression is not that common. We attribute this to data availability. Loan-level data for banks is often proprietary or confidential, which makes it difficult for researchers to access and use in research. We do have access to loan-level data and, because we are not interested in distinguishing

between the determinants of pure and residual spreads, we use the single-stage regression method to estimate the impact of various determinants on bank spread.

In the literature, two main types of spreads are considered: the net interest margin (NIM) and the spread on new loans (see the appendix in Dumičić and Rizdak (2012) for a review of studies analysing each of the spreads). NIM is calculated at the bank level and reflects the composition of the whole balance sheet of a bank, while loan spread is calculated for new loans only. We have loan-level data for new loans, so we analyse the determinants of spreads for new loans.

3 Data

Our sample consists of new housing and consumer loans approved by banks in Slovenia. One small savings bank and two branches of foreign banks are excluded because of data gaps. We also do not include SID Bank (the Slovenian export and development bank), because it did not issue any housing or consumer loans during the observation period. Our sample covers loans approved between the start of October 2018 (when new loan-level regular reporting for housing loans was introduced) and the end of March 2022 (last available data point at the time of analysis). The sample is highly representative, despite the exclusion of braches and one savings bank, and covers about 97% of total loan volume approved during the observed period.

The sample includes thirteen banks (one of them is present only until the end of August 2020, when it was acquired by another domestic bank). The data on loan approval is available at the monthly level, so we have 42 time periods. Altogether we have an unbalanced panel with 521 (out of 546 possible) combinations of bank and time variables. Our data also has a third dimension, as for each bank and time period combination we have information on individual loans. The number of loan issued varies across banks and time.

Table 1: **Loan-specific variables included in the analysis.**

Variable (unit)	Observations	Mean	SD
Loan amount (in 10k EUR)	358,001	19.70	32.30
Maturity (in years)	358,001	6.81	5.62
Interest rate type (dummy)	358,001	0.24	0.43
Secured (dummy)	358,001	0.36	0.48
Debt service-to-income (DSTI in %)	358,001	29.00	11.60
Maturity (in years) * DSTI (in %)	358,001	174.49	195.94
Maturity deviation (dummy)	295,117	0.02	0.15
DSTI deviation (dummy)	358,001	0.13	0.34
LTV deviation (dummy)	62,884	0.09	0.29
DSTI deviations (dummy) * Maturity deviation (dummy)	295,117	0.00	0.06
DSTI deviation (dummy) * LTV deviation (dummy)	29,557	0.01	0.08

Source: Banka Slovenije. Note: For loans that have multiple borrowers, the weighted average DSTI is used. The weight is the loan-servicing cost of individual borrowers. The DSTI is also calculated as the weighted average, where the weight is the loan amount. In all other cases the column “mean” features simple average unless stated otherwise.

The descriptive statistics of the loan characteristics which vary over time, bank and loan (later denoted as X_{itj}) are presented in Table 1. The sample includes only loans where average debt service-to-income ratio (DSTI) is larger than zero. Cases where this is not true are treated as reporting errors. We also remove loans which are loan-to-value (LTV) or DSTI outliers to eliminate the effect of reporting errors or one-off transactions. Outliers are determined for each bank for each quarter separately and are defined as loans which have DSTI or LTV below the 2nd or above the 98th percentile of the distribution.

The loan-specific variables are defined as follows. Loan amount is expressed in EUR 10,000 and is defined as the total loan amount approved regardless of when or in how many tranches it was drawn. Maturity is measured in years and is generally defined as the time between the drawing of the (first tranche of the) loan and the due date of the last loan instalment. Interest rate type is a dummy variable, which is one if the interest rate is variable and zero if it is fixed. Loans which have an initial interest rate fixation period shorter than ten years are treated as variable rate loans. Secured is also a dummy variable, set at one when the loan is secured and zero when there is no collateral present or if the loan is secured by a personal guarantee or by residential real estate (RRE). The real estate collateral is excluded from the secured dummy variable, because all loans secured by RRE are considered in a separate model (see model gamma in Section 4). The DSTI is calculated by dividing the total annual debt servicing cost of the borrower and the borrower's annual net income. We also consider the interaction term between DSTI and loan maturity.

Already in 2016 Banka Slovenije introduced a macroprudential recommendation for new housing loans. Housing loans are defined as loans used for the purchase, construction or renovation of RRE, regardless of the collateral, or loans secured by RRE, regardless of the purpose. All other loans in the sample are consumer loans. The recommendation from 2016 set the caps on DSTI and LTV ratio for new housing loans. The LTV is defined as the ratio between the loan amount and the value of the RRE collateral. In the case of construction, the value of the expected value of real estate collateral upon completion of construction or renovation is considered. According to Banka Slovenije's recommendation, LTV should not exceed 80%, while the DSTI cap is between 0% and 67% depending on the borrower's income, the presence of dependent family members and the amount of the gross minimum wage. In October 2018, the macroprudential recommendation was extended to consumer loans, where in addition to a DSTI cap, a maturity limit of 10 years was introduced. In November 2019, the DSTI cap became binding for all loans. Concurrently, the maturity cap of seven years became binding for consumer loans, while the LTV cap for housing loans secured by RRE remained in the form of a recommendation.

Our dataset includes five additional loan variables which are related to the macroprudential restrictions. The maturity, DSTI and LTV deviations are dummy variables, which are one when a loan deviates from the corresponding recommendation or binding measure and zero if it does not. The DSTI deviations variable is available for all loans, while the LTV deviations variable is present only for housing loans secured by RRE. The maturity deviation dummy is present only for consumer loans. Our dataset also includes two interaction terms. The first is between the DSTI and LTV deviation dummy, while the other is between the DSTI and maturity deviation dummies. These variables are available for housing loans secured by RRE and consumer loans respectively.

Table 2: **Dependent variable definition.**

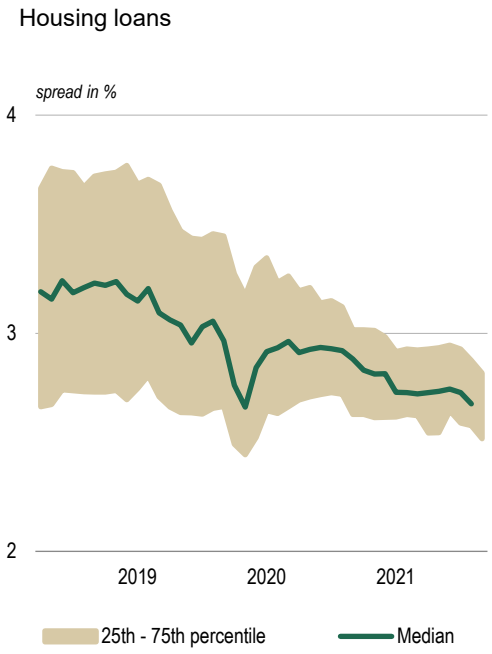
Variable (unit)	Observations	Mean	SD
Contractual interest rate spread (in %)	358,001	5.44	1.72
Contractual interest rate spread (EURIBOR floor, in %)	358,001	5.06	1.72

Source: Banka Slovenije and ECB SDW.

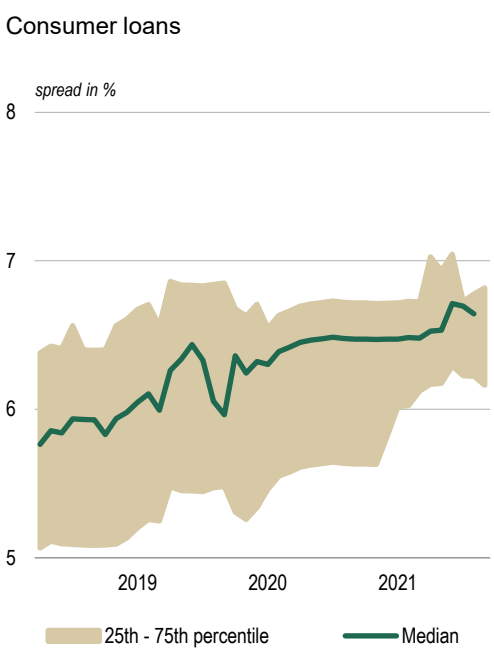
The interest rate spread is calculated as the difference between the contractual interest rate of the loan and the average value of the 6-month EURIBOR in the month of loan approval. The use of EURIBOR as the reference rate follows Gropp, Kok and Lichtenberger (2014). The distribution of the effective interest rate spreads in time is displayed in Figure 1 separately for housing and consumer loans. The median rather than the mean value of the spread is shown to better illustrate the shape of the interest rate spread distribution. Looking at the figures, we see that the dynamics of housing and consumer loan spreads are quite different. For housing loans, the average spread decreased over the observed period and the distribution of spreads became narrower over time. In contrast, for consumer loans, the median spreads increased over time, but we can also observe a narrowing of the distribution in the final part of the sample.

The value of EURIBOR is negative throughout the whole sample, which could present a problem. Banks normally price loans as EURIBOR plus a spread, but in recent years, Slovenian banks started using a EURIBOR floor of zero, and hence some banks may calculate the spread based a EURIBOR value of zero rather than its true (negative) rate. For this reason, we will also consider an alternative specification of interest rate spread which uses the EURIBOR floor of zero.

Figure 1: **Distribution of contractual interest rate spread in time.**



Source: Banka Slovenije.



Source: Banka Slovenije.

Statistics of time-varying bank-specific characteristics (later denoted as Z_{ti}) are presented in Table 3. The market share of the bank is determined monthly separately for consumer and housing loans, based on the total amount of new loans a particular bank issued each month. The total capital ratio is calculated quarterly and is defined as the

total capital over the risk-weighted assts. The data is extrapolated to a monthly frequency using the last available value. For instance, for October and November 2018, the data for September 2018 is used. For December 2018, we use the reported information for that month. The data on non-performing exposures (NPEs) also has a monthly frequency. The classifications of NPEs follows the EBA definition, meaning that NPEs are exposures which are 90 days past due or are unlikely to be paid.

Table 3: **Bank- and time-specific variables included in the analysis.**

Variable (unit)	Frequency	Observations	Mean	SD
Total capital ratio (in %)	Quarterly	521	19.84	4.67
Market share (in %)	Monthly	521	17.49	12.21
Non-performing exposure ratio (NPE in %)	Monthly	521	2.22	1.12

Source: Banka Slovenije. Note: The market share data in the table refers to the whole sample, but the information is determined separately for housing and consumer loans. Where the data frequency is quarterly, the number of observations corresponds to the total number of observations, but not all of them are unique.

4 Empirical results and discussion

In this section, we present the econometric model and discuss the results. Following the literature (presented in Section 2), we assume that the interest rate spread for new loans is a factor of loan-specific characteristics (X_{itj}), time-varying bank characteristics (Z_{ti}), bank-fixed effects (α_i) and time-fixed effects (Q_t). According to our model, the interest rate spread IR_{itj} of a new loan j approved by bank i in time period t is given by:

$$IR_{itj} = \alpha_i + X_{itj}\beta + Z_{ti}\gamma + Q_t + \varepsilon_{it}$$

In the literature (see Were and Wambua (2014), Claeys and Vennet (2008), Hubbard, Kuttner and Palia (2002), etc.), the coefficients are most often estimated using fixed effects estimators, which accounts for the unobserved heterogeneity across banks (e.g. different customer bases). A fixed effects estimator is appropriate, because we have reasons to believe that the unobserved heterogeneity and covariates are likely correlated i.e. $Cov(X_{it}, \alpha_i) \neq 0$. Our model does not include macroeconomic characteristics, because their impact is captured by time-fixed effects. They also account for possible unobserved heterogeneity across time (e.g. differences in loan demand).

We estimate the variable coefficients using the least squares dummy variable method (LSDV). We have 12 bank dummies ($i \in [1,2 \dots 13]$) and 41 time period dummies ($t \in [1,2 \dots 42]$) in the model. We are able to use the LSDV method because the sample is large compared to the number of bank and time period dummies. In the LSDV model, we control for bank- and time-fixed effects.

Table 4: **Results of the model.**

	Alpha	Beta	Gamma
	(1)	(2)	(3)
Intercept	5.634 *** (0.029)	3.469 *** (0.046)	3.361 *** (0.055)
Loan amount (in EUR 10k)	-0.017 *** (0)	-0.003 *** (0)	-0.002 *** (0)
Maturity (in year)	0.118 *** (0.001)	0.014 *** (0.001)	0.022 *** (0.001)
Interest rate type (dummy)	-1.167 *** (0.004)	-0.667 *** (0.004)	-0.738 *** (0.006)
Secured (dummy)	-0.157 *** (0.005)	0.018 * (0.011)	
Debt service-to-income (DSTI in %)	0.016 *** (0)	-0.004 *** (0)	0.001 . (0.001)
Maturity (in years) * DSTI (in %)	-0.002 *** (0)	0 *** (0)	0 ** (0)
DSTI deviations (dummy) * Maturity deviations (dummy)	0.121 *** (0.028)		
DSTI deviations (dummy) * LTV deviations (dummy)			-0.02 . (0.031)
Maturity (deviation)	0.104 *** (0.012)		
DSTI deviations (dummy)	-0.041 *** (0.005)	0.043 *** (0.01)	0.012 . (0.011)
LTV deviations (dummy)			0.069 *** (0.008)
Market share (in %)	-0.012 *** (0.001)	-0.024 *** (0.001)	-0.013 *** (0.001)
Total capital ratio (in %)	-0.022 *** (0.001)	-0.013 *** (0.001)	-0.018 *** (0.002)
Non-performing exposure ratio (NPE in %)	0.092 *** (0.004)	-0.028 *** (0.005)	-0.015 *** (0.005)
Bank-fixed effects	Yes	Yes	Yes
Time-fixed effects	Yes	Yes	Yes
Number of observations	295,117	33,327	29,557

Note: The model was estimated using the least squares dummy variable (LSDV) method. We do not show the time- and bank-fixed effects. The first number gives the size of the estimated coefficient, while the number in brackets denotes standard errors. The results are rounded to three decimal places. The symbols next to coefficients have the following meanings: "." means the p value is less than 0.1, * means the p value is less than 0.05, ** means the p value is less than 0.01 and *** means that p value is less than 0.001.

We estimate the coefficients of three different models, because Banka Slovenije's macroprudential restrictions distinguish between three types of loans. Model alpha covers consumer loans for which maturity and DSTI caps are in place. Model beta includes housing loans not secured by RRE; for these loans, the DSTI cap is in place. Finally, model gamma includes housing loans secured by RRE for which both the DSTI and LTV caps are in place.

We find that loan-specific variables are both statistically and generally economically significant for explaining interest rate spreads. Loans with variable interest rate have on average lower spreads than fixed interest rate loans. This is expected, since fixed rate loans offer the borrower a guaranteed interest rate in the future, for which the borrower is expected to pay extra. The absolute difference in spread ranges between 67 bps and 117 bps and is the highest for consumer loans. This is expected, because the interest rate spreads for consumer loans are the highest (which can be seen by comparing the intercept terms). However, in relative terms, the additional spread for fixed rate loans is similar for all loan types. On average the fixed rate loans have a 20% higher spread than variable rate ones.

We would expect that loans with higher maturity are more expensive, because there is a higher probability that the borrower will default over a longer time period. This is indeed what we observe: the spread is larger for loans with longer maturity in all models. However, the size of the effect varies among loan types and is again highest for consumer loans, where each additional year of maturity is associated with an additional

11.8 bps spread. For housing loans, this effect is between five and ten times smaller. Our results are supported by some previous studies. For instance, Dietrich and Wernli (2016) found a positive relationship between maturity and loan spread when looking at determinants on interest rates on a Swiss P2P platform. However, some other studies found the opposite relationship between maturity and spread. Hubbard, Kuttner and Palia (2002) found a negative relationship between loan spreads and loan maturity, but that study focused on US corporate spreads, which may have different spread determinants.

One would expect that a higher DSTI would increase the borrower's probability of default (PD). This would suggest a positive relationship between DSTI and spread. For consumer loans, this is indeed the result we find. Each percentage point higher DSTI is associated with 1.6 bps higher spread. This result is consistent with the findings of Dietrich and Wernli (2016), who investigated Swiss P2P loans. However, for housing loans not secured by RRE, we find the opposite relationship, though it is economically very weak: each percentage point higher DSTI is associated with 0.4 bps lower spread. In the model for housing loans secured by RRE, DSTI is not a statistically significant determinant of spread.

Generally speaking, we would expect that secured loans are less risky than unsecured loans, because the lender can recoup (at least a part of) its exposure by selling collateral. We find that this is indeed the case for consumer loans, where secured loans have on average 16 bps lower spread. In contrast, for housing loans not secured by RRE (specification beta) we observe the opposite effect. Housing loans which are secured by non-RRE collateral are on average more expensive than unsecured loans. This effect is economically small, at 2 bps. This result is rather counter-intuitive but can be explained by the fact that for housing loans not secured by RRE, collateral is requested only when loan is perceived as riskier.

The effect of loan size on the spread is statistically significant, but it is very small. On average each EUR 10,000 increase in the loan amount decreases the spread by just 1.7 bps for consumer loans and between 0.2 and 0.3 bps for housing loans. This means that in practice the extra spread arising from loan size is very small. This finding is consistent with Dietrich and Wernli (2016), though some other studies investigating subprime loan spreads (Haugwout, Mayer and Tracy, 2009) found the opposite (positive) relationship between spread and loan size to hold.

Having considered the impact of DSTI and maturity separately, we also want to consider their interaction using the Maturity * DSTI variable. Its coefficient tells us how increasing one variable impacts the other variable's effect on the spread. For instance, if the coefficient of the interaction term is negative, this means that as maturity increases, the effect of DSTI on spread becomes weaker. We would expect a positive coefficient of the cross term, because we would assume that DSTI has a larger impact on loan spread for loans with high maturity. Surprisingly, we find that although the interaction term is statistically significant, it is economically irrelevant for both housing and consumer loans.

Next, we consider the impact of compliance with macroprudential restrictions. In the period covered by the sample, DSTI, maturity and LTV caps were in place. For consumer loans, DSTI and maturity cap were introduced. For housing loans not secured by RRE, a DSTI cap was introduced. Finally, for housing loans secured by RRE, DSTI and LTV caps were introduced. In November 2019, the maturity and DSTI cap became binding, while LTV remained in the form of a recommendation. We consider the impact

of deviations from the macroprudential measures on the spread without distinguishing between the binding measures and recommendations.

One of the aims of macroprudential measures was to introduce minimum lending standards for new loans to households. Banka Slovenije found that loans not compliant with macroprudential measures are generally riskier (Banka Slovenije, 2021). For instance, this was reflected in their more frequent deferrals during the COVID-19 pandemic. Hence we expect the sign of the deviation dummies to be positive and statistically significant. Consumer loans not compliant with the DSTI cap have on average 4 bps lower margins. This is not an expected result, but the coefficient is small, suggesting that in practice it is the DSTI, which has a positive impact on spread, rather than the compliance with the DSTI cap that is the more important for consumer loan pricing. For housing loans not secured by RRE, there is a positive impact of DSTI deviations on spread, but at 4.3 bps this effect is small and in most cases only partly offsets the previously identified negative impact of DSTI on spread. The spread of housing loans secured by RRE is not affected by compliance with DSTI.

For consumer loans, we find a positive relationship between the maturity cap deviation and the spread. Loans deviating from the maturity cap have on average 10.4 bps higher spreads. There is also a positive relationship between LTV deviations and the spread for housing loans secured by RRE. Loans deviating from the LTV cap have on average 6.9 bps higher spreads. Both of these results are expected, but we note that the economic effect on the spread in both cases is quite small.

We also considered the impact of double deviations. Surprisingly, we find that for housing loans secured by RRE, the DSTI deviations * LTV deviations variable (dummy denoting double deviations) is statistically insignificant. In contrast, for consumer loans, the DSTI deviations * Maturity deviations variable (dummy denoting double deviations) is non-negligible, leading to a 12 bps higher spread. Generally, we can conclude that although loans which deviate from macroprudential restrictions have higher spreads, these effects are small and are unlikely to be noticed by the borrowers. The results also suggest that banks do not see the loans deviating from the macroprudential restrictions as much riskier and therefore do not assign them much higher spreads.

Next, we turn our attention to time-varying bank variables. First, we examine the impact of bank market share. This variable is statistically significant in all three models. According to the model proposed by Ho and Saunders (1981), we would expect the market structure to affect the interest rate spreads. We would expect that banks with larger market shares would have economies of scale and thus be able to offer lower spreads. This is indeed the result we find. Each percentage point increase in the market share of a bank is associated with a 1.2 bps to 2.4 bps decrease in the spread. This finding remains true even when taking into account the different cost-to-income ratios of the banks (not shown in the model). Our results agree with Claeys and Vennet (2008), who found the market share variable to be significant, having a negative impact on the spread. However, in the literature the impact of bank market share on spread remains a matter of debate. For instance, Hubbard, Kuttner and Palia (2002) did not find market share to be a statistically significant variable explaining corporate loan interest spread in the US.

We find that the bank's non-performing exposure (NPE) ratio affects the spreads of consumer and housing loans differently. For each percentage point of higher NPE ratio, the average interest rate spread on new consumer loans is 9 bps higher. This positive relationship between spread and NPE has also been established in the literature (see

Brock and Suarez (2000), Were and Wambua (2014), etc.). However, for housing loans, the spread is 1.5 bps lower if the loan is secured by RRE or 2.8 bps lower if not secured by RRE. The different effect of NPE on the spreads for housing and consumer loans can be explained. A high NPL ratio puts pressure on the bank's capital position. The bank can conserve capital by moving its portfolio towards lower risk weight exposures. To do this, the bank would have to offer more attractive terms (lower spreads) on housing loans, which have lower capital requirements, and increase the spreads on the riskier consumer loans. This is consistent with our observations.

Finally, we estimate the effect of total capital ratio on the spread. In the literature, many papers find a positive relationship between capital and spread (see Hainz, Horvath and Hlaváček (2014), Fungáčová and Poghosyan (2011), etc.). However, we find the opposite, i.e. a negative relationship between the total capital ratio and the spread. This result can be explained by arguing that better capitalised banks compete by charging lower spreads to borrowers, because the additional capital gives them extra risk-carrying capacity. The observed effect is small, however, with one percentage point higher capital resulting in 1.3 bps to 2.2 bps lower interest spread.

4.1 Additional analyses

We also tested the inclusion of two additional bank-specific time-varying variables, i.e. cost-to-income ratio and liquidity coverage ratio (LCR). Cost-to-income is defined as the ratio between the operating costs of the bank including administrative costs and amortisation (numerator) and the gross income (denominator). LCR is defined as the ratio between the amount of the bank's high-quality liquid assets (numerator) and expected net cash outflows over 30 days in a severe scenario (denominator). For both variables, we use monthly data. We find that when included in the model, those variables are not economically and/or statistically significant. The reason why these two variables were tested is that previous economic and theoretical work suggested that they could affect the interest rate spreads. We would generally expect more efficient banks (i.e. those that have a lower cost-to-income ratio) to have higher spreads (Dumičić & Rizdak, 2013). For LCR, we would also expect that banks with higher liquidity risk (lower LCR) would offer loans with higher spreads (see Hainz, Horvath and Hlaváček (2014) and Were and Wambua (2014)).

We also tested the impact of the LTV ratio on the spread and the interaction between DSTI and capital to see if the level of the bank capital affects the way in which the DSTI impacts the interest rate spread. For LTV, we would expect that higher LTV would result in higher spreads, because the loss given default (LGD) for high LTV loans is higher. While the LTV variable is significant when included in the model for housing loans secured by RRE, its effect is economically insignificant, with a ten percentage point higher LTV ratio increasing the spread by just 0.3 bps. The interaction between DSTI and capital shows a statistically significant impact in all three models, but its size is small (in the order of ten to the power of minus five). That suggests that the impact of DSTI on loan pricing does not depend on the capital position of the bank.

Finally we re-estimated the models by changing the definition of the interest rate spread by considering an interest rate floor of zero when EURIBOR is negative. Unsurprisingly, we found that the regression coefficients other than the intercept remained exactly the same. This is because the changes in the spread are captured by time dummies.

5 Conclusion

This discussion paper presents some preliminary results regarding the determinants of interest rate spread on new housing and consumer loans in Slovenia. We looked at the sample of new housing and consumer loans approved between October 2018 and March 2022. We found that loan-specific and bank-specific time-varying variables play an important role in determining the spread on new loans. They are both statistically significant and generally economically significant. We also found that loans which are not compliant with Banks Slovenije's macroprudential restrictions have on average higher spreads.

We find that variable rate loans, larger loans and housing loans tend to have lower interest rate spreads. Generally, secured loans have lower spreads than unsecured ones, except for housing loans which are secured but not by RRE. Higher loan maturity generally leads to larger spreads. The impact of DSTI differs on the loan type. It is positive for consumer loans and negative for housing loans not secured by RRE. Loan maturity and DSTI have a statistically significant interaction. For consumer loans, higher maturity results in lower impact of DSTI on interest rate spread. For housing loans, the interaction is statistically significant but the coefficient is zero, meaning that DSTI and maturity have independent effects on spread.

Macroprudential restrictions have a statistically significant impact on loan spreads. The impact differs across measures and loan types. For consumer loans, maturity and joint maturity and DSTI deviations are associated with higher spreads. In contrast, the DSTI deviations have a small but statistically significant negative impact on spread. For housing loans not secured by RRE, DSTI deviations have a small but positive impact on spread, whereas this effect is not statistically significant for housing loans secured by RRE. For these loans, the LTV deviations are associated with higher spreads, whereas the spread is not affected by joint LTV and DSTI deviations. Although spreads of loans deviating from macroprudential restrictions are generally larger, the size of the effect is small and is unlikely to be noticed by borrowers who are creditworthy.

We also considered the effect of time-varying bank variables, i.e. the ratio of non-performing exposures (NPE), the market share of banks and total capital ratio. We found that all of them materially affect interest rates of new loans. Higher market share and total capital ratio are associated with lower spreads for all types of loans. In contrast, a higher NPE ratio is associated with lower spreads for housing loans and higher spreads for consumer loans. This can be explained by capital conservation efforts by banks, which shift their portfolio towards loans with lower capital requirements (housing loans).

There are several possible ways to advance our work. As loan determinants turned out to be significant and economically important for explaining the interest rate spreads, it could be beneficial to try and find other relevant determinants (e.g. debt-to-income ratio, borrower's age, loan purpose, etc.). An important, policy-relevant extension of this work would be to analyse whether the higher spreads identified for loans deviating from macroprudential restrictions are sufficient to offset the riskiness (expected losses) of such loans.

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