

Short economic and financial analyses

Why is the LSTI ratio increasing? Explaining factors of synthetic LSTI dynamics

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Table of contents

Abstract	4
Povzetek	4
1 Introduction	5
2 The loan service-to-income (LSTI) ratio	7
3 Data and descriptive statistics	8
4 The LSTI ratio given different assumptions	11
5 Misalignment factors of the LSTI ratio	12
6 Conclusions	14
References	15

Abstract

Financial systems are exposed to structural systemic and cyclical risks that may be a consequence of various economic shocks. With the help of various economic policies, for example the macroprudential policy, supervisory institutions aim to mitigate the effects of financial cycles and try to increase the resilience of financial systems. In doing so, supervisory institutions conduct macroprudential policy by monitoring and analyzing cyclical and structural systemic risks and evaluate the effectiveness of macroprudential instruments and measures that have been or are planned to be implemented. In this paper, we focus solely on borrower-based types of measures. A vast strand of literature examines the effectiveness of different types of BBM measures. However, little has been done in the direction of determining LSTI factors and to what extent they influence the development of the LSTI ratio. In this paper, we try to bridge this gap by introducing a synthetic LSTI calculation and examine how the factors affecting the LSTI ratio affected the LSTI ratio of borrowers that took out consumer or housing loans in Slovenia. We note that in Slovenia, the general growth in the incomes of consumers who took out a loan inhibited the growth of the average LSTI ratio. Factors affecting the LSTI ratio had an offsetting effect on the LSTI ratio of consumers who took out a consumer loan, while factors affecting the LSTI ratio caused an increase in the LSTI ratio of consumers who took out a housing loan. One of the more important factors that influenced the growth of the LSTI ratio of consumers who took out a housing loan was the increase in the interest rate for housing loans.

Povzetek

Finančni sistemi so izpostavljeni cikličnim in strukturnim sistemskim tveganjem, ki so običajno posledica ekonomskih šokov. S pomočjo različnih ekonomskih politik, predvsem makrobonitetne politike, nadzorne institucije blažijo (negativne) vplive delovanja finančnih ciklov in poskušajo povečati odpornost finančnih sistemov. Pri tem nadzorne institucije izvajajo makrobonitetno politiko s spremljanjem in analiziranjem cikličnih in strukturnih sistemskih tveganj ter ocenjujejo učinkovitost makrobonitetnih instrumentov in ukrepov, ki so bili ali še bodo implementirani. V tem prispevku se osredotočamo izključno na vrsto ukrepov, ki temeljijo na posojilojemalcih. Kar nekaj literature preučuje vplive sprejetja in implementacije različnih makrobonitetnih instrumentov, malo pa je bilo veliko storjenega v smeri ugotavljanja, kateri dejavniki in v kakšni meri vplivajo na razmerje LSTI. S tem gradivom skušamo torej prispevati k literaturi z vpejljavo izračuna sintetičnega LSTI in preučiti, kako so dejavniki, ki vplivajo na razmerje LSTI, vplivali na razmerje LSTI posojilojemalcev, ki so najeli potrošniško ali stanovanjske posojilo v Sloveniji. Ugotavljamo, da je v Sloveniji splošna rast dohodka potrošnikov, ki so vzeli posojilo, zavirala rast povprečnega razmerja LSTI. Dejavniki, ki vplivajo na razmerje LSTI, so pri potrošniških posojilih v opazovanem obdobju ohranili razmerje LSTI potrošnikov, ki so vzeli potrošniško posojilo, bolj ali manj nespremenjen, medtem ko so dejavniki, ki vplivajo na razmerje LSTI pri stanovanjskih posojilih, povzročili rast razmerja LSTI. Eden izmed pomembnejših dejavnikov, ki je vplival na rast razmerja LSTI pri stanovanjskih posojilih, je bila rast obrestnih mer za stanovanjska posojila.

1 Introduction

Financial systems are per se exposed to various cyclical and structural systemic risks, which may be a consequence of various types of economic shock. That said, with the help of various economic policies, for instance the macroprudential policy, the relevant supervisory institutions try to mitigate the effects of financial cycles and increase the resilience of the financial systems that they supervise. In order to do so, the relevant supervisory institutions have to conduct the macroprudential policy by successfully monitoring and analyzing the cyclical and structural systemic risks and estimate the effectiveness of the macroprudential instruments and measures that have been or are planned to be implemented.

A relatively large strand of literature studies the effectiveness of different types of BBM measures. Dietsch and Welter-Nicol (2014) use a housing loan-level database to demonstrate the efficiency of credit standards that constrain households' indebtedness. They find that the utilization of the LTV/DSTI ratios combination rather than the use of each ratio separately helps to maintain the total portfolio credit risk under check. Similar was done by Hodula et al. (2022), as they study the effects of regulatory recommendations concerning maximum LTV, DTI and DSTI ratios on new loans secured by residential property. Franz (2020) uses a structural approach with a SVAR model that estimates the effects of binding LTV/DSTI ratios. Bańbuła et al. (2016), on the other hand, focus on the DSTI type of measures and provide a model for calibration of DSTI/DTI limits. Based on survey HFCS data, Gross and Población (2017) develop an integrated micro-macro model framework that is used for scenario and sensitivity analyses with respect to the drivers of households' income, expenses and asset values and the structure of their balance sheet.¹ De Haan and Mastrogiacomo (2019) conclude that the LTV/DSTI ratios affect the incidence of possible non-performance of loans. Dirma and Karmelavičius (2023) express doubt in the effectiveness of macroprudential toolkits' ability to contain excessive housing loans growth, depending also on other factors, such as a low interest rate environment.

Other studies, such as Martins et al. (2021), discuss the appropriate policy approaches to the dynamics of different macroeconomic developments (in their case the relevance of housing markets). Požlep (2023) studies the impact of loan-specific and time-varying bank factors (for instance loan amount, maturity, interest rate type, presence of loan security, DSTI ratio, etc.) on the interest rate spread of new loans in Slovenia. Teixeira and Venter (2021) estimate the positive relationship between the tightness of macroprudential policy and the growth in savings in households. Valderrama (2023) tries to set macroprudential policy tools in response to housing-related systemic risk, which include design solutions to avoid unintended consequences during a tightening phase and navigating the trade-offs between managing the build-up of vulnerabilities.

However, little has been done in the direction of determining how the factors affecting the LSTI ratio has influenced this ratio for Slovenian borrowers. For instance, Bandoni et al. (2024) find that LSTI increases depend on the mortgage loan characteristics, but their study is done on EA data. Less work has been done in the case of Slovenia. In this paper, we try to bridge this gap by introducing a synthetic LSTI calculation and

¹ See the similar analysis based on the same model on Slovenian data in Banka Slovenije's Financial Stability Review in Banka Slovenije (2024).

examine how the factors affecting the LSTI ratio affected the LSTI ratio of borrowers that took out consumer or housing loans in Slovenia.

The results of the analysis show that the increase in the average loan amount of consumer loans has the strongest positive effect on the synthetically calculated LSTI ratio of borrowers who took out a consumer loan, *ceteris paribus*. Other factors affecting the LSTI have a smaller effect on the synthetically calculated LSTI ratio of borrowers who took out a consumer loan. In fact, the increase in the average interest rate for consumer loans has the smallest impact on the synthetically calculated LSTI ratio of borrowers who took out a consumer loan. While the increase in market interest rates had a positive effect on the LSTI ratio of borrowers who took out a consumer loan mainly in the second half of 2022, the effect was not pronounced, due to the limited rise of the average interest rate of consumer loans. The increase in the average maturity of consumer loans had a negative impact on the LSTI of borrowers who took out consumer loans; however, due to the maturity limits set by the macroprudential regulation, the extension of the loan maturity to reduce monthly installments and thus the LSTI ratio is limited. The increase in the average income of the borrowers who took out a consumer loan, however, offset the increase of the synthetically calculated LSTI ratio. We conclude that the factors affecting the LSTI ratio of borrowers who took out a consumer loan more or less leveled off in the observed period and that the general increase of market interest rates only had a minor impact on the LSTI ratio of borrowers who took out a consumer loan. On the other hand, the rise in market interest rates had a more pronounced impact on the synthetically calculated LSTI ratio of borrowers who took out a housing loan. This is due to the fact that the average interest rate for housing loans had almost doubled compared to the limited increase in the average interest rate for consumer loans. Also, the increase in the average housing loan amount contributed significantly to the increase in the synthetically calculated LSTI of borrowers who took out a housing loan. The reduction of the average maturity of housing loan also had a non-negligible positive impact on the synthetically calculated LSTI ratio of borrowers who took out a housing loan. As with consumer loans, the general growth in the average income of borrowers limited the rise of the synthetically calculated LSTI of borrowers who took out a housing loan, but the increase in the average loan amount, the average interest rate and a reduction of the average maturity of the housing loans resulted in an overall increase of the synthetically calculated LSTI ratio of borrowers who took out a housing loan.

In Section 2, we present some stylized facts about the LSTI ratio, while in Section 3 we present the separate components of the LSTI calculation and their dynamics. In Section 4, we show how the LSTI ratio would evolve given different *ceteris paribus* assumptions, and in Section 5, we use the misalignment methodology in order to show the contributions of the main components of the LSTI share.

2 The loan service-to-income (LSTI) ratio

The loan service-to-income (LSTI) ratio measures how much income a borrower has to devote to repaying the loan. It is a way of measuring the borrower's ability to service the loan. By limiting the borrower's maximum allowed LSTI ratio, regulators can reduce the probability of a default and loss given default.

The monthly loan installment i.e. the loan service amount, can be calculated using three variables. It is determined by the interest rate on the loan, loan maturity and loan amount. Below we show the formula for calculating the monthly loan installment:²

$$P = \frac{(PV * r)}{[1 - (1 + r)^{-n}]}$$

where:

- P = monthly installment
- PV = present value (loan amount)
- r = periodic interest rate (annual interest rate divided by number of interest periods)
- n = total number of interest periods

Dividing the above formula by the borrower's income yields the LSTI ratio. From the formula above, we can understand that a higher periodic interest rate and a higher loan amount increase the monthly installment, while a longer maturity of a loan lowers the loan installment. Furthermore, the higher the borrower's income, the lower the LSTI ratio.

In this analysis, we will investigate how the variables affecting the LSTI ratio have behaved over the past few years. Based on the loan-level data, we will show how LSTI would evolve if other variables effecting the LSTI were held constant. We will further evaluate the movement of synthetic LSTI according to changes in the above mentioned variables. With the results of our analysis, we will better understand how these factors influenced the development of LSTI in Slovenia and when an individual factor dominated.

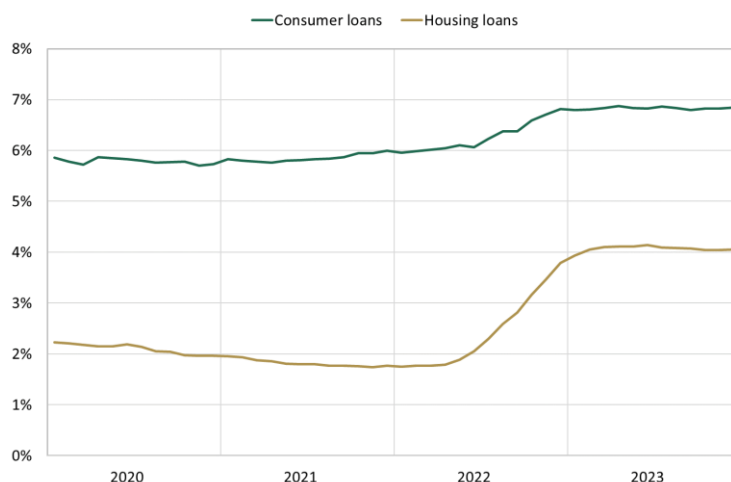
² A financial function that calculates payment of a loan based on constant payments and a constant interest rate. The payment returned by the function includes principal and interest but not other fees sometimes associated with loans.

3 Data and descriptive statistics

The analysis is based on loan-level data from January 2020 to the end of 2023. Only loans with the French amortization system were taken into account.³ Data is further separated between loans for consumption purposes and loans for house purchase.⁴ First, we will show the movement of the variables that affect the LSTI ratio in the time frame taken into analysis. Since we have loan-level data, we will first aggregate the data by month of loan origination and show the average value for that month.

Figure 1 shows the trend in the variable average interest rate of newly approved loans to households by type of loan. It can be seen that interest rates on newly approved housing loans have increased significantly compared to the increase in interest rates on consumer loans. While in 2023 the average interest rate for new consumer loans was about 18% higher than in 2020, it almost doubled for housing loans. Holding other variables affecting the LSTI ratio constant, we can assume that an increase in the average interest rate of newly approved loans led to an increase in the LSTI ratio for both type of loans, with the increase being more pronounced for housing loans.

Figure 1: Interest rate on new loans by type of loan



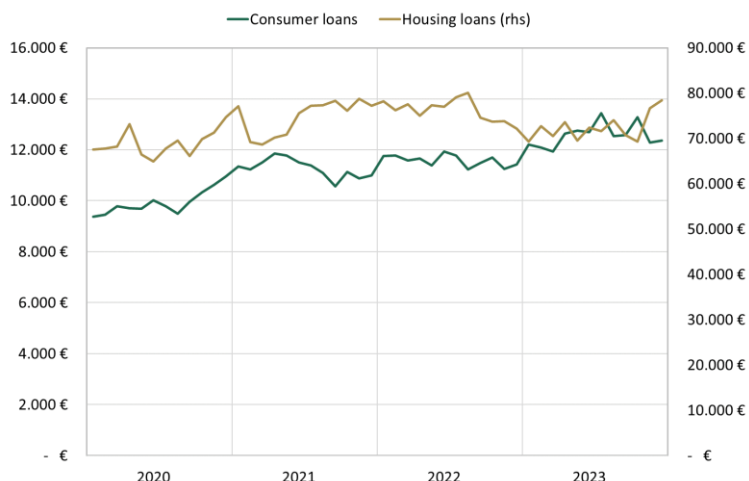
Source: Banka Slovenije.

Next, we show the trend in the variable average loan amount of newly approved loans to households by type of loan. From Figure 2, we can see that the average loan amount has increased for both type of loans. However, the increase was more pronounced in consumer loans. From January 2020 to December 2023, the average loan amount increased by 32% for consumer loans and 16% for housing loans. Holding other variables affecting the LSTI ratio constant, we can assume that an increase in the average loan amount of newly approved loans led to an increase in the LSTI ratio for both type of loans.

³ Also known as the progressive (quota) method, it consists of paying back the same amount each month until the debt is fully settled. 99% of all loans were approved with the French amortization method.

⁴ Loans for house purchase are all loans that are either secured by residential property or where the purpose of the loan was to acquire or maintain ownership of an existing or planned residential property (including renovation).

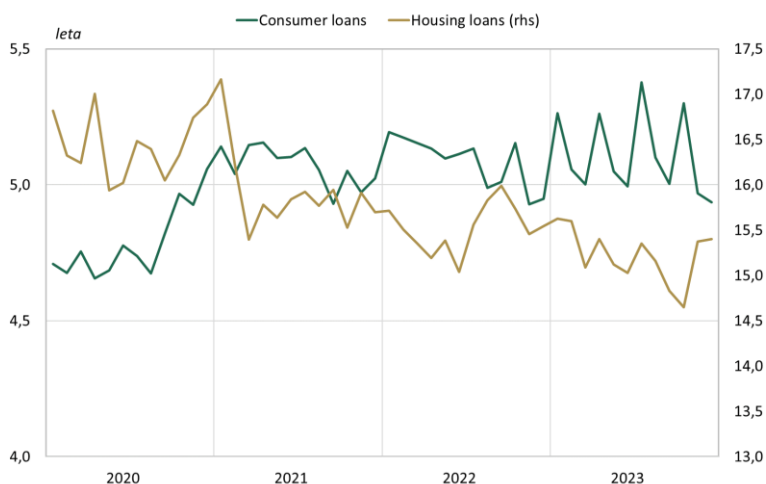
Figure 2: Average loan amount of new loans by type of loan



Source: Banka Slovenije.

Below we show the trend in the variable average loan maturity of newly approved loans to households by type of loan. Figure 3 shows that the average maturity of consumer loans was slightly longer in 2023 than in 2020, while it actually decreased for housing loans. Holding other variables affecting the LSTI ratio constant, we can assume that an increase in the average maturity of consumer loans decreased the overall LSTI for consumer loans, while a decrease in the average maturity of housing loans increased the overall LSTI ratio for housing loans.

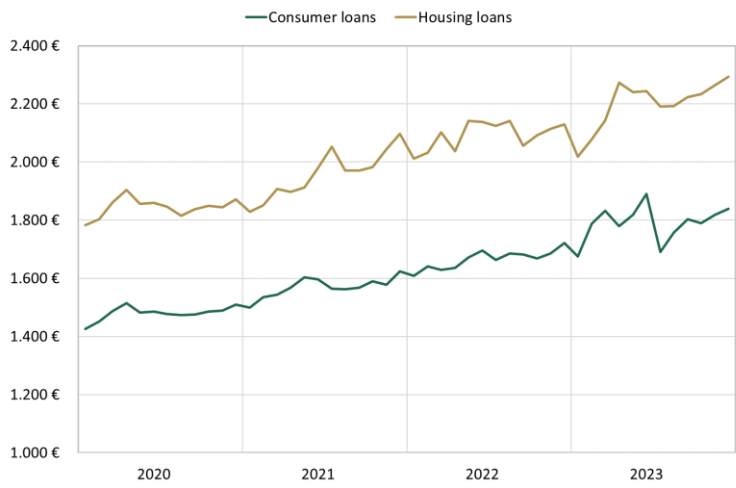
Figure 3: Average maturity of new loans by type of loan



Source: Banka Slovenije.

Finally, we show the movement of the denominator of the LSTI ratio, i.e. the average monthly income of borrowers. Figure 4 shows that borrowers who took out a housing loan had, on average, higher monthly incomes than borrowers who took out a consumer loan. In addition, we can see that the average income of households that took out loans increased. We can conclude that the growth of the average income of borrowers limited the increase in the LSTI ratio.

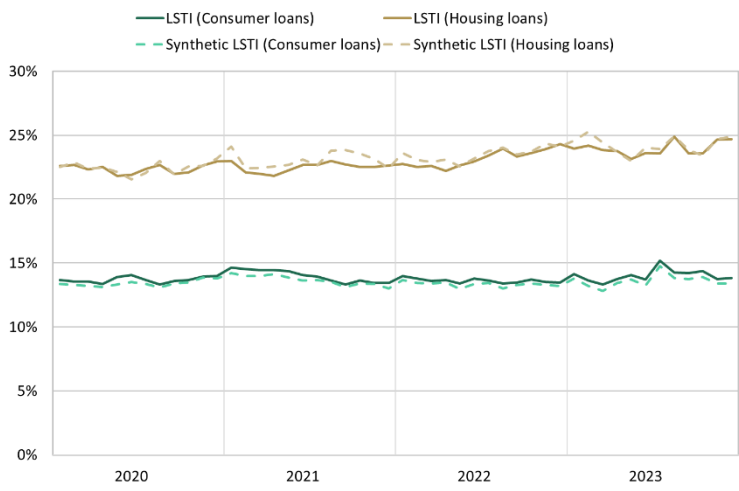
Figure 4: Average monthly income of borrowers by type of loan



Source: Banka Slovenije.

Lastly, in Figure 5 we show actual average LSTI ratio as reported by banks and synthetically calculated LSTI ratio based on average values of variables needed for its calculation.⁵ We can see that the average or the synthetically calculated LSTI ratio of borrowers who took out housing loans is much higher than that of borrowers who took out consumer loans. This is due to the fact that the loan amount for a housing loan was on average six times higher than that of consumer loans, which significantly increases the monthly installment. We can also see that the average or the synthetically calculated LSTI ratio of borrowers who took out consumer loans did not increase during the observed period, but it did increase for housing loans.

Figure 5: Average LSTI by type of loan



Source: Banka Slovenije.

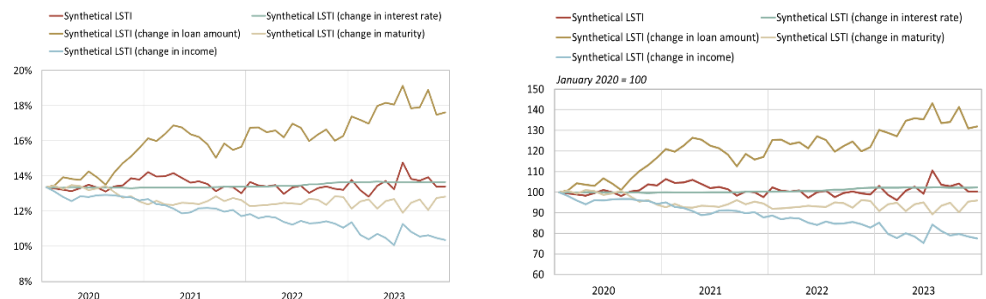
⁵ The differences between average LSTI ratio and synthetically calculated LSTI ratio occur mainly due to the use of contractual interest rates in the calculation of synthetic LSTI ratio, while average LSTI ratio as reported by banks is based on effective interest rate, which includes the cost of credit approval and other fees.

4 The LSTI ratio given different assumptions

Here we investigate what would happen to the LSTI ratio if only one of the variables that affect LSTI were to change and the other variables were to remain unchanged. The idea is to highlight how a change in a single variable would affect the dynamics of the synthetically calculated LSTI ratio.

Figure 6 show the dynamics of the synthetically calculated LSTI ratio of borrowers who took out a consumer loan if only one variable affecting the LSTI ratio changed while the others remained unchanged. We can see that the increase in the average loan amount had the strongest positive effect on the synthetically calculated LSTI ratio of borrowers who took out a consumer loan. The increase in the average income of the borrower who took out a consumer loan, however, offset the increase of the synthetically calculated LSTI ratio. Other factors affecting the LSTI ratio had a smaller effect on the synthetically calculated LSTI ratio. In fact, the increase in interest rates had the smallest impact on the synthetically calculated LSTI ratio. We can conclude that the factors affecting the LSTI ratio of borrowers who took out a consumer loan more or less leveled out in the observed period and that the general increase in interest rates had only a minor impact on the LSTI ratio of borrowers who took out a consumer loan.

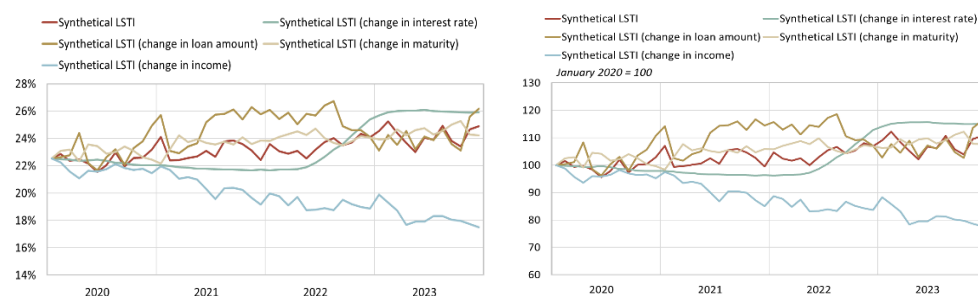
Figure 6: Synthetically calculated LSTI ratio of borrowers who took out consumer loans



Source: Banka Slovenije.

Figure 7 show the dynamics of the synthetically calculated LSTI ratio of borrowers who took out a housing loan, if only one variable affecting the LSTI ratio changed, while the others remained unchanged. We can see that the increase in the average loan amount and the increase in the average interest rate had the strongest positive effect on synthetically calculated LSTI ratio of borrowers who took out a housing loan. The reduction of the average maturity of housing loan also had a non-negligible positive impact on the synthetically calculated LSTI ratio. Similar to borrowers who took out consumer loan, among borrowers who took out a housing loan, the growth of general income inhibited the increase of the LSTI ratio, but the growth of the average loan amount, the average interest rate and a reduction of the average maturity of the housing loans resulted in an increase in the overall LSTI ratio of borrowers who took out housing loan.

Figure 7: Synthetically calculated LSTI ratio of borrowers who took out consumer loans



Source: Banka Slovenije.

Next we show how factors affecting the LSTI ratio affected the LSTI ratio each month of the observed period and in which way were they driving the LSTI ratio. We do this by utilizing the misalignment indicator methodology, which was seminaly applied by Schneider (2013).

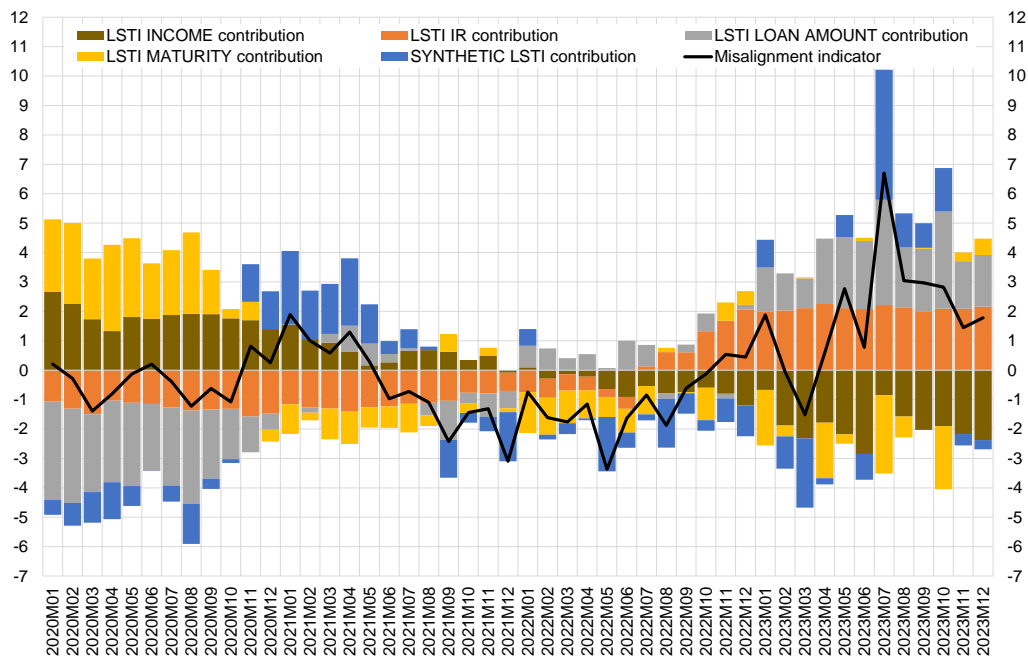
5 Misalignment factors of the LSTI ratio

We simulate contributions of the separate sub-factors that were explained above and are the main drivers of the LSTI dynamics. We did this by utilizing the misalignment indicator methodology, which was seminaly applied by Schneider (2013). In short, with the misalignment methodology, we first determine weighting factors of sub-factors by applying a PCA analysis with which the cyclical co-movement of the separate sub-factors is emphasized. In the second step, the aggregate misalignment indicator can be derived by weighting the sum of all sub-factors.⁶

Figure 8 shows the contributions of the main factors to the LSTI deviation for consumer loans. The figure shows the positive contribution of the interest rate of consumer loans to the LSTI ratio when the interest rates started to increase, i.e. in the second half of 2022. Before that period, decreasing interest rates had a deductive effect on the average LSTI ratio. The increase in the average loan amount also contributed positively to the rise of the LSTI ratio in 2023. In July 2023, Banka Slovenije changed the methodology for calculating consumers' creditworthiness. This amendment allowed consumers to take out a larger loan amount based on their income. On the other hand, the effect of the average maturity was rather subdued. What is also noteworthy to the analysis is that the income effect had a negative contribution to the LSTI ratio dynamics only in the second half of the observed period. This is due to a sizeable increase in average wages of consumers in 2023.

⁶ See Schneider (2013), Lenarčič and Damjanović (2015), Micallef (2018), Hertrich (2019), and Damjanović and Lenarčič (2023) for more detail. The aim of the misalignment methodology is to combine various aspects of what drives the LSTI ratio dynamics via different factors that are used to calculate the LSTI ratio (i.e. interest rate, loan amount, income and maturity).

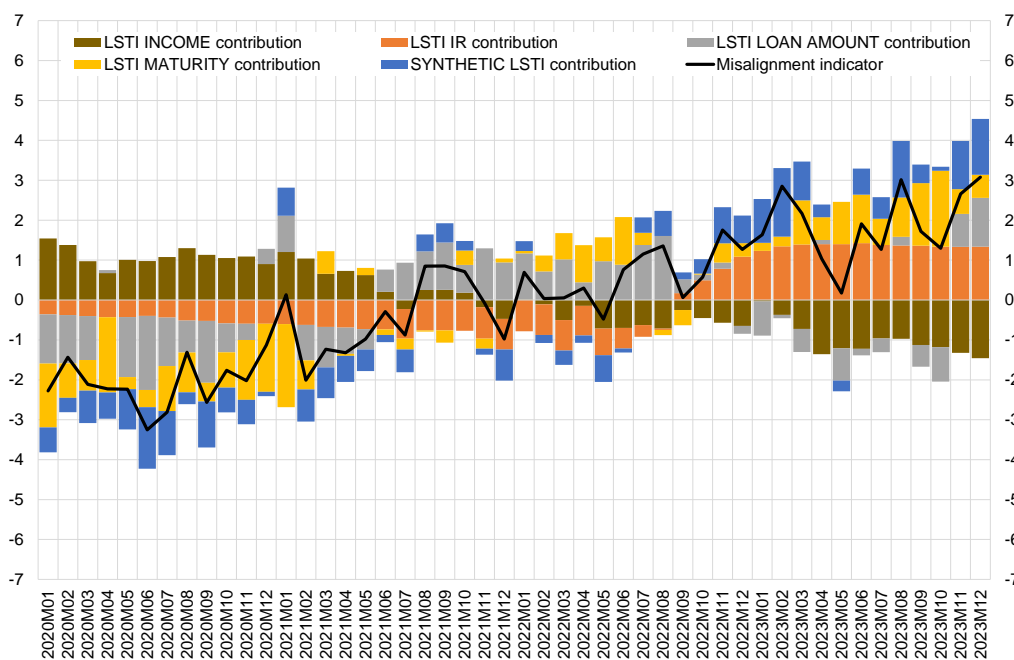
Figure 8: Contributions of factors driving the LSTI deviation for consumer loans



Source: own calculations.

Further, Figure 9 shows the contributions of the main factors to the LSTI deviation for housing loans. Similarly to the case of consumer loans, the synthetic LSTI ratio is increasing due to the increase in the interest rates on housing loans. Contrary to the increase of the loan amount in consumer loans, the loan amount contribution effect of the housing loans has stayed rather subdued in the last year or so. On the other hand, the decrease in the average maturity of housing loans increased the average LSTI ratio. As with consumer loans, the income effect had a negative contribution to the LSTI ratio dynamic.

Figure 9: Contributions of factors driving the LSTI deviation for housing loans



Source: own calculations.

6 Conclusions

In this analysis, we introduce a synthetically calculated LSTI and evaluate the dynamics of the synthetically calculated LSTI given different assumptions of factors affecting the LSTI. We simulate contributions of the individual sub-factors, i.e. borrowers' income, interest rate of loans, loan maturity and loan amount, for which we know that are the main drivers of the LSTI dynamics. We did this using the misalignment indicator methodology seminally applied by Schneider (2013) and other studies.

The results of the analysis show that the increase in the average loan amount had the strongest positive effect on the synthetically calculated LSTI ratio of borrowers who took out a consumer loan, *ceteris paribus*. Other factors affecting the LSTI had a smaller effect on the synthetically calculated LSTI ratio of borrowers who took out a consumer loan. In fact, the increase in the average interest rate for consumer loans had the smallest impact on the synthetically calculated LSTI ratio of borrowers who took out a consumer loan. While the rise in market interest rates had a positive effect on the LSTI ratio of borrowers who took out a consumer loan mainly in the second half of 2022, the effect was not pronounced, due to the limited rise of the average interest rate of consumer loans. The increase in the average maturity of consumer loans had a negative impact on the LSTI of borrowers who took out consumer loan; however, due to the maturity limits set by the macroprudential regulation, the extension of the loan maturity to reduce monthly installment and thus the LSTI ratio is limited. The increase in the average income of the borrowers who took out a consumer loan, however, offset the increase of the synthetically calculated LSTI ratio. We conclude that the factors affecting the LSTI ratio of borrowers who took out a consumer loan more or less leveled off in the observed period and that the general increase of market interest rates only had a minor impact on the LSTI ratio of borrowers who took out a consumer loan. On the other hand, the rise in market interest rates had a more pronounced impact on the synthetically calculated LSTI ratio of borrowers who took out a housing loan. This is due to the fact that the average interest rate for housing loans had almost doubled compared to the limited increase in the average interest rate for consumer loans. Also, the increase in the average housing loan amount contributed significantly to the increase in the synthetically calculated LSTI of borrowers who took out a housing loan. The reduction of the average maturity of housing loans also had a non-negligible positive impact on the synthetically calculated LSTI ratio of borrowers who took out a housing loan. As with consumer loans, the general growth in the average income of borrowers limited the rise of the synthetically calculated LSTI of borrowers who took out a housing loan, but the increase in the average loan amount, the average interest rate and a reduction of the average maturity of the housing loans resulted in an overall increase of the synthetically calculated LSTI ratio of borrowers who took out a housing loan.

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