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CONFERENCE PAPER

Interest Rate Exposure of Households in Croatia: A Simulation of the National Reference Rate

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Abstract: *The 2022-23 monetary policy tightening of the European Central Bank led to a strong rise in bank credit interest rates in the euro area. However, the regulatory specifics of the Croatian banking system, namely the existence of the National Reference Rate and the interest rate limit on variable rate loans have so far muted the effects of the increase in key ECB interest rates. Towards the end of 2023, while the interest rates on new household credit and term deposits have significantly increased, the effect on regulatory benchmarks is absent and expected with a time lag. This paper uses an algorithmic approach to univariate time-series modelling to estimate three scenarios, differing in the intensity of the rise in the volume and interest rates on new term deposits. The estimated series are then used in stock-flow consistent calculations to simulate three possible paths of the National Reference Rate over a three-year horizon. A strong rise in the National Reference Rate of 210 basis points towards the end of 2026 is associated with a scenario which entails the most intense rise in term deposits, such which would result in almost three quarters of all deposits being in the form of term deposits, the level which was previously observed a decade ago. The used approach could be employed to provide inputs to stress-testing and sensitivity analyses.*

Keywords: household deposits; National Reference Rate; monetary policy transmission; cash-flow channel; stock-flow consistency

JEL Classification: E43, E52, G21

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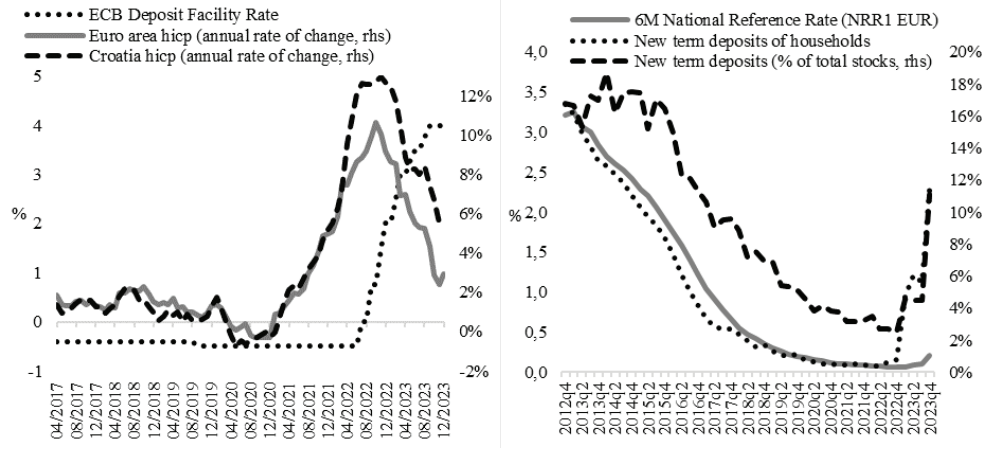
Introduction

The acceleration of inflation during 2021 and 2022 led to a strong monetary policy tightening and the increase in the key interest rates of central banks of largest world economies. Likewise, the rise in the Deposit Facility Rate (DFR) and other key rates of the ECB has been quite strong. While the euro area inflation rate reached its peak of 10% in November 2022 and has been gradually slowing down towards the end of 2023, the DFR has surged by 450 basis points, from -0.5% in June 2022 to 4% in October 2023 (Figure 1, left).

Inflation developments in Croatia have been similar, although the acceleration in the first half of 2022 was much faster and resulted in the inflation rate being 2-4 percentage points above euro area level. The entry of Croatia into the euro area led to the adoption of the monetary policy instruments of the ECB, in principle allowing for a more direct transmission of the movements in ECB key rates to the domestic money and credit markets. However, the transmission to both deposit and credit interest rates has been slower than in other euro area countries, due to high excess liquidity in the domestic banking system, possible benefits of the reduction of the regulatory cost for banks as the euro was adopted as well as institutional and other rigidities in the domestic banking system.

Figure 1: Inflation rate in Croatia and the euro area and the ECB Deposit Facility Rate for euro area (left chart) and interest rates on household bank deposits in Croatia (right chart)



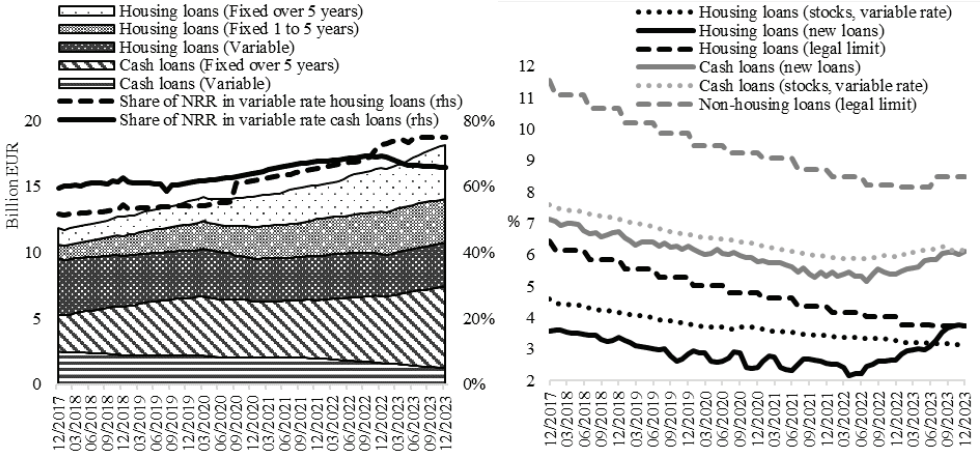
Sources: Croatian National Bank, ECB, Eurostat

High excess liquidity in the domestic banking system can be illustrated by very low interest rates on household deposits. Calculated as the average relative cost of funds received from natural persons (Croatian National Bank, 2023c; Deković, 2019) over a chosen time horizon (3, 6 or 12 months), the National Reference Rate 1 (NRR1) reflects the average interest rate on household deposit stock, and in the fourth quarter of 2023 stood at 0.18% (Figure 1, right). The low level of the interest rate on household deposit stock, of which overnight deposits constitute 73% is, however, contrasted by the increase in the interest rates on new term deposits which have on average increased from 0.15% at the end of 2022 to 2.3% in the final quarter of 2023. The importance of new term deposits for bank funding has seen a simultaneous increase. Measured as the ratio of new term deposits to total household deposits, it grew from 3% to 11% per quarter.

Since mid-2022, the transmission to new credit interest rates has been gradual, with the interest rates on new housing loans and general-purpose cash loans rising by around 150 and 100 basis points, respectively (Figure 2, right). Similar to deposits, the increase in interest rates on existing loans has been weak, curbed by several factors: the modest share of variable rate loans (26%), the fact that the currently low NRR is the dominant benchmark parameter among variable rate loans (around 75% of variable rate loans, Figure 2, left), and the legal limit on interest rates on variable rate loans. This limit is calculated as the average interest rate on the stock of loans with variable rates, increased by one third for housing loans, and by one half for other consumer loans (Consumer Credit Act, 2023; Act on Consumer Housing Loans, 2023).

Although the interest rates on loans linked to the NRR are below the current limit of 3.73%, the limit is still binding for other variable rate housing loans for which interest rates are at this ceiling and currently unable to increase further (Croatian National Bank, 2023a). Furthermore, the low level of the limit has also prompted banks to start granting loans exclusively with interest rates fixed to maturity in order to be able to contract higher interest rates (Figure 2, right; also see Croatian National Bank, 2023b).

Figure 2: The structure of loans to households with respect to interest rate fixation period (left chart) and interest rates on loans to households (right chart)



Source: Croatian National Bank

The movements of the NRR are central to household interest rate transmission. Namely, the NRR reflects the interest revenue of depositors while it determines rates on loans linked to the NRR, influences the legal limit through the effect on the average housing loans' interest rate and has a cost-of-funds effect on new loans' interest rates. However, although the low level of the NRR is currently muting the monetary policy transmission, it is dependent on stock movements which may, more or less gradually, change over time.

This paper aims to explore possible future movements of the NRR. Namely, this paper aims to answer the question: "What is the effect of the increase in volume and interest rates of new term deposits on future movements of the NRR and how high and fast can it be expected to rise, given possible paths of key determinants?" A univariate time-series approach is combined with ECB interest rate staff projections to formulate three scenarios, each differing in the intensity of the movements in volume and interest rates on new term deposits. With additional assumptions about the movements in household stock variables, stock-flow calculations are used to estimate the NRR. The main advantage of the approach is that the estimated dynamics of the NRR are consistent with the interest rates on new term deposits and other deposit flows. As such, the proposed approach could be used as input for household interest rate sensitivity analysis, stress-testing and other relevant simulations. The results suggest that significant increases in the NRR of over 210 bps are possible solely in the case of very strong activity in new term deposits, whereby the share of term deposits would have to almost triple.

The paper is structured as follows. The next section provides a brief literature review, followed by a description of historical movements in term deposits and a short note on data sources. The fourth section defines the methodology, followed by the exposition of the results in the fifth section. The final section concludes.

Literature review

This paper could be considered as related to the study of the interest rate pass-through of monetary policy, which has been extensively researched for the euro area and often characterised as incomplete and heterogenous (Bernhofer & van Treeck, 2013; Holton & Rodriguez-d'Acri 2018; Sørensen and Werner, 2006). The research focusing on the most recent cycle of monetary policy tightening suggests that the pass-through has been even more heterogenous across countries and sectors than what has been historically experienced (Beyer, et al., 2024). It has further been found that the rise in interest rates has on general been weaker for household term and, especially, overnight deposits, depending on factors such as banking competition and liquidity as well as deposit abundance (Beyer, et al., 2024; Byrne & Foster, 2023; Kho, 2023; Messer & Niepmann, 2023) all of which can in the Croatian banking system be considered as present and contributing to weak interest rate pass-through.

The methodology used in this paper differs from available research on interest rate pass-through as it is forward-looking and aims to model hypothetical future movements of the NRR, given different possible deposit interest rate pass-through intensities which are implicitly assumed across scenarios. Further, the NRR is specific to the Croatian credit market, introduced to ameliorate interest rate credit risk which was traditionally high due to the presence of variable rate loans, which amounted to 90% of all loans in 2010 (Croatian National Bank, 2023a). Furthermore, the lack of relevant interest rate benchmark in the 2000s, representative of domestic cost of funds, further heightened interest risk in the banking sector. Therefore, by using data published by the Croatian National Bank, the Croatian Banking Association began in 2012 to calculate the National Reference Rate defined as the average cost of financing of the Croatian banking sector for certain currencies (Deković, 2019). From 2020, the Croatian National Bank calculates and publishes the NRR (Croatian National Bank, 2023d).

As the motivation to model the NRR is due to implications for the cash-flow of households, the focus is on the NRR1 variant which refers to the cost of funds received from natural persons. Furthermore, the dynamics of the NRR is of little relevance for corporate debtors, as corporate loans indexed to the NRR are negligible (Croatian National Bank, 2023a). Regarding indebted households, it is worth noting that 90% of loans to households indexed to the NRR are indexed to the NRR1 (Croatian National Bank, 2021). Further, loans indexed to the NRR are almost exclusively

indexed to the 6-month NRR, while over 95% of the household deposit stock is in euro, so only "6M NRR1 EUR" is modelled (referred to as the NRR throughout the paper).

The dynamics of the NRR are important from both monetary policy and financial stability perspectives. By representing the interest revenue of the depositors, and influencing borrowers' interest costs, the NRR reflects the cash-flow channel of the monetary policy transmission (Lane, 2022), while it is also a key factor of household interest rate exposure (Auclert, 2019; Tzamourani, 2021). In addition, the movements of the NRR are a reflection of the share of household term deposits' volume and interest rate, therefore strongly affecting bank profitability in Croatia (see Rosan & Beriša, 2024).

The estimation of the possible movements of the NRR done in this paper primarily aims to supplement existing analyses of household interest rate risk by providing relevant input which could be used in such analyses, whereby the interest rate increases could be modelled as well. Namely, many analyses focus on the sensitivity of household loan repayments to either exogenous or recent increases in interest rates (see e.g. Bullock, 2023; Byrne, McCann, & Gaffney, 2023; Brown & Suman Guin, 2015).

For households in Croatia, the possible increase in loan repayment stemming from interest rate increases of 50, 100 and 200 bps on the stock of all household loans with a fixation period has been analysed with the assumption of the absence of the limit on variable interest rate (Croatian National Bank, 2022a). Next, the interest rate repayment sensitivity of the segment of loans with variable and rates fixed up to the period of one year indexed to EURIBOR has been analysed, assuming a 300 bps increase and no interest rate ceiling (Croatian National Bank, 2022b). More recently, the interest rate sensitivity of the total stock of loans has been analysed taking both the current level of the interest rate ceiling into account as well as assuming the absence of the limit (Croatian National Bank, 2023a).

The mentioned analyses have been informative, as they quantify the possible increase in repayment costs, given different levels of interest rate increase, with or without the constraint given by the legal limit, for different loan segments. However, the mentioned analyses are time-inconsistent as they assume point-in-time increases, which are unrealistic, and therefore do not provide insight into the speed of the possible interest rate and repayment cost increase. Further, these are also stock-flow inconsistent as they lack the underlying model for movements in deposit interest rates, which are desirable, as the NRR is the dominant interest rate benchmark in the domestic credit stock.

This paper aims to contribute to the existing literature by providing a simulation which could give insight into how much can the NRR be expected to increase, given possible paths of new term deposit activity. In this respect, the estimated NRR dynamics is stock-flow consistent, as it is calculated based on projected paths of other

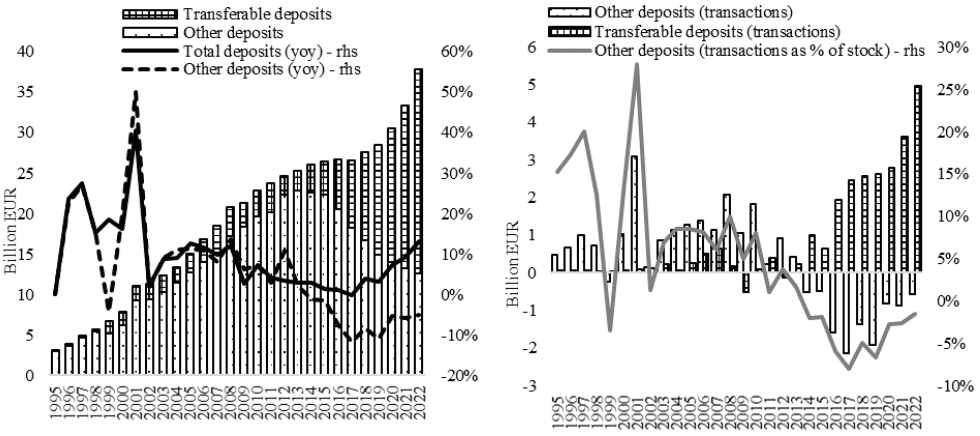
input variables, rather than simply assumed into existence. To the best of the author's knowledge, the topic of NRR prediction has not been researched so far, although it may inform policymakers about the necessary conditions and possible timing of the materialization of households' interest rate risk.

Data and descriptive statistics

Before explaining the data and the methodology used for simulating possible paths of the NRR, a short overview of past and present dynamics of the deposit volume and interest rates is given in the current section. Regarding the historical movements of household deposits, the data from financial accounts are available for a sufficiently long period and offer a few insights.

First, the nominal amount of total household deposits has strongly increased in the last two decades; by more than 250% since 2001 (Figure 3, left). Second, the share of transferable deposits, i.e. those which are "directly usable for making payments" (European Commission, 2013, p. 135), has increased significantly since 2016 but has historically been much lower. Namely, as the average interest rate on new term deposits fell to around 1% and continued to fall further in the subsequent period (Figure 4, left), households were discouraged from renewing term deposits, resulting in the strong inflow of transferable deposits (Figure 3, right). This led to the increase in the share of transaction deposits from around 25% in 2016 to around 75% towards the end of 2023 (Figure 4, right).

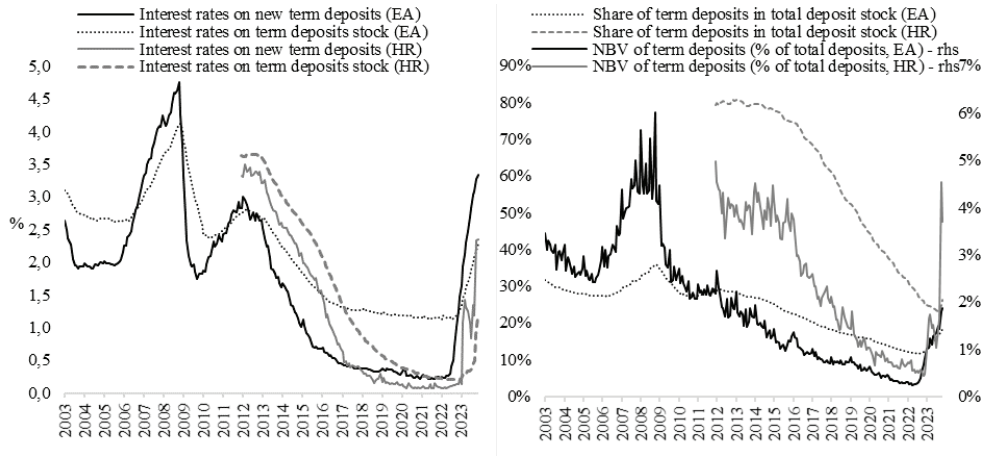
Figure 3: Transferable (demand) and other household deposits: stocks (left) and transactions in deposits (right)



Source: Eurostat

Next, the data on interest rates reflect the fact that interest rates on household term deposits have historically been significantly higher than what was experienced in the period from 2016 to 2022, and, although the recent rise in the interest rates on new term deposits has been very fast, the level it has reached so far is not atypical of historically observed rates. The earliest available data for Croatia suggest that, in 2012, the level of interest rates on term deposit stock revolved around 3.6% (Figure 4, left). In the recent period, the interest rates on new term deposits in the euro area surged, from around 0.3% in mid-2022 to over 3.3% at the end of 2023, while the increase in interest rates on new term deposits in Croatia came with a lag, from around 0.1% in February 2023 to around 2.4% in December 2023.

Figure 4: Interest rates on term deposits in Croatia and the euro area (left) and shares of new and existing term deposits in total household deposits (right)



Source: ECB

Finally, the ratio of new term deposit business volume (NBV) to total household deposit stock, has revolved around 4% per month in the period from 2012 to 2015, when interest rates were comparatively high (over 2%), subsequently fell to a very low level, and strongly increased towards the end of 2023, simultaneously with the increase in interest rates (Figure 4, right).

The data used in subsequent simulation come from statistics on interest rates which contain volumes of household deposit stocks and flows, as well as applicable interest rates. The data on transactions, defined as acquisitions less disposals of term deposits, are also used, to estimate net growth in term deposits. The distribution of NBV by initial maturity and stocks by remaining maturity of term deposits are used to achieve consistency between outflows, inflows and stocks of term deposits. Finally, the projections of short and long-term interest rates are taken from ECB

staff projections (European Central Bank, 2023). This data is regularly collected and published by the Croatian National Bank and the ECB. The cut-off date for the data is December 2023.

Methodology

In order to simulate stock dynamics, from which the NRR can be calculated, it is necessary to have information on the dynamics of key nominal variables: the stock of total deposits, volume of new term deposits and net transactions in term deposits (net nominal growth). Further, the information on future movements of interest rates on overnight and new term deposits is also necessary. As this information is not available in official projections, besides annual short and long-term interest rates in ECB staff projections, certain assumptions are made about the dynamics of these variables. Because uncertainty is high and significant forecast errors likely, the dynamics are assumed for three scenarios, which differ in the intensity of growth of term deposits as well as the level of interest rates.

Scenario construction

To reduce the degree of arbitrariness in scenario construction, univariate time series modelling is used, and for each variable a seasonal autoregressive integrated moving average (S-ARIMA) model is estimated. The estimation is done using the "forecast" package for R programming language (R Core Team, R Foundation for Statistical Computing, 2023; RStudio Team, 2020; Hyndman, et al., 2022). Particularly, the estimation of the S-ARIMA model is achieved using a function which estimates a wide range of S-ARIMA models and selects the one with the best fit, based on diagnostic (unit-root) tests and AIC model selection criterium (Hyndman & Khandakar, 2008). After the model is chosen, it is used to predict the movements in key input variables until the end of 2026. It should be noted that the predicted dynamics are partly constrained ex ante (e.g. by limiting the number of parameters and by benchmarking), as small changes in the chosen parameters may produce largely different dynamics. However, this is desirable, as the objective is not to estimate most reliable predictions, but to construct three diverging scenarios, roughly describing a wide range of possible realizations with the estimation of the probability a specific scenario occurs outside the scope of this paper. Instead, the likeliness of scenario realization is commented in the concluding section.

Table 1 contains combinations of parameters used to predict variable dynamics in each of the three scenarios: number of autoregressive terms, number of differences and number of lagged forecast errors for non-seasonal (p, d, q) and seasonal (P, D, Q)

parts of the estimation equation (for a primer on S-ARIMA models see e.g. Kocenda & Cerný, 2014). In addition, Table 1 contains other information regarding calculations used for scenario construction.

Table 1: Methods used to estimate input series in the three scenarios

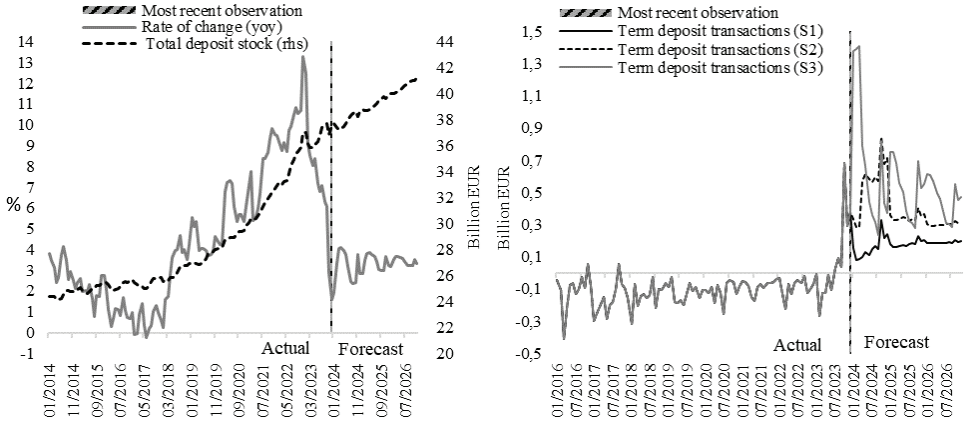
SCENARIO:	S1	S2	S3
Stock of total deposits	S-ARIMA (0,2,2; 1,0,0) to predict total stock.		
New term deposits	Transactions in term deposits increased by the amount of existing term deposits maturing in the present period (estimated recursively).	Transactions in term deposits increased by the amount of existing term deposits maturing in the present period and multiplied by 1.5.	S-ARIMA (1,1,0; 1,0,0) to predict the ratio of new business volume to the total stock. NBV extrapolated from the ratio and total stock.
Transactions in term deposits	S-ARIMA (3,1,1; 1,0,0) to predict transactions in term deposits.	NBV minus the amount of existing term deposits maturing in the present period (estimated recursively).	NBV minus the amount of existing term deposits maturing in the present period (estimated recursively).
Interest rates on overnight deposits	S-ARIMA (0,0,0; 0,0,0) to predict interest rate on transaction deposits (a constant).		
Interest rates on new term deposits	S-ARIMA (1,0,0; 1,0,0) to predict interest rates on new term deposits. Chow-Lin max log likelihood to benchmark to ECB short term interest rate projections. The interest rates are set to be equal to S2 interest rates for those periods for which S2 interest rates would have otherwise been lower than S1 (from January 2024 until January 2025).	S-ARIMA (1,0,0; 1,0,0) to predict interest rates on new term deposits.	S-ARIMA (1,0,0; 1,0,0) to predict interest rates on new term deposits. Chow-Lin max log likelihood to benchmark to ECB long term interest rate projections.

Source: Author's preparation

The estimation of term deposit growth across scenarios is based either on transactions or the new business volume (NBV) of term deposits. Estimating S-ARIMA for transactions of term deposits results in a modest growth of term deposit stock, whose share in total deposits increases by an average of 5.4 pp. annually and is used for the "low-intensity" scenario S1 (Figure 5, right; Table 2). As explained later, the subsequent calculations allow for the estimation of maturing deposits in each period, representing outflows from the term deposit stock. The NBV of term deposits in S1 are then estimated as the sum of transactions and maturing deposits, recursively for each period (Figure 6, left). Next, to produce the "middle-intensity" scenario (S2), the NBV of term deposits from S1 is increased by 50% to get to the NBV estimation (Figure 6, left), with the transactions in S2 estimated as NBV less maturing deposits. This results in a robust growth of term deposit share of an average of 12.4 pp. annually (Figure 5, right; Table 2). The growth of term deposits in the "high-intensity" scenario (S3) is estimated using the ratio of term deposit NBV to total deposit stock. This results in an increasing amount of new term deposits over time. The amount of

estimated maturing deposits is then deducted from the NBV to estimate transactions. The estimated transactions imply a very strong annual average growth in the share of term deposits of 17.5 pp. (Figure 5, right; Table 2).

Figure 5: Actual and forecasted values of total household deposit stock (left) and transactions in term deposits (right)

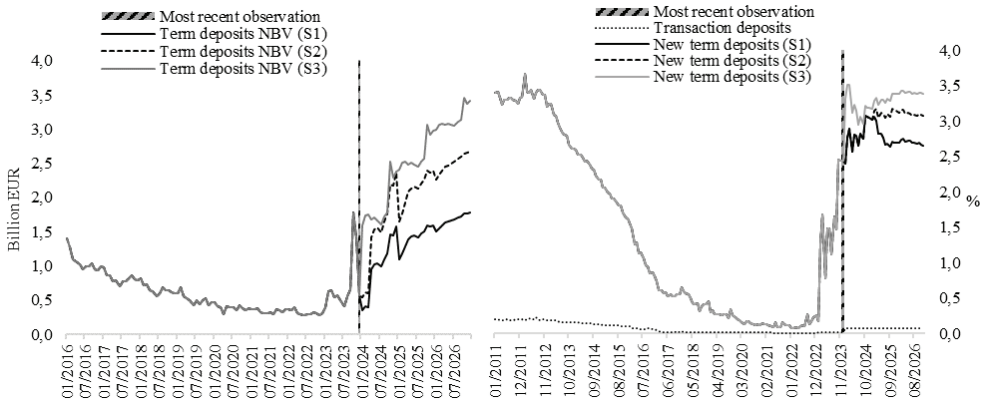


Source: Croatian National Bank, author's calculation

The interest rates on new term deposits are forecasted by S-ARIMA, and in S1 and S3, benchmarked to the annual averages of short and long-term interest rates used in Eurosystem staff projections from December 2023 (European Central Bank, 2023). The benchmarking is done using the Chow-Lin max log likelihood estimation (Chow & Lin, 1971; Sax & Steiner, 2013), whereby the annual interest rates are estimated at monthly frequency using the previous S-ARIMA estimation of interest rates on new term deposits as indicators.

As the short-term interest rate projections are lower, these are used for S1, reflecting a financial environment where the interest rates on new term deposits stay at the level comparable to that observed at the end of 2023, while long-term interest rate projections are higher, and used in S3. The "middle" scenario (S2) uses original S-ARIMA predictions as in Table 1. Additional constraint imposed for S1 is that the interest rates may not be higher than those predicted in S2, which is relevant until the end of third quarter of 2024 (Figure 6).

Figure 6: New business volume (NBV) of household term deposits (left) and interest rate on new term deposits and transaction deposit stock (right)



Source: Croatian National Bank, author's calculation

Table 2: Movements in key input variables over the forecasted horizon (annual averages)

	S1			S2			S3		
	2024	**2025**	**2026**	**2024**	**2025**	**2026**	**2024**	**2025**	**2026**
Total deposit growth (yoy)	3.2%	3.4%	3.4%	3.2%	3.4%	3.4%	3.2%	3.4%	3.4%
Transactions in term deposits (mio EUR)	1,917	2,196	2,274	6,634	4,161	3,638	8,608	6,334	5,509
Transactions in term deposits (as % of total deposit stock)	5.1%	5.6%	5.6%	17.5%	10.6%	9.0%	22.7%	16.1%	13.6%
Interest rate on new term deposits	2.80	2.80	2.70	2.80	3.11	3.11	3.20	3.30	3.40
Interest rate on overnight deposits	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08

Source: Author's calculation

Stock-flow calculations

The estimated input series are then used in stock-flow calculations, required for the estimation of the NRR. The last available observation is used to determine stock values and interest rates in the base period: the stock of total deposits, the stock of term deposits broken down by remaining maturity as well as interest rates on these stocks. The information on the remaining maturity of term deposit stock ($Stock_{TD}$) is used to determine term deposit outflows (O_{TD}) as those with one-month maturity in the previous period:

$$O_{TD,\ t} = Stock_{\ TD,\ t-1}\ (Maturity = 1),\ \ t = 0, 1, 2, 3\ \ldots \tag{1}$$

Then, the stock of term deposits in subsequent periods is calculated as:

$$Stock_{\ TD,\ t} = Stock_{\ TD,\ t-1} + NBV_{TD,\ t} - O_{TD,\ t}, \tag{2}$$

where new term deposits (NBV_{TD}) are broken down by initial maturity, using average shares of initial maturity of NBV_{TD} for the three most recent observations ($t-1$, $t-2$, $t-3$). The NBV_{TD} is differently defined across scenarios as noted in Table 1:

$$\begin{aligned} NBV_{TD,\ t,\ S1} &= TR_{TD,\ t,\ S1} + O_{TD,\ t,\ S1} \\ NBV_{TD,\ t,\ S2} &= NBV_{TD,\ t,\ S1} \times 1.5 \\ NBV_{TD,\ t,\ S3} &= \rho_{t,\ S3} \times Stock_{\ D,\ t}, \end{aligned} \tag{3}$$

where TR_{TD} denotes transactions in term deposits, $Stock_D$ denotes the stock of all deposits, and ϱ_{S3} denotes the ratio of NBV of term deposits to total deposit stock. The average interest rate on term deposit stock ($IR_{Stock_{TD}}$) is calculated as the weighted average of interest rate on term deposit stock outstanding from the previous period and the interest rate on new term deposits ($IR_{NBV_{TD}}$):

$$IR_{Stock_{\ TD,\ t}} = \frac{IR_{Stock_{\ TD,\ t-1}} \times (Stock_{\ TD,\ t-1} - O_{TD,\ t}) + IR_{NBV_{TD,\ t}} \times NBV_{TD,\ t}}{Stock_{\ TD,\ t-1} - O_{TD,\ t} + NBV_{TD,\ t}} \tag{4}$$

Next, interest costs of total household deposit stock (IC_{Stock_D}) are estimated using average interest rates on term and overnight deposit stocks ($IR_{Stock_{ON}}$):

$$IC_{Stock_{\ D,\ t}} = IR_{Stock_{\ TD,\ t}} \times Stock_{\ TD,\ t} + IR_{Stock_{\ ON,\ t}} \times (Stock_{\ D,\ t} - Stock_{\ TD,\ t}) \tag{5}$$

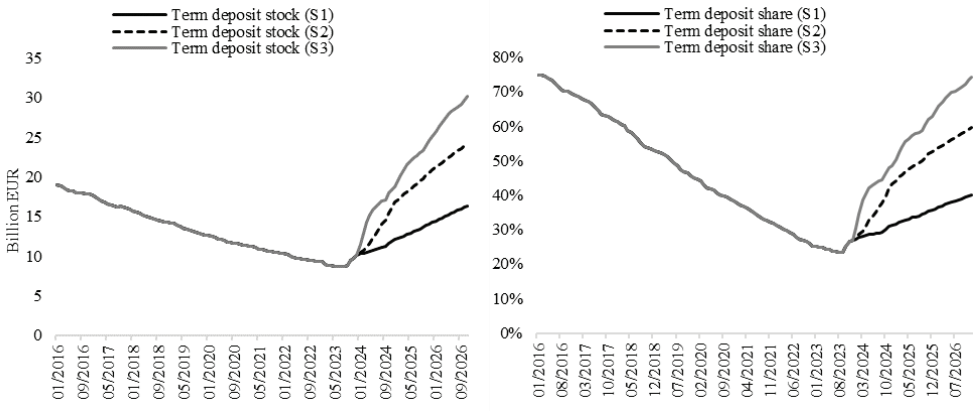
Finally, the NRR is calculated every three periods, as the sum of interest costs in the current and previous five periods, divided by the average stock in the current and previous five periods and multiplied by the number of days (*ND*) in the current and previous eleven periods divided by the number of days in the current and previous five periods (Croatian National Bank, 2023c; Deković, 2019):

$$NRR_t = \frac{\sum_t^{t-5} IC_{Stock_{\ D,\ t}}}{\frac{\sum_t^{t-5} Stock_{\ D,\ t}}{6}} \times \frac{\sum_t^{t-11} ND_t}{\sum_t^{t-5} ND_t}, t = 0, 3, 6\ \ldots \tag{6}$$

Results

The results suggest that a relatively modest increase in new term deposits in S1 results in the increase in the share of term deposit stock by 13 pp. over the period of three years, reaching 40%, a level which was last observed in August 2020 (Figure 7) and is relatively modest in historical perspective. In S1, average interest rate on term deposit stock reaches 2.6% in February 2025 and stabilizes at that level, with the NRR amounting to an average of 1% in 2026 (Figure 8, Table 3).

Figure 7: Nominal stocks of household term deposits (left) and shares of term deposits in total household deposit stock (right)

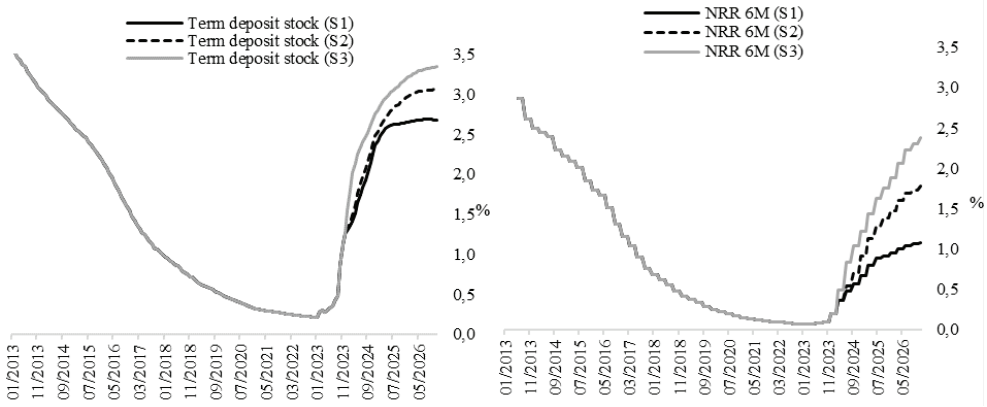


Source: Croatian National Bank, author's calculation

In S2, the growth of term deposits is robust, and very strong in the first projected year (2024), during which the share of term deposits increases by over 16 pp., followed by additional 16 pp. over the next two years, reaching 59.6% by the end of 2026. In this period, the average interest rate on term deposit stock slightly surpasses 3%, resulting in a stronger growth of the NRR than in S1, which by the end of 2026 reaches 1.78%.

Finally, S3 represents a "shock" scenario with the growth of term deposit share being the strongest, 22 pp. in the first year, with additional 25 pp. in 2025 and 2026. In this scenario, the interest rate on outstanding term deposits reaches an average 3.35% by the end of 2026. The NRR increases by more than 200 bps, reaching 2.39% at the end of 2026.

Figure 8: Average interest rates on the stock of term deposits and the 6-month National Reference Rate of funds received from natural persons



Source: Croatian National Bank, author's calculation

Table 3: Main results of the simulation in three scenarios (annual averages)

	S1			S2			S3		
	2024	2025	2026	2024	2025	2026	2024	2025	2026
Share of term deposits in total stock of household deposits (%)	29.0%	33.7%	38.2%	34.9%	48.4%	56.4%	42.0%	57.2%	69.7%
Stock of term deposits (mio EUR)	11,007	13,204	15,479	13,256	19,007	22,892	15,966	22,441	28,272
Interest rate on stock of term deposits	1.80	2.59	2.68	1.90	2.78	3.04	2.30	3.03	3.30
Interest rate expenses on funds from natural persons (mio EUR)	220	362	434	279	546	709	391	693	943
6-month NRR for funds from natural persons	0.44	0.84	1.02	0.51	1.23	1.65	0.72	1.56	2.16

Source: Author's calculation

Conclusion

The results presented suggest that, given roughly unchanged stance in the monetary policy of the ECB and in the absence of abrupt disruptions in the banking system, the National Reference Rate for the funds of natural persons could rise by around 100 bps or higher in the case of the continuation or intensification in the growth of term deposits, as was observed in the final quarter of 2023. The case of mild growth of term deposits and the NRR reaching 1.08% at the end of 2026, represented by S1, may be deemed likely, as the monetary policy of the ECB is expected to gradually loosen, starting in the second half of 2024.

On the other hand, there may be underlying economic processes, for example wage growth, which may make the current rate of inflation difficult to bring down to the target of 2%. In this case, S2 may materialize, if, for example the ECB is forced to postpone rate cuts more than what the markets expect, which would encourage banks to continue to offer interest rates slightly higher than 2.8% over the next three years and be ready to hold additional term deposits.

Finally, the materialization of S3 would require a strong and proactive participation of banks and depositors, as the amount of existing term deposits would need to roughly triple, e.g. in the presence of additional investment opportunities for depositors, offering high yields, which would threaten deposit bank funding. This may also happen in the case the ECB needs to continue to implement tight monetary policy, or even tighten further, for example in the case of an unforeseen geopolitical event which would increase inflation pressures. While at the current juncture this scenario seems less likely than S1 and S2, the results suggest it would lead to the NRR reaching 2.39% by the end of 2026.

It should be noted, that only those scenarios in which the interest rates on new term deposits stay above 2.7% have been explored in this paper. It is assumed that the ECB does not significantly relax monetary policy stance in the next three years, i.e. that the key interest rates do not return to zero or below zero levels, but stay in the "neutral" territory of between 2% and 3%. Whether this will be the case is a discretionary decision by the ECB which depends on many factors, some of which are unpredictable. However, in this paper only those scenarios in which significant cash-flow effects on households materialize are explored.

While it is highly unlikely that we experience a scenario stronger than S3, it is possible a less intense scenario than S1 materializes, if for example, the ECB starts lowering its key interest rates earlier than expected and to the degree that would stop the growth of the volume and interest rates on new term deposits. Depending on the trajectory of the monetary policy, and the dynamics of new term deposits, the NRR may increase towards a maximum predicted by S1 in the second year (between 0.84%) and continue to fall afterwards if, from the second half of 2025, the ECB starts to lower its key interest rates gradually towards zero.

In the analysed scenarios, the debtors holding variable rate loans would see a rise in their interest costs, stemming both from the rise in the NRR affecting loans indexed to the NRR as well as from the rise in the limit on variable rate loans which would affect the interest costs of all variable rate loans. While additional simulations are necessary for precise estimates, existing sensitivity analyses may offer an approximation of the possible rise in loan service costs (Croatian National Bank, 2022a). According to those results, in S1, debtors may experience an average rise of 100 bps, leading to the average rise of loan service costs of around 5% for housing loans, with a very small, almost negligible, rise for short-term loans, and a rise of over 10% for loans with remaining maturity of over 20 years. In the case of S3, and the increase

in the NRR of over 200 bps, the additional loan service costs could on average be higher by more than 11.5% for housing loans, with the rise for loans with remaining maturity of over 20 years amounting to more than 22%.

The current approach to the simulation of the possible dynamics of the NRR can be used for more precise assessment of the interest rate risk of debtors. As such, it could be used as input for stress tests, sensitivity analyses and other simulations. A possible strand of future research consists of using the estimated path of the NRR to simulate the dynamics of the interest rates on stock of household loans, with the limit on variable rate loans and the rise in interest costs modelled endogenously with the simulated movements of the deposit rates (NRR), providing an encompassing stock-flow consistent overview of the households' interest revenue and interest costs, i.e. the cash-flow channel.

Declarations

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Conflicts of interest/Competing interests

All opinions expressed in this article are the author's own and do not necessarily reflect the views of the Croatian National Bank.

Availability of data and material

The data that support the findings of this study are openly available in the website of the Croatian National Bank (www.hnb.hr).

Code Availability

The computer program results are available on demand.

Authors' Contributions

Not applicable.

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