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Deposit Channel of Monetary Policy in European Countries

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Abstract: This paper focuses on the first link of the monetary transmission mechanism – interest rate channel. It forks on two sub-channels: credit vein and deposit vein. We will investigate the second one, i.e. the impact of the discount (also key, reference) rate of a central bank on the deposit policy of commercial banks. Deposit channel is a very rarely treated as a separate line of the monetary policy from the credit channel. On the basis of VAR analysis of monthly data over several-years period on the banking system of Ukraine, Poland, and Montenegro we found out a tendency of the discount rate to impact banks' deposit rates changes with some lag of time. The tightest liaison between these indicators is observed during the periods of discount rate stability and sloping down. However, sensitivity of banks' deposit rates is lost when the discount rate is rapidly increased during the periods of restrictive monetary policy. It was defined that the essential reason for such picture is an extra liquidity of the banking system. On the one hand, it symbolizes the soundness of banking system, while from the other it makes more difficult for a central bank policy to absorb extra liquidity from the market to reduce pressure on prices. The paper contains some thoughts for increasing effectiveness of restrictive monetary policy in such periods.

Keywords: discount rate, deposit channel of monetary policy, deposit rates, excess liquidity.

JEL Classification: E43, E52, E58.

1. Introduction

The aim of this study is to analyse the deposit channel of monetary policy as an independent sub-channel of the interest rate channel of its transmission mechanism. Many researchers (e.g. Taylor, 1993; Cecchetti, 1994; Mishkin, 1995; Fountas & Papagapitos, 2001; Ireland, 2005) assigned to the banks' interest rate an important role in regulating macroeconomic processes, development, inflation and employment. The interest rates channel of central bank becomes a core vein of monetary policy with the set of instruments for its regulation. But attention is mostly focused on credit channel of monetary policy and banks' lending rates, but not on deposit one.

Empirical research allows a number of authors to single out deposit policy as a separate channel of the monetary mechanism (Drechsler, Savov & Schnabl, 2016; Repullo, 2020). However, the deposit channel of the monetary transmission framework is not yet sufficiently studied and requires additional study. Majority of research mostly focused on the impact of key rate changes on the final link of monetary transmission chain, – inflation, consumption, output. But, the first and very important link, – the effect of the key rate on the deposit rates of banks, which transmit the monetary policy of the central bank to society on achieving its ultimate goals, needs more deep analyses. If the first link of the transmission chain does not function properly, then the chosen monetary policy strategy could not be realized as a whole.

That is why this paper intends to cover the following issues:

- How closely banks' deposit rate correlate to the changes in the central bank's discount rate;
- How promptly banks' deposit rate react to the changes in the central bank's discount rate;
- Whether banks' deposit rate react in the same way under different types of monetary policy: sharp increase of discount rate under restrictive policy, slow growth in the case of a disinflationary monetary policy, sloping down and stable discount rate periods;
- How banks' deposit rate change under altered key (reference) rate policy in different countries;
- Which factors determine weak response of banks' deposit rates to the rapid growth of key rate and what are the tools for managing these factors in order to increase the effectiveness of the monetary transmission mechanism.

The main goals of this study are: the recognition of deposit channel as an independent channel of monetary policy; finding out the lag of time when the deposit rates react more tightly on the discount rate changes; develop the tools to strengthen the effect of the discount rate changes on deposit channel of monetary policy.

We use VAR methodology to determine the impact of the discount rate changes on the banks' deposit rate, different types of lines in order to find out the best formula which reflects such correlation. For this purpose, we create 3 arrays of monthly data for the period April 2014 until October 2022 (103 figures) for the Ukrainian banking system; the period of January 2005 – May 2023 (221 figures) for Poland; December 2007 to May 2023 (186 figures) for Montenegro, which makes the statistical models representative for the correlation analysis.

As a result of this research, using an empirical method, it was proved that banks' deposit rate react most sensitively to changes in the discount rate with the lag of several months. We find out that excess liquidity of banks significantly breaks the sensitivity of banks' deposit rate to a rapid increase of discount rate during periods of restrictive monetary policy. At the same time, this factor is not significantly realized in the periods of slow growth of the discount rate. In our opinion, this is due to the fact that the factor of anticipating a further increase in the discount rate is playing the important role and banks are raising deposit rates.

Central banks should take into account a certain time lag between the change in the discount rate and the response of banks' deposit rate. During the periods of restrictive policy, the discount rate channel should be strengthened with additional tools: changing reserve norms, flexible management of the corridor of interest rates on central bank' deposits, regulation of banks' liquidity standards. Approaches to the formation of optimal reserve norms and the corridor of a central bank' interest rates require additional research.

The results of this research have certain limitations: they are obtained on the basis of data for several countries; the reluctance of banks to raise deposit rates simultaneously with a rapid increase of the discount rate may be also impacted by factors other than excess liquidity.

2. Researches of the monetary policy transmission mechanism – literature overview

Studies of the transmission mechanism of the key rate of central banks have a long history. In February 1936, John M. Keynes (1936) published his well-known paper “General Theory of Employment, Interest, and Money”, where he assigned an important role of interest in economic development. A few months later, John Hicks (1936) formalized the cohesion between market of goods and the value of money in the model “investment - savings” (IS) and “liquidity preference - money supply” (LM). Although this model is macroeconomic and did not apply directly to the central bank's discount rate but rather to the search for the optimal level of the cost of capital, it provided an impetus for further research of the role of commercial banks' interest rate and central bank's discount policy in particular, in economic processes. Until 1970s, discount rate did not play an exclusive role in the monetary policy of the world's leading countries. In England, “Prior to September 1971, the main policy objectives of the authorities had been controlled over the supply of credit available to the private sector and control over the level and structure of interest rates. The former objective was achieved by the imposition of quantitative and qualitative restrictions on bank lending and setting the conditions for hire purchase credit. The latter was achieved by an interest rate set by the Bank of England - Bank Rate” (Bank of England, 2022). A similar situation took place with the Fed. Funds Rate, which was actively used in the USA to combat inflation in the 1970s, caused by the withdrawal of the USA from the gold standard in 1973 and reached a maximum mark of 20% in 1980.

In 1995, at the Symposium on the Monetary Transmission Mechanism, Frederic S. Mishkin (1995), based on the Keynesian model, formalized the impact of the interest rate channel of monetary transmission mechanism on investments and, accordingly, on demand and product supply. But what is more important for our paper, he singled out the credit as a separate channel of monetary policy and install bank deposits into the framework of its transmission mechanism:



In this blockchain, where the final results of monetary supply impact (M) on changes in investment (I) and production (Y), the first link is important for our research: M – bank deposits. At this stage, the deposit paradigm is formed: on the one hand, during a crisis and a tight monetary policy, commercial banks offer of deposits falls, while on the other hand, it leads to outflow of deposits into the consumer sphere, stimulating inflation. Therefore, the craft of monetary policy

consists in maintaining the supply of banks' deposits in order to sterilize part of the money supply if the central bank does not aim to stimulate price growth. The importance of the deposit link of the transmission chain of monetary policy prompts its in-depth study.

Most authors focused on the study of the final impact of monetary policy on investment and production (Cecchetti, 1994; Brunner and Meltzer, 1972; Bain and Howells, 2003). Taylor (1995) emphasized that the management of long-term and short-term interest rates is a prerequisite for a successful monetary transmission mechanism. Monetary transmission mechanism can be described as the effect of change on nominal money stock or nominal short term interest rates on real variables such as aggregate output and employment (Ireland, 2005).

When studying the transmission mechanism of key rate on inflationary processes, the interest rate of banks is considered as its first link from the perspective of credit rates (Westaway, 2004; Loayza and Schmidt-Hebbel 2002). A number of researchers focus monetary policy on the management of monetary aggregate M2, assigning interest instruments the role of moderator of such policy (Cecchetti, 1994).

After Mishkin's publication (Mishkin 1995), many economists began to focus their attention on the study of the role of bank credit in the monetary transmission mechanism (Chow, 2004; Çavuşoğlu, 2002; Bolton & Freixas, 2006). A good operating credit channel affects not only the general level of interest rates but also the magnitude of external finance premium (Fountas & Papagapitos, 2001). The term "broad lending channel" or "financial accelerator" appears in the literature. Bernanke and Gertler (1995) explained the broader credit channel as "the balance sheet channel", in which lending is assigned the role of a separate channel of the transmission mechanism. At the same time, in the earlier study by Bernanke and Blinder (1988), they synergistically linked monetary policy not only with bank loans but also with deposits. They also concluded that according to the credit channel, monetary policy impacts the economy by affecting bank assets such as loans and bank liabilities (deposits). The importance of the deposit component in the transmission mechanism of monetary policy is determined also by others: "It should be emphasized that the quantitative performance of the bank lending channel partly depends on the size of the contraction in deposits for a given monetary shock. Deposits and loans with more elastic money demand will show a higher degree of variation in response to a policy shock" (Bean, Larsen & Nikolov 2003, p.111). Kashyap, Raghuram & Stein (2002) determined a direct connection between credit and deposit policies of banks. However, most of the authors

consider the deposit system as secondary to lending channel in the transmission mechanism of monetary policy.

On the basis of empirical studies, Hannan and Berger (1991) and Neumark and Sharpe (1992), put forward an important hypothesis that deposit rates are not sensitive to declines and are flexible to increases as a result of market influences. Stein (2012) developed the model for regulating the deposit component of monetary policy to ensure financial stability. Acharya & Mora (2015) and Egan, Hortacsu & Matvos (2015) determined the tendency of significant redistribution of deposits between banks in crisis conditions. The importance of the influence of optimal interest rates on economic processes is also noted by Polish researchers: "We find an unambiguous result in that interest rate smoothing substantially limits the welfare loss distributions" (Górajski & Kuchta, 2022, p. 166).

The fundamental work in determining the important role of deposit policy of banks in the implementation of the transmission mechanism of monetary policy was the publication by Itamar Drechsler, Alexi Savov & Philip Schnabl titled "The deposits channel of monetary policy" (2016). The authors "propose and test a new channel for the transmission of monetary policy, the deposits channel. ...Since the financial system relies heavily on deposits, our results imply that monetary policy has a large impact on the cost and composition of the financial system's funding ...". On the basis of statistical analysis, the paper determined a direct correlation between changes in the Federal rate and the volume of banks' time deposits and the inverse reaction of check and current accounts to the Fed rate rising. Since the 1990s, the response of deposits to monetary policy has been attenuated (Kang-Landsberg & Plosser, 2022).

A number of authors rightly suggest adjusting the transmission mechanism of monetary policy for political and other types of risks in developing countries and take into account their socio - economic features when targeting the effect of its implementation (Maliszewski, 2005; Ghatak & Spanjers, 2007; Przystupa & Wróbel, 2016). The results of studies of the transmission mechanism of monetary policy both in general and in part of the deposit policy in particular may be acceptable for certain groups of countries and require some adaptation and adjustment for other countries, depending on the degree of their socio-economic development and level of the banking system.

3. Deposit channel of monetary policy – methodology of analyses and calculations

Based on above mentioned researches, it is possible to assume that the transmission mechanism of the discount rate is implemented through the following blockchain: **Change of the discount rate – changes in rates on the interbank market – changes in banks' deposit and loan rates – impact on the money supply in circulation – impact on inflation, production, consumption.**

Any change in the discount rate automatically leads to a change in the rates on deposits and loans of the central bank and, accordingly, to a change in rates on the interbank market. The final part of the transmission chain: "change in bank loan and deposit rates – effect on the money supply in circulation – effect on inflation, production, consumption" is influenced by a group of factors that are mostly outside of the central bank competence. For example, a change in consumer behaviour under the power of panic, the appearance or loss of effective investment tools (e.g., cryptocurrency), a change in the cost of products, and many others. However, the volume and to a certain extent, the structure of the money supply largely depends on the central bank, even without usage of interest monetary channel.

In this paper, we will focus on the part of the monetary transmission chain related to the regulation of banks' deposit rates. An increase of these rates leads to a squeeze in bank's margin and a decrease of the volume of lending. Accordingly, it provides the maintenance of the credit multiplier and absorption of part of money supply from circulation on deposit accounts in banks. This is how the restrictive policy of the central bank is implemented, while on the contrary, the reduction of rates realizes the expansionary policy and leads to an increase in solvent demand for goods and services that can provoke inflation. At the same time, the deposit channel should be singled out as a separate channel of the transmission mechanism since the deposit policy of banks, directly and without involving the credit channel, affects the volume of money in banks and outside banks, the structure of the money supply on current and deposit accounts, and therefore impacts the consumer demand of households and businesses. The consequence of the implementation of deposit channel of monetary policy is to restrain or stimulate inflationary processes and development of production.

Let's analyse the impact of discount rate fluctuation on banks' deposit rates in Ukraine. To do this, we created an array of monthly rates on short-term and long-term deposits of Ukrainian banks in the national currency for the period from April 2014, when the National Bank of Ukraine (NBU) began to actively

use the discount rate as a monetary policy tool with inflation targeting, until October 2022 (total 103 monthly data). The source of information is the report "The value of time deposits according to the statistical reporting of banks of Ukraine", posted on the website of the NBU (data until February 2022) (NBU, 2022). This report contains daily rates, which we transformed into monthly rates as daily averages. To generate data from March to October 2022, the NBU report "Interest rates on new deposits of non-financial corporations by types of currencies and maturity dates" was used (file 4- Financial markets). Based on the NBU report of the discount rate changes, monthly data of the discount rate for the corresponding period of these 103 months were formed. We use the following rule: if the rate was changed before the 15th day of the current month, it is applied to this month, if it changes afterward, it corresponds to the following month.

The study of the impact of changes in the discount rate on bank deposit rates at the first stage was provided with correlation analysis, using the following methods: month-to-month (lag between discount rate and bank's deposit rates 0 months), with a shift in data on deposit rates by 1 month later compared to the discount rate (lag 1 month), 2 months shifting deposit rates (lag 2 months), with a lag of 3 months, a lag 4 months, a lag 5 months. The results of the calculations are presented in Table 1.

Table 1: Correlation ratios of the impact of the change in the discount rate on the rates for short-term and long-term deposits of banks in the national currency

Correlation between	Lag 0 months	Lag 1 month	Lag 2 months	Lag 3 months	Lag 4 months	Lag 5 months
Discount rate \short- term deposits rate	0.732527	0.77405	0.780882	0.765653	0.73124	0.693239
Discount rate \long-term deposits rate	0.634649	0.683027	0.715989	0.724519	0.765151	0.752177

Source: Compiled based on NBU reports Percentlastb _ DEP, 4- Financial markets, discount rate

As a result of calculations, we can make the conclusion that the strongest impact of the change in the discount rate on the rates of short-term deposits of banks in the national currency is achieved on the 2nd month after its change ($r = 0.780882$) and subsequently it decreases. On the rates of long-term deposits, the best sensitivity is achieved on the 4th month ($r = 0.765151$) after changing the discount rate.

We used ADL model from the toolkit of Time series models in order to check obtained results. We constructed 0-,1-,2-,3-,4-,5-month lag ADL model for short-term and long-term banks' deposits (Table 2).

Table 2: Results of autoregression model for the short-term (s.t.) and long-term (l.t.) deposits rates with 95% probability

Indicators	Lag 0 months		Lag 1 month		Lag 2 months		Lag 3 months		Lag 4 months		Lag 5 months	
	s.t.	l.t.	s.t.	l.t.	s.t.	l.t.	s.t.	l.t.	s.t.	l.t.	s.t.	l.t.
R ²	0.54	0.40	0.60	0.47	0.61	0.51	0.59	0.52	0.53	0.59	0.48	0.57
St.deviation	0.54	3.48	2.32	3.30	2.29	3.15	2.36	3.13	2.51	2.92	2.66	3.00
F criteria	116.9	68.2	149.5	87.5	154.7	104.1	138.8	108.3	111.5	137.0	88.8	125.1
P criteria	1.45e ⁻¹⁸	6.09e ⁻¹³	1.44e ⁻²¹	2.61e ⁻¹⁵	5.99e ⁻²²	3.91e ⁻¹⁷	1.74e ⁻²⁰	1.59e ⁻¹⁷	8.40e ⁻¹⁸	2.97e ⁻²⁰	2.56e ⁻¹⁵	4.37e ⁻¹⁹
K statistic	0.42	0.44	0.44	0.48	0.45	0.51	0.44	0.52	0.43	0.55	0.41	0.55
T statistic	10.8	8.25	12.2	9.35	12.4	10.2	11.8	10.4	10.6	11.7	9.4	11.2

Source: Compiled based on NBU reports Percentlastb _ DEP, 4- Financial markets, discount rate

For the short-term deposits we got the most appropriate results for the two-month lag to the discount rate: regression ratio is 0.78, $R^2 = 0.61$, standard deviation is 2.29. For the long-term deposits, the best results have the 4 months lag array: regression is 0.77, $R^2 = 0.59$, standard deviation is 2.92 and other parameters are better. That validates the outcome of correlation analyses.

To create the most appropriate formulas for dependence of deposits rates on discount rates changes, we built the array of R^2 using the functions from standard Excel toolkit (Table 3).

Table 3: R^2 depends on type of regression function

Functions	Lag 0 months		Lag 1 month		Lag 2 months		Lag 3 months		Lag 4 months	
	s.t.	l.t.	s.t.	l.t.	s.t.	l.t.	s.t.	l.t.	s.t.	l.t.
Linear	0.537	0.403	0.599	0.466	0.610	0.513	0.586	0.525	0.535	0.586
Exponential	0.440	0.468	0.491	0.425	0.489	0.461	0.460	0.467	0.410	0.517
Logarithmic	0.630	0.458	0.687	0.521	0.703	0.570	0.685	0.585	0.639	0.641
Polynomial	0.642	0.447	0.696	0.508	0.720	0.560	0.710	0.576	0.675	0.634
Power	0.563	0.440	0.622	0.498	0.632	0.545	0.610	0.557	0.562	0.615

Source: Compiled based on NBU reports Percentlastb _ DEP, 4- Financial markets, discount rate

The highest R^2 for short-term deposits rates is 0.72 for 2-month lag with polynomial function; for long-term deposits rates R^2 is 0.64 for 4 months lag logarithmic function. So, the most appropriate formula for the dependence of short-term deposits rates(y) on the discount rate level(x), is:

$$y = 0.0242x^2 + 1.2697x - 2.5647 \quad (1)$$

For the long-term deposit rates(y) dependence on the discount rate (x), the most appropriate formula is:

$$y = 8.2331\ln(x) - 6.5773 \quad (2)$$

During the analysed period from April 2014 to October 2022, the discount rate either increased rapidly or smoothly, sloped down or remained flat. Based on the publication of Nain & Kamaiah (2020), we assumed heterogeneity of deposit rate's reaction on discount rate in the periods of stability and uncertainty. In order to study more deeply, we extracted from our array two periods, when the discount rate increasing quickly in crisis periods in order to disrupt rising inflation as a core part of restrictive monetary policy, which reflects the uncertainty times, and when it increased slowly, thus corresponding to the disinflationary monetary policy and relatively stable periods. We have calibrated the following periods for the restrictive policy:

- January-March 2015, when the discount rate increased from 14% to 30%, as well as another 4 months until July 2015, when the rate was stable at this level;
- October 2018 - September 2019, when the rate increased from 12.5% to 18% and remained the same for another 4 months until January 2020;
- June 2022, when the rate increased from 10% to 25% and stayed the same for another 4 months until October 2022.

A total of 28 months were selected.

The periods of the disinflationary policy, when the discount rate grew more slowly, are the following:

- July-November 2014, when the discount rate increased from 9.5% to 14% and was maintained for another 2 months.
- October 2017-March 2018, when the discount rate increased from 12.5% to 17% and was maintained for 3 months until June 2018.
- February 2021 - February 2022, when the discount rate increased from 6% to 10%, with March 2022 included to take into account the impact of the change in the discount rate on banks' rates.

A total of 30 numbers are selected.

In order to take into account time factor of the discount rate growth impact on banks' deposit rates, we took in array several months on the peak of discount

rate, but before it starts sloping down. We exercised correlation between banks' deposit rates and discount rate with 0-month lag (the same month) and with the lag of 1 month. The results are presented in Table 4.

Table 4: Dependence of changes in bank deposit rates in national currency on changes in the NBU discount rate in the periods of a significant increase in the discount rate (restrictive policy) and in the periods of moderate growth (disinflationary policy)

Policy\indicators	Lag 0 months	Lag 1 month
Restrictive policy		
Discount rate\short-term deposits	0.443919495	0.381388634
Discount rate\long-term deposits	0.327668	0.367231
Disinflation policy		
Discount rate\short-term deposits	0.837961	0.7536
Discount rate\long-term deposits	0.711407	0.636494

Source: Compiled based on NBU reports Percentlastb _ DEP, 4- Financial markets, discount rate

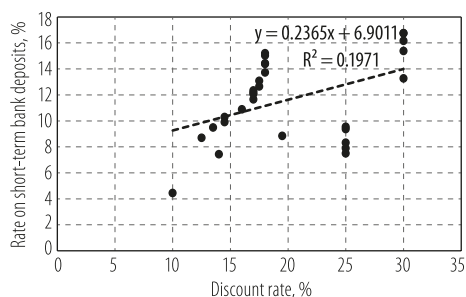
The obtained results indicate that there is no significant cohesion between the rapid increase of the discount rate and banks' deposit rates, both in the same month of its change and in the following month. That tells about a significant influence of other factors on the deposit policy of banks during the periods of the restrictive policy of the central bank which corresponds to uncertain times.

When there were the periods of disinflationary policy, the contact between the moderately growing discount rate and the rates on short- and long-term bank deposits was much tighter, especially in the first month (r is 0.837961 and 0.711407, respectively). In cases of more months lag, the correlation decreases, although it remains at an acceptable level. This applies to both short-term and long-term deposit rates. It should be noted that during the period of disinflationary policy, the relationship between the discount rate and banks' deposit rates in the first months is even tighter than between the change in the discount rate and banks' deposit rates for entire period under the study (Table 1). That is, the transmission mechanism of the discount rate is most significantly manifested in the first months of the disinflationary policy, and the high level of correlation between the discount rate and banks' rates for 2-4 months after its change (Table 1) is more determined by regularities in the periods of discount rate reduction and stable periods than in the periods of its increase.

In order to study the degree of influence of the discount rate on short-term rates on bank deposits in the national currency during periods of restrictive and disinflationary monetary policy, we built corresponding models with zero lag. The

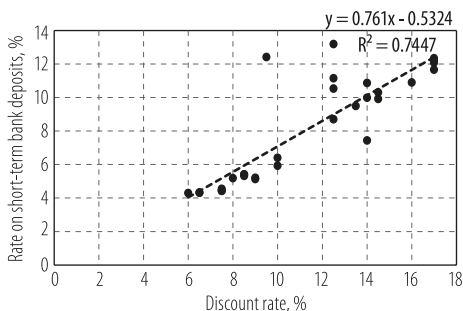
graph of the dependence of short-term banks' deposit rates on the discount rate during the periods of the restrictive policy is presented in Figure 1, and in the periods of disinflationary policy in Figure 2.

Figure 1: Dependence of short-term deposit rates of banks in the national currency on the discount rate changes with a zero months lag in the case of a restrictive policy



Compiled based on NBU reports
Percentlastb _ DEP, 4- Financial markets,
discount rate

Figure 2: Dependence of short-term deposit rates of banks in the national currency on the discount rate with a zero months lag under disinflationary policy



Compiled based on NBU reports
Percentlastb _ DEP, 4- Financial markets,
discount rate

The coefficient of determination R^2 in the restrictive policy model (0.1971) is low, which indicates the absence of a significant dependence of banks' deposit rates in the national currency on changes in the discount rate, at least in the short-term period. It is unlikely that dependence appears in the long-term perspective, especially since other factors begin to impact and/or the discount rate itself changes. In the disinflationary policy model, the coefficient of determination R^2 (0.7447) indicates a significant dependence of banks' deposit rates on the discount rate changes under this scenario.

These results contradict a little to the conclusions of Yildirim & Turan (2023): "it is seen that monetary policy is an effective tool that can be used in the high regime in economic management through the interest rate channel". Probably, they mean credit channel of monetary policy and its impact on consumption and investments trends, but we focused only on liaison between the key and deposits rates. This means that the credit channel of monetary policy should be investigated separately.

4. Factors which break the deposit channel in the period of restrictive monetary policy

We have looked more deeply at the problem why banks' deposit policy is not sensitive to a sharp increase in the discount rate of the central bank. It could be due to several reasons. Bankers may think that the discount rate will slope down soon and they will be exposed to interest rate risk between the floating discount rate and fixed rates on deposits. Usually, there are no reliable instruments for investing expensive resources other than in central bank' short-term deposits. Lending at high rates becomes risky in case when discount rate and inflation go down. This risk often rises together with a high level of banks' liquidity, which they created as a buffer for crisis times. As a result, they do not need additional resources and when a central bank raises interest rates on its deposits (usually overnight) in line with the increase in the discount rate, banks allocate extra liquidity in central bank, but do not raise rates on medium and long-term deposits. Moreover, they may raise rates on current accounts of clients for matching terms of assets and liabilities but this step blocks deposit channel of monetary policy aimed to absorb liquidity from the market to investment (long-term) and not current accounts in order to curb inflation. Simultaneously, by raising rates on overnight deposits, central banks open a new channel of money emission – deposit channel, which can reach a significant scale if banks actively use it.

We could not quantify bankers' expectations over discount rate fluctuations, but we looked more deeply into the banks' extra liquidity factor. First, we checked connection between the level of Ukrainian banks' liquidity and changes in the discount rate. The correlation ratio between the short-term liquidity of banks (the ratio of assets with a maturity of up to 1 year to the liabilities of banks of the same term) and the discount rate is negative (-0.27603). Calculations were based on monthly data for the period April 2014 - February 2022, which is the last month when this normative of short-term liquidity was calculated, based on the data of the NBU file "Ratios _ Banks". That means no impact of the discount rate on banks' liquidity in the same month. But it's possible to assume that increase of the discount rate in a certain period of time leads to growth of the level of banks' liquidity because increase of the discount rate disrupts banks' lending activity and creates the prerequisites for rising their excess liquidity.

Second, we have tried to answer the question how banks' liquidity impacts deposit policy when the discount rate has changed. We built a correlation model of the impact of level of short-term liquidity ratio on the 1st date of each month on the interest rate of short-term banks' deposits for the corresponding month in the period April 2014 - February 2022. The correlation ratio r was only (-) 0.11896,

which means there is no liaison between these indicators. Then we focused the research on the times of restrictive monetary policy periods. The correlation ratio between these indicators for such periods has increased to -0.45441. That means that during the periods of the restrictive monetary policy, the excess liquidity of banks to a certain extent began to slow down the rising of interest rates on banks' deposits in correspondence with discount rate sharp increase.

Third, in order to determine the degree of impact of excess banks' liquidity on their interest rates on deposits during the periods of reduction of the discount rate (reflationary monetary policy), we selected adequate for such policy 38 months from the analysed period. Next, the correlation coefficient between the short-term liquidity indicator and interest rates on short-term banks' deposits in the national currency with a lag of 0 and 1 month was determined. The results describe a low level of correlation between these indicators (-0.3137 and -0.2509, respectively), although a much higher negative coefficient was expected. At the same time, the level of correlation between the discount rate decreasing and banks' deposit rates in these months was high (+0.81497). It is possible to conclude that the increased liquidity was not the key driver of the decrease in banks' deposit rates in such period. This function was performed directly by the sloped down discount rate of the central bank.

We worried that our results were influenced by some changes in the landscape of the Ukrainian banking system during last decade, which characterized by 3 times reduction of banks quantity and concentration of funds in the state-owned banks, - more than 50% of total deposits. That may play, but endeavour of Awdeh, Jomaa & Kassem (2020) revealed that "banks with different size, different capitalisation, and different credit risk react similarly to an interest rate shock".

5. Poland and Montenegro cases

The study of the impact of changes in the key (reference) rate on banks' deposit rates in Poland gives similar results as for Ukraine, but with certain differences. The calculations were based on the data of the Central Bank of Poland (NBP) regarding interest rates on deposits in zloty for current (bieżące) and term (Depozyty z terminem pierwotnym ogółem) private persons accounts (Gospodarstwa domowe i instytucje niekomercyjne działające na rzecz gospodarstw domowych) and business (Przedsiębiorstwa niefinansowe) for the period January 2005 – May 2023 on a monthly basis (NBP, 2023). The source of data on the NBP reference rate for this period was the data from Tradingeconomics (2023). A total of 221 figures (months) were obtained, which makes the statistical array repre-

sentative. The correlation effect of the change in the reference rate on the above-mentioned 4 types of interest rates on current accounts and time deposits was exercised. The analysis was conducted with a lag of 0 months (the month of the reference rate coincides with the month of deposit rates), with a lag of 1 month (rates on deposits are shifted by 1 month later than the reference rate), with a lag of 2,3,4,5 months (table 5).

Table 5: Correlation coefficients between the reference rate and deposit rates in Poland

Indicator\Lag	0m	1 m	2 m	3 m	4 m	5 m	6 m
Current acc. Households	0.658	0.686	0.710	0.731	0.748	0.762	0.773
Deposit acc. Households	0.818	0.849	0.874	0.891	0.900	0.903	0.900
Current acc. Business	0.823	0.843	0.856	0.863	0.866	0.865	0.861
Deposit acc. Business	0.962	0.976	0.980	0.975	0.962	0.942	0.916

Source: calculated based on: <https://nbp.pl/statystyka-i-sprawozdawczosc/statystyka-monetarna-i-finansowa/statystyka-stop-procentowych/>, <https://tradingeconomics.com/poland/interest-rate>

The correlation coefficients for all indicators, except household current accounts, reached a maximum in 2-5 months after the change in the NBP reference rate and then sloped down. This corresponds to the Ukrainian trend with an even higher level of correlation compared to the NBU discount rate. As for household current accounts, the correlation coefficient continues to increase over time, albeit more slowly. This gives reason to assume that the behaviour of rates on such accounts is influenced also by other factors.

For this purpose, as in the case of Ukraine, we have highlighted the periods of growth of the reference rate NBP, although their amplitude is much lower in Poland. We selected 64 months: March 2007 - October 2008, December 2010 - October 2012, September 2021 - May 2023. Correlation coefficients for the same 4 indicators turned out to be slightly different (Table 6).

Table 6: Correlation coefficients between deposit rates of Polish banks and the reference rate during periods of its growth

Indicator\Lag	0 months lag	1 month lag	2 months lag
Current acc. Households	0.1882	0.2192	0.2451
Deposit acc. Households	0.7505	0.7636	0.7539
Current acc. Business	0.3958	0.3901	0.3740
Deposit acc. Business	0.8933	0.8464	0.7710

Source: calculated based on: <https://nbp.pl/statystyka-i-sprawozdawczosc/statystyka-monetarna-i-finansowa/statystyka-stop-procentowych/> and <https://tradingeconomics.com/poland/interest-rate>

During the periods of growth of the reference rate, its connection with the dynamics of rates on the current accounts of both the population and legal entities is actually lost, that is, they do not react to its changes with any lag, which also corresponds to Ukrainian realities. However, unlike Ukraine, interest rates on time deposits respond to changes in the reference rate. This could be explained by changes in reservation norms, but this norm in Poland is practically unchanged at the level of 3.5%. Only in the Covid-19 pandemic years 2020-2021, it decreased to 0.5%. Therefore, it is possible to assume that the reason is the same as in Ukraine - excess liquidity of banks, but there is also a peculiarity. Interest rates at the Polish interbank for many years had been at the level of about 2% for 3-month deposits, about 1% for clients' current accounts in banks, and only during the Covid-19 period they decreased, and in 2022-2023 they increased. So, taking into account that the NBP usually increased reference rate insignificantly, it was not too much profitable for Polish banks to place short-term resources on interbank market, therefore they did not increase the rates on current accounts radically. A different thing happened in Ukraine, where with a significant increase in the discount rate and, accordingly, the yield on deposit certificates of the NBU, banks received sufficient risk-free marginal income from the placement of current funds in the NBU.

The reverse trend was with the rates on term deposits. Unlike Ukrainian banks, Polish banks did not stop lending to their borrowers during the periods of increase in the reference rate, but increased the rates on their loans. This is confirmed by the high correlation between the average loan rate and the NBP reference rate in such periods, r was 0.75 even with 0 months lag. Therefore, Polish banks were able to allow the rates on their time deposits to rise, while maintaining a sufficient interest margin. In Ukraine, lending was practically stopped during periods of significant increase in the discount rate, and banks could place resources either in short-term certificates of the NBU or in government bonds, the yield on which did not increase synchronously with the increase in the discount rate of the NBU. Hence, it is possible to conclude that the effectiveness of the transmission mechanism of the discount rate is weak when it is sharply increased, if the banking sector does not receive an effective tool for placing additional resources, involved in financial sector by the increased rate and other levers, such as a change in cash reserve norms.

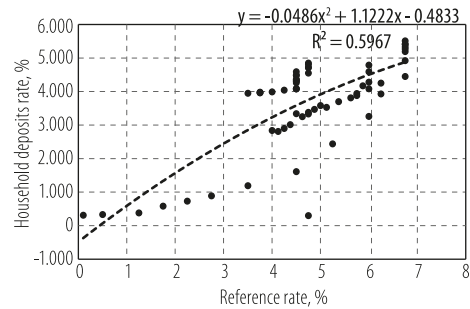
For rates on time deposits of Polish households, we determined the most acceptable formula for their dependence on changes in the reference rate, based on a polynomial function with a coefficient of determination of almost 0.6 (Figure 3).

A more specific transmission mechanism of the deposit channel of monetary policy is in the euro area member states. The reference rate and central bank's deposit rate is not determined by the countries' central banks, but by the European Central Bank (ECB). At the same time, commercial banks' deposit rates vary depending on the country. It is possible to assume that deposit rates are more likely to be in liaison with the loan rates in the country than to correlate to the rates of the ECB.

For example, we studied the rates on deposits of Montenegrin banks for the period from December 2007 to May 2023. The source is data from the Central Bank of Montenegro (CBCG, 2023, Table 2.1.9 - Weighted average deposit interest rates (nominal and effective), in %, annually). A total of 186 figures (months) were generated. ECB (2023) data on Deposit facility rates for the relevant period were used for the comparative analysis. As for Ukraine, we have applied the following rule: if the ECB rate changed before the 15th day of the month, then this rate corresponded to that month, if after the 15th day, then the previous month Deposit facility rate applied in that month.

We noticed that in first 5 months of 2023, even with 13% inflation for 2022 and the ECB raising the Deposit facility rate to 3.25% in May 2023, deposit rates of Montenegrin banks almost did not increase during 5 months of 2023 and were at a rather low level of 0.31% for legal entities and 0.34% for individuals. This is due to fairly stable interbank rates up to 1 year of 2.4% and 4.7% for loans to corporate clients. That is, the ceiling for raising deposit rates is limited by excess liquidity with stable (not growing) demand for loans. Against this background, we did not expect to find a significant linkage between the change in the ECB rates and the deposit rates of Montenegrin banks. However, we were wrong. The correlation between these indicators grew at least 8-9 months after the month of the Deposit facility rate was changed by the ECB (table 7).

Figure 3: Dependence of interest rates on the time deposits of households in zlotys from changes in the reference rate during the periods of its increase with a 1-month lag



Source: Compiled based on: <https://nbp.pl/statystyka-i-sprawozdawczosc/statystyka-monetarna-i-finansowa/statystyka-stop-procentowych/>, <https://tradingeconomics.com/poland/interest-rate>

Table 7: Correlation coefficients between the change in the ECB deposit rate and the average rates on the funds of clients of Montenegrin banks with lag

Indicator\Lag	0 months	1 month	3 months	6 months	8 months	9 months
Rates on legal entity accounts	0.568	0.613	0.691	0.761	0.777	0.781
Rates on natural per-son accounts	0.407	0.454	0.542	0.645	0.69	0.709

Source: calculated based on: <https://www.cbcbg.me/en/statistics/statistical-data/interest-rates>, https://www.ecb.europa.eu/stats/policy_and_exchange_rates/key_ecb_interest_rates/html/index.en.html

We cannot clearly state why the close relationship between the change in the ECB rate reaches significant value with such a large lag of 9 months, and whether this is a characteristic trend for most banking systems in the euro area, but some light on this issue is shed by an additional analysis of such relationship in periods when the ECB raised its reference rate. There were only three such periods on the horizon of our research and they were insignificant and not long-lasting, except for the second half of 2022 - 5 months of 2023. We chose the following periods (including month with the rate to increase and all months at the peak to start decrease): 2008 from the 6th to the 10th month, 2011 from the 3rd to the 10th month, and from the 7th month of 2022 to the 5th month of 2023. A total of 24 figures. Although they are not sufficient for reliable statistical analysis, we determined correlation coefficients. Even with a lag of 2 months (they are lower in 0 and 1 months lag), they did not reach 0.4 for legal entities and 0.31 for individuals, that is, they were insufficient. This means that the closeness of the dependence of the change in rates on deposits of Montenegrin banks from the change in the ECB rate was determined by the periods of the latter decrease and its stable level periods. That is, banks reacted with a significant lag to the reduction of the ECB rate and did not take too much into account its increase in their deposit policy.

Summarizing the analyses of deposit channel of the monetary policy of Ukraine, Poland and Montenegro, it is possible to note that the banking systems of these countries approached the periods of central bank interest rate increases, i.e. unstable periods with upper level of inflation, with a reserve of liquidity. This ensured their financial stability, but weakened the transmission channel of the deposit policy. By raising reference rates, central banks hoped that banks would similarly raise deposit rates and thereby divert part of the money supply from the consumer market on banks' deposits, which would curb inflation. In Ukraine, since June 2022, banks could place their resources in the NBU at a high overnight rate, but they were not in hurry to raise deposit rates, so in the spring of 2023, the NBU increased the reserve requirements to 30% for current accounts and introduced a fork in its deposit rates: 20% overnight and 25%, i.e. discount rate level,

for 3 months deposits. This has encouraged banks to raise interest rates on time deposits and lower interest rates on current accounts.

6. The toolkit for improving the efficiency of the deposit channel in the restrictive policy conditions

When a central bank plans to start restrictive monetary policy and raise the key rate, it should think over how to buffer excess liquidity of banks as otherwise they will not increase the rates on term deposits and efficiency of deposit channel of monetary policy will be low. The toolkit of instruments for this purpose is rather limited, but let's look at some of them:

1. Changing the norms of banks' cash reserves in central bank. This instrument is used in Ukraine, as well as in some other countries, but these norms historically did not change often and usually go together with the discount rate fluctuations. So, it is impossible create reliable statistical model of their impact on banks' deposit rates. The logic says that if it wants to stimulate the increase of banks' interest rates on term deposits in order to squeeze the money supply M1, a central bank should increase the reserve ratio for current accounts in banks and keep reserves for term deposits at zero level.

In June 2022, the NBU raised the discount rate from 10% to 25%, but banks were not eager to raise rates on their deposits, using their liquidity surplus. From January 2023, the NBU decided to increase the reserve requirement: from 0 to 5% for national currency funds on current accounts; for term deposits of legal entities (except other banks) and individuals it remained at 0%; in foreign currency accounts on demand - from 10% to 15%; for term deposits in foreign currency – 10% (no changes). But it was not good enough and from May 11, 2023 the NBU set the following norms for current accounts of legal entities: 10% in national and 20% in foreign currency; for current accounts and deposits up to 93 days maturity of private persons: 20% in national and 30% in foreign currency; for deposits of private persons more than 93 days maturity: 0% in national and 10% in foreign currency. As a result, the rates on 12-month deposits of households increased from 13.93% as at May 1, 2023 to 15.20% as at July 1, 2023. That is why it is advisable to change reserve rates simultaneously with the changes of the discount rate.

The methodology for determining reservation norms requires a separate study. The question of high level of reserve norms for deposits in foreign currency is particularly debatable. On the one hand, such high norms inhibit the flow of funds from national to foreign currency and maintain the exchange rate of the

national currency, but on the other hand, it not stimulates banks to collect foreign currency on deposits.

Table 8 contains the data on the norms of obligatory reserves (cash reserve ratio) in some countries, which indicate that there is no unified formalized approach to this instrument of monetary policy. It is only possible to note that in countries where deposit rates and the discount rate are higher, reserve norms are usually higher in absolute terms. In relation to their level compared to deposit rates and the discount rate, this issue needs additional study.

Table 8: Norms of reservation in central bank of funds raised by banks in different countries

Country	Last	Previous	Reference	Unit
Brazil	21	21	December 22	%
China	11	11	January 23	%
Czech Republic	2	2	November 22	%
Hungary	5	5	December 22	%
India	4.5	4.5	January 23	%
Indonesia	9	7.5	September 22	%
Malaysia	2	2	December 22	%
Moldova	40	40	November 22	%
Nigeria	32.5	32.5	January 23	%
Poland	3.5	3.5	December 22	%
Turkey	25	25	December 22	%
USA	0	0	November 22	%
European Union	1	1	November 22	%

Source: Compiled based on: <https://tradingeconomics.com/country-list/cash-reserve-ratio>, <https://www.ceicdata.com/en/indicator/united-states/reserve-requirement>

If the central bank wants to focus the banks' attention on raising interest rates on term deposits in the national currency, then it can allow banks to keep part of the reserves in government bonds, or even set a negative rate of reserves on time deposits in the national currency. Banks can use saving on term deposits' reserves to reduce reserves on other resources. It is possible to look for a scheme where cash reserve ratio can be weighted on banks' lending activity, e.g., increase on consumer lending to weaken inflation and decrease on business lending to accelerate economy, or/and take into account the share of term deposits in the bank's liabilities. Theoretically, reserve norms can be set for the banks' capital instruments, including zero level or even negative ones.

In our opinion, the template for determining reserve norms should cover various banks' creditors and the terms of their funds (Table 9).

Table 9: The matrix of determination of reservation norms by a central bank, %

Types of resources	National currency			Foreign currency		
	current	short-term	long-term	current	short-term	long-term
Private funds						
Legal entity funds						
Funds of financial institutions						
Other creditors						

Source: Compiled by the authors

So, cash reserve ratio is a very efficient instrument of monetary policy, which can operate even separately from the key rate mechanism and can be widened to compare to the existing simple model.

2. Management of the corridor of interest rates. As of January 2023 in Ukraine, with a discount rate of 25%, the corridor of interest rates for the NBU to take deposits from banks and lend them was ± 2 pp. In 2021, when the discount rate was less than 10%, the corridor was ± 1 pp. At the end of December 2022, the re-financing rate of the European Central Bank was 2.5%, the rate on margin loans was 2.75%, and the rate on deposits was 2%, i.e. the deposit corridor was twice as wide as the credit corridor. In the USA, the key rate is used, which was 4.5% in early January 2023. And the National Bank of Poland keeps the interest rate corridor stable ± 0.5 pp. with a reference rate of 6.75% in early 2023. So, there is no universal approach to the measurement of central bank interest rates corridor.

A central bank can use the corridor of interest rates more flexibly, for example, leaving the lower limit of the corridor for rates on overnight deposits and raising rates up to the discount rate for longer terms. This would reduce the interest rate risk of banks which take long-term deposits. Such step was taken by the NBU in April 2023, when it reduced the rate on overnight deposits to 20% and increased 3 months deposit rate to 25%.

It is possible to consider the option when rates on term deposits of central bank (if any) can be lower than overnight rates. As for the terms of deposits of the central bank, this is a debatable issue. But it should be taken into account that banks are exposed to a significant interest rate risk, collecting funds at fixed rates for a long period, and placing overnight deposits tied to the floating reference rate, which can change quickly. Having long-term deposit in central bank, a com-

mercial bank can use it as a collateral for collecting cash anywhere, including central bank. Government bonds can play a certain role here, but determining their value is beyond a direct authority of the central bank. Only if they are in the portfolio of the central bank, it can sell them to banks at a greater discount.

3. Management of banks' liquidity standards. The central bank can impact on surplus of banks' liquidity by flexible usage of liquidity normative. The key liquidity standards according to Basel III are: liquidity coverage ratio of short-term liabilities (30 days) by liquid assets – LCR; net stable funding ratio which reflects the coverage of banks' active operations by long-term resources – NSFR. Normative level for them is at least 100%. If a central bank wants to push banks to collect more time deposits, it is possibly changing the NSFR calculation methodology, for example, by lowering coefficients for certain types of resources, e.g. short-term household' deposits, or by increasing the floor of this norm above 100%, e.g. for banks which have low level of household' term deposits, for the period of restrictive monetary policy execution. Such a step can encourage banks to collect long-term deposits following the central bank's monetary strategy for the sterilization of the money supply M1.

Prospects. It is appropriate to investigate the impact of the central bank interest rate policy on the credit strategy of banks as it directly affects the monetary system through the credit multiplier. Monetary policy tools such as cash reserve ratio and corridor of interest rates of the central bank require additional research. There is an interest in joining research on monetary policies in different countries based on sufficient statistical data.

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