

Description of selected market conditions and aspects related to input data used in the process of determining WIRON benchmark for December 29, 2023.

1. Introduction

In relation to the focus on WIRON interest rate benchmark for December 29, 2023 (the last business day of 2023), as expressed in questions addressed to the administrator by some benchmark users and media representatives, the administrator has decided to present information on the market conditions affecting WIRON on that date and to present selected issues on the input data used to the calculation of the benchmark for that date.

The paper is informative and may act as a part of educational and promotional activities on the use of the new benchmark, necessary to recognize the characteristics of WIRON and the reference market that WIRON is intended to measure. The WIRON benchmark was determined on the basis of data regarding transactions concluded on the reference market and correctly reflected the situation in the domestic money market at the end of 2023.

The specific market conditions prevailing on the last business day of the year create a set of incentives that influence market participants' decisions regarding allocation of funds. This, in turn, is reflected in the contributed input data, in particular in interest rate, which relatively low value, combined with a lower propensity to enter into transactions expressed by a lower than usual volume and number of transactions, affects the characteristics of the volume-weighted interest rate distribution. The administrator has repeatedly presented information¹ confirming the relatively high volatility of O/N interest rates in the domestic money market. Under specific market conditions, the spread of the benchmark to the NBP (National Bank of Poland) reference rate may be higher than under normal conditions, even if high volatility is a permanent feature of the benchmark. The administrator emphasizes the correct functioning of the process of determining the WIRON benchmark, which is subject to the supervision of the Polish Financial Supervision Authority and to mandatory audits.

¹ [Public consultation results analytical supplement November 2022 update January 2023.pdf \(gpwbenchmark.pl\)](#) or [Report_Verification_WIRON_Input_Data.pdf \(gpwbenchmark.pl\)](#)

2. Information on market conditions and events

Comparison of the WIRON benchmark with other O/N indices.

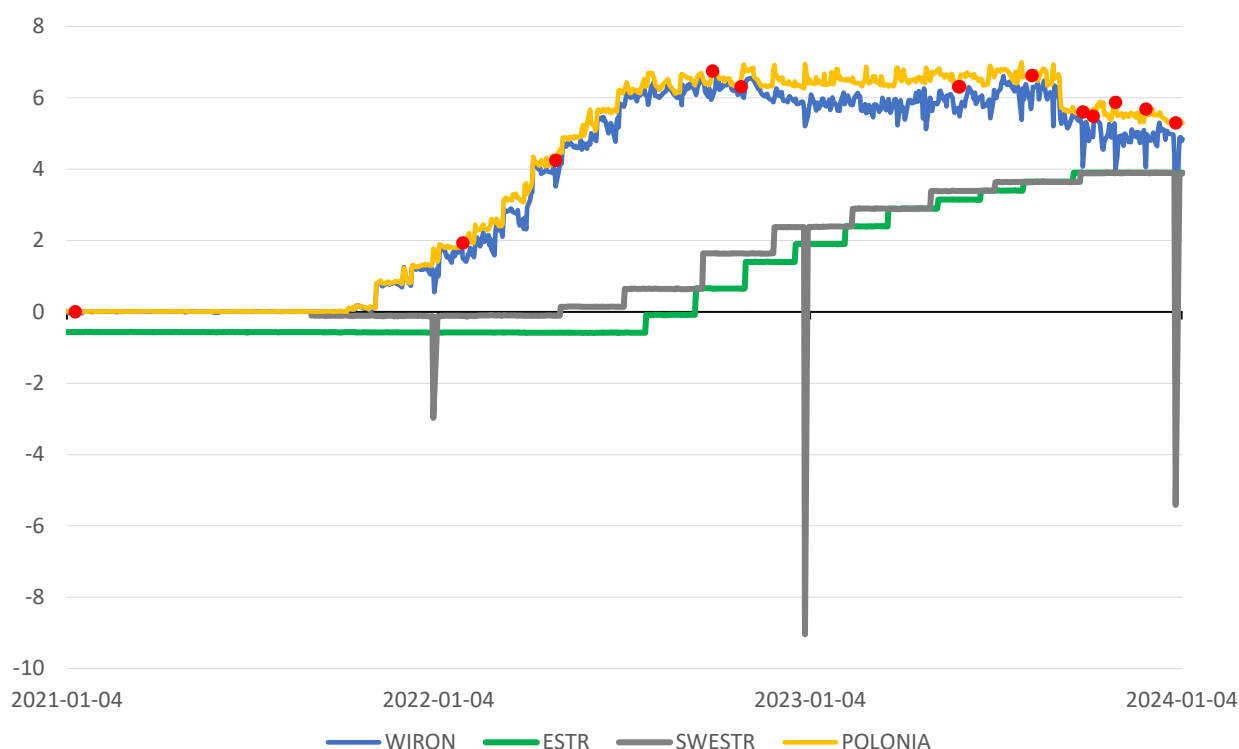


Chart 1 Graph (values expressed in %) of the WIRON, ESTR, SWESTR and POLONIA indices for January 4, 2021 - January 5, 2024. Red dots indicate the days on which the POLONIA Reference Rate was determined based on the fallback procedure.

Chart 1 shows the trends of selected interest rate indices: WIRON and ESTR benchmarks and interest rate indices in the form of SWESTR and the POLONIA Reference Rate. Based on Chart 1, we can conclude that the year-end effect is noticeable for the WIRON and SWESTR indices. This is particularly clear for the SWESTR index, whose value on the last day of a given year falls significantly below the value on neighbouring days. In the case of WIRON, a decline in the value of the benchmark can also be seen on the last business day of the year compared to neighbouring observations due to specific market and regulatory conditions. In the case of the ESTR benchmark, this effect is negligible² due to the volume of transactions concluded, the number of contributing banks and the size of the reference market. In the case of the POLONIA Reference Rate, there is a noticeable decrease in interest in concluding O/N deposits around the calendar months' ends, including the year-end, which is reflected by reduced volume of deposits, as well as cases of determining the index value using a fallback procedure, which also took place on December 29, 2023. Data regarding the values of indices and benchmarks can be found in Table 1 in the next section of this document.

² The graphical presentation is intended to highlight the scale of the phenomenon to SWESTR and WIRON. The year-end effect occurs for ESTR and its scale is shown in the table in the next section.

The interquartile range of some indices in relation to the characteristics of the benchmark

The *interquartile* range³ of the volume-weighted interest rate distribution for the ESTR and SWESTR⁴ indices was analyzed in order to compare the features of the WIRON benchmark with other O/N indices in Europe, determined on similar methodological assumptions and based on the unsecured deposits market: ESTR is a benchmark describing a highly developed heterogeneous money market of the euro area, where a large number of banks operates, and the reference market refers to credit and financial institutions. SWESTR also describes a developed money market with an index segment structure identical to WIRON, and with currently the same number of banks contributing to the index⁵. The data prove that in the case of the above indices, there is an increase in the range between the relevant quantiles on the last business day of the year. The size of input dataset is also important - in the case of WIRON and SWESTR, where the increases in the range are most visible, the reference market of both indices includes the broadest range of money market segments.

Chart 2 presents the evolution of the range between quantiles determined in accordance with the method of a given index (see below) for WIRON, ESTR and SWESTR in the period 4 January 2021 – 5 January 2024, and Table 1 presents basic statistics for the above indices in the period 27 December 2023 – 5 January 2024.

In the light of the comparison of statistics in Chart 2, it is worth noting that the *interquartile* range, i.e. the difference between the observations determined by the quantiles of the volume-weighted interest rate distribution determined by the method, is different for each of the indices. The presented range is the result of measuring the difference between the quantiles of the distribution which, in the case of the method used to determine a given index, correspond to the levels of the symmetrical trimming of the input data range, on the basis of which the value of the benchmark is ultimately determined.

At the end of 2023, ESTR is marginally affected by calendar year-end conditions due to the depth of the market. In its case, the range increases to 10 bp, and then at the beginning of 2024 it reaches 5 bp. It is worth noting that the statistic behaviour for ESTR on the analyzed day is not significantly different from the average levels of this measure over the period of analysis, as is the case for the other presented indices. For SWESTR, the range increases rapidly from 5 bp to 305 bp, and then quickly returns to the values observed under standard market conditions. Due to the different range of the symmetrical trimming in the distribution adjustment process, no comparison is made of the absolute values of the range in relation to other indices, as the measure presented for SWESTR is not a representation of the quartile range.

The *interquartile* range for SWESTR is the difference between the 87.5% and 12.5% quantiles, as the rules for determining this index assume a smaller scale of symmetrical trimming of input data than in the case of ESTR or WIRON. This means that the measure presented for SWESTR presents a difference for a range wider than observations representing 50% of the total volume of input data on each day - in the case of SWESTR, the used quantiles define a set of observations representing 75% of the total volume of input data. Generally, the larger the value of the quarter range, the greater the variation of the tested feature in the statistical sample. Moreover, in the case of the same set, the wider the range of quantiles for which we determine the range, the higher the value will be recorded (up to the difference between the maximum and minimum of the tested feature).

³ The basic measure of the dispersion of a given feature is the quarter range (i.e. interquartile range), which is a measure of the variation in a given population's feature between the lower and upper quartiles, i.e. within the middle 50% of observations of the value of a given feature. The administrator uses the term "interquartile range" to reflect the fact that not every range presented is a quarter range. Each of the interquartile ranges is a symmetrical range.

⁴ In the case of SWESTR, its administrator Riksbank reports volume-weighted interest rate values at the 12.5th and 87.5th percentile.

⁵ Historically, the actual number of contributors to SWESTR was lower than 9 - the average number of contributors in the period 2021-2023 was 5.5.

Taking this into account it should be emphasized that the interquartile range for WIRON is, on average, the largest of the measures presented below, even though the range between the quantiles indicated for SWESTR is a measure that covers a wider range of data from a given sample. The level of the range determined for SWESTR is, on average, less variable, but at the same time relatively more sensitive to the year-end effect, as can be observed in Chart 2. The differences in the evolution of the analyzed volatility measure between these indices confirm the relatively high variability and diversity of interest rates on unsecured deposits in the Polish money market (compare Section 4 of the report). In addition, attention should be paid to the deep decline in the SWESTR value to -5.413%⁶, while the value of the WIRON on December 29, 2023 was set at 2.043%.

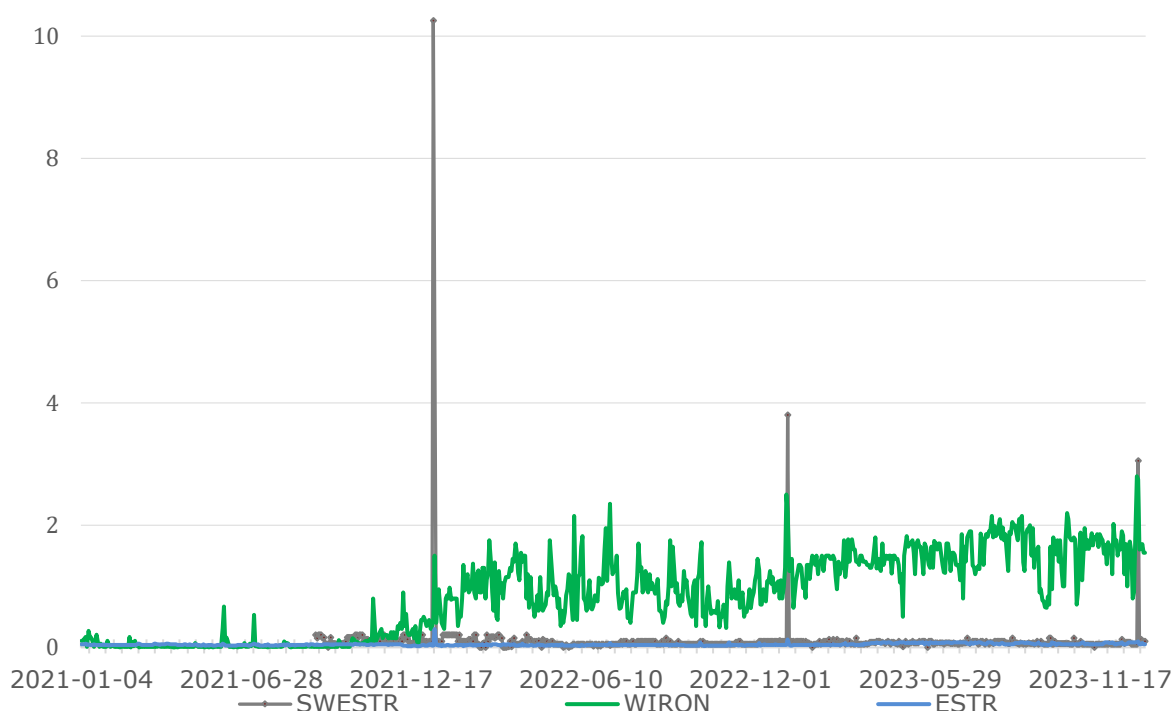


Chart 2 Graph of the interquartile range measure (taking into account the range for the appropriate quantiles for SWESTR) for selected benchmarks and interest rate indices (expressed in percentage points).

Table 1 Selected indices and benchmarks at the turn of 2023 and 2024.

Index date	ESTR			SWESTR			WIRON			POLONIA	Interquartile range (in p.p.)		
	Index value	25th percentile of the interest rate distribution	75th percentile of the interest rate distribution	Index value	12.5th percentile of the interest rate distribution	87.5th percentile of the interest rate distribution	Index value	25th percentile of the interest rate distribution	75th percentile of the interest rate distribution	Index value	ESTR	SWESTR	WIRON
2023-12-27	3,9	3,85	3,93	3,897	3,85	3,9	4,975	3,65	5,65	5,37	0,08	0,05	2
2023-12-28	3,9	3,85	3,93	3,894	3,85	3,9	4,406	2,5	5,3	5,30	0,08	0,05	2,8
2023-12-29	3,882	3,83	3,93	-5,413	-7	-3,95	2,043	0,75	3,5	5,30	0,1	3,05	2,75
2024-01-02	3,906	3,88	3,93	3,892	3,82	3,9	4,88	3,75	5,35	5,39	0,05	0,08	1,6
2024-01-03	3,904	3,88	3,93	3,88	3,77	3,9	4,901	3,74	5,35	5,34	0,05	0,13	1,61
2024-01-04	3,902	3,86	3,93	3,878	3,8	3,9	4,794	3,66	5,35	5,31	0,07	0,1	1,69
2024-01-05	3,905	3,88	3,93	3,881	3,8	3,9	4,848	3,75	5,3	5,29	0,05	0,1	1,55

⁶ At the end of 2022, SWESTR was -9.038% (with the central bank's main rate at 2.50%), while WIRON was then 5.201% (with the reference rate at 6.75%).

3. Information on the value of the WIRON benchmark

Interquartile range for WIRON at the turn of the year

As we approach the end of 2023, the volume of transactional set for WIRON declined steadily to reach PLN 4.94 billion on December 29, 2023. This was accompanied by a widening of the interquartile range, which on that day reached 2.75 percentage points.

Table 2 and Table 3 present key statistical information allowing to effectively illustrate the reason for the significant decline of the WIRON. The attention should be paid to the low number of transactions from the interbank market, which are characterized by a higher interest rate and a higher volume of the concluded transactions compared to the other market segments covered by the index, which, together with the low tendency of banks to conclude transactions on the last day of the year, resulted in a downward shift of the trimming values for lower and upper quartiles, respectively, to 0.75% (from 2.50% on the previous day) and 3.50% (from 5.3% on the previous day) and determining the value of the WIRON index at 2.043% (compared to 4.406% on the previous day). In the first week of 2024, WIRON (and its main descriptive statistics) reached values oscillating around standard levels recorded under normal market conditions observed at the current levels of NBP interest rates. Table 2 shows the development of individual statistics at the turn of 2023 and 2024.

Table 2 Information on some statistics regarding WIRON at the turn of 2023 and 2024; own study based on the Data Delivery Procedure.

Index date	Value (in %)	Ql (in %)	Qh (in %)	Range (in p.p.)	Volume (in PLN)
27.12.2023	4,975	3,650	5,650	2,00	9 072 942 298
28.12.2023	4,406	2,500	5,300	2,80	7 583 851 001
29.12.2023	2,043	0,750	3,500	2,75	4 941 053 493
02.01.2024	4,880	3,750	5,350	1,60	9 098 784 802
03.01.2024	4,901	3,740	5,350	1,61	11 226 267 800
04.01.2024	4,794	3,660	5,350	1,69	10 437 321 288
05.01.2024	4,848	3,750	5,300	1,55	11 212 189 832

Structure of input data at the turn of 2023 and 2024

Table 3 presents the structure of the input data and the Eligible Transactions Pool⁷, which was used to determine the WIRON. The share of the Banks segment⁸ in the volume of the Eligible Transactions Pool was 2.6%, implying a negligible potential impact of the data coming from this segment on the level of the benchmark. Moreover, the number and volume structure of the Eligible Transactions Pool and interest rate distribution across its segments on that day indicate that after applying the Main Adjustment, the WIRON calculation did not include data from the Banks segment. The largest share of volume in the Eligible Transactions Pool on December 29, 2023 was recorded by the Large Enterprises segment - almost half of the volume before trimming at Main Adjustment concerned deposits from the non-financial sector, which combined with the low level of the average volume-weighted interest rate in this segment, resulted in a shift in the distribution of the entire dataset in the Eligible Transactions

⁷ As defined in the Rules of WIRON Interest Rate Index.

⁸ On that day, the Banks Segment did not include any transactions concluded between Data Contributors (all of these entities are institutions delivering input data for determining the POLONIA Reference Rate, for which no turnover was recorded on that day).

Pool towards low interest rates. The Financial Institutions segment had an almost 30% share in the Eligible Transactions Pool and a volume-weighted average interest rate close to 3%.

For comparison purposes to the information regarding December 29, 2023, Table 3 presents information on the structure of the input data to WIRON from the days December 27, 2023 and January 5, 2024, i.e. the beginning and end of the period presented in Table 1, for which the total volume of Eligible Transactions Pool for WIRON fluctuated at "average" levels⁹ for WIRON. What is particularly noteworthy is the limited representativeness of the banking sector on December 29, 2023 compared to the other days in Table 3 - e.g. the share of the banking sector on January 5, 2024 was, in accordance with the average state of the market structure, approximately 33% (Reporting Banks + Banks (other)), while on the last day of 2023 it was only 2.6%.

Table 3 Information on the structure of the input data to WIRON and the structure of the Eligible Transactions Pool on December 29, 2023; own study based on the Data Delivery Procedure.

Date	Segment	Eligible Transactions Pool Volume-weighted average interest rate (%)	Eligible Transactions Pool Total volume	Eligible Transactions Pool Number	Eligible Transactions Pool Volume share (%)	Input data Total volume	Input data Number
27.12.2023	Reporting Banks ¹⁰	5,280	100 000 000	1	1,1	100 000 000	1
27.12.2023	Other Financial Institutions	3,956	571 941 374	30	6,3	573 371 889	35
27.12.2023	Large Enterprises	3,342	2 909 246 538	142	32,1	2 914 870 906	154
27.12.2023	Banks (other)	5,356	1 157 200 000	6	12,8	1 157 450 000	7
27.12.2023	Financial Institutions	5,300	4 334 554 386	63	47,8	4 346 158 255	113
29.12.2023	PIF	2,176	1 056 479 758	32	21,4	1 060 501 327	47
29.12.2023	Large Enterprises	1,831	2 292 753 575	125	46,4	2 300 539 006	146
29.12.2023	Banks (other)	5,076	128 350 000	2	2,6	128 750 000	3
29.12.2023	Financial Institutions	2,938	1 463 470 161	61	29,6	1 480 384 298	113
05.01.2024	Reporting Banks	5,280	1 490 000 000	4	13,3	1 490 000 000	4
05.01.2024	Other Financial Institutions	4,094	1 140 040 585	36	10,2	1 142 888 060	44
05.01.2024	Large Enterprises	3,551	3 459 662 505	180	30,9	3 468 380 345	203
05.01.2024	Banks (other)	5,319	2 252 100 000	11	20,1	2 252 150 000	12
05.01.2024	Financial Institutions	5,057	2 870 386 742	70	25,6	2 881 518 868	111

Information on the POLONIA index

On the last business day of 2023, any transactions were not recorded by NBP that could be used to calculate the POLONIA Reference Rate and, in accordance with the regulations, the value from the previous business day was taken that day. The absence of transactions constituting the basis for determining the POLONIA Reference Rate does not mean that no transactions were concluded on the interbank market - not all domestic banks deliver input data for the calculation of this index (see Table 3). However, determining the value of the POLONIA Reference Rate using the fallback procedure indicates that the share of turnover on the interbank market in the total turnover on the broad money market was negligible. Chart 1 shows that the non-determination of the POLONIA Reference Rate on the basis of the standard method is not typical for the last business day of the year during the period

⁹ The average daily volume of the Eligible Transactions Pool for WIRON in 2023 was PLN 11.5 billion, and the average daily volume in the period 2021-2023 was PLN 10.1 billion.

¹⁰ Reporting banks means banks that have a special status of data contributors in accordance with the administrator's documentation.

under study. The most such cases were recorded in 2023, when from the end of September the fallback procedure was used on every last business day of the month, although instances of non-determination of the index value by the standard method also concerned days within the calendar month. The non-determination of the value of the POLONIA Reference Rate on the basis of the standard method from the point of view of the specific nature of the domestic money market means that the set of transactions contributing to WIRON, there is a loss of information on the deposit activity of the segment of entities, that by virtue of direct access to central bank liquidity facilities, carry out transactions whose interest rates are closest to NBP rates (under conditions of excess liquidity, apart from the reference rate, the NBP deposit rate plays a key role).

A medium-term look at factors related to the liquidity situation

December 29, 2023 was the last day of the mandatory reserve maintenance period and the last business day of December¹¹ and 2023, which affects the behaviour of the money market and, therefore, of the indices determined on such day. The National Bank of Poland was an active participant in the money market on that day due to the closing of the December maintenance period of mandatory reserve.

On December 29, 2023, NBP sold PLN 303,233.09 million of the nominal value of the NBP bills to banks in the main and fine-tuning operation and accepted PLN 25,495.74 million in deposits facility. Chart 3 presents the scale of excess liquidity in the banking sector since 2005 by presenting banks' funds on the current account in NBP, the value of NBP bills issued in open market operations and banks' end-of-day deposits. Over the last 4 years, a marked increase in the level of excess liquidity can be observed, measured mainly by banks' exposure to NBP bills, which causes a greater tendency to decrease the level of O/N interest rates on the money market under special market circumstances e.g. the combination of the last business day of the calendar year with the last day of maintenance period.

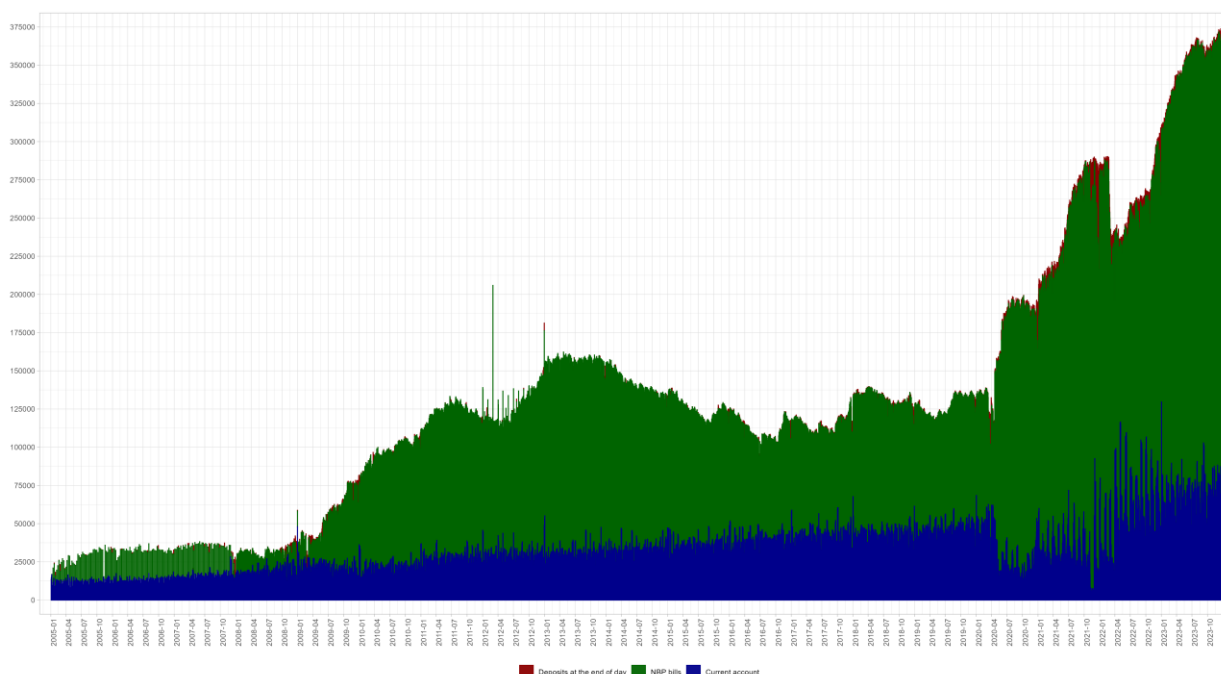


Chart 3 Liquidity structure in the banking system; own study based on NBP data

¹¹ In accordance with the mechanism for calculating tax on certain credit institutions specified in the relevant act, the basis for calculating the tax is the sum of the value of specific assets resulting from the turnover and balance statement established, as determined on the last day of the month, which has historically had an impact on the behaviour of entities active on the money market.

Interest rate distributions

Descriptive volatility statistics for WIRON, which the administrator presents in some analytical materials¹², confirm the relatively high volatility of the index, which is a reflection of the market this benchmark is intended to measure. Figure 1 presents the frequency and volume-weighted distributions of transaction interest rates.

The presentation of the two distributions is done firstly by segment, in order to present the differences between the rate distributions of the different money market segments included in the WIRON Eligible Transactions Pool and to show the impact of volume on the shape of interest rate distributions. Figure 1 presents the distribution of interest rates by individual segments of the WIRON Eligible Transactions Pool, but also divided into two datasets: the WIRON Eligible Transactions Pool and the Eligible Transactions Pool for WIRON excluding interbank market transactions. The latter division indicates that the impact of the interbank market on the distribution of the interest rate in the Eligible Transactions Pool is mainly visible in volume-weighted terms, which is related to the high volume of individual transactions in this segment of the money market. The observed trends also confirm that the lack of transactions on the interbank market in a given period of determining WIRON results in a shift of the overall structure of the interest rate distribution to the left, i.e. towards lower interest rates. What is noteworthy is the impact of the volume weight in the analysis of the interest rate distribution - volume changes the structure of the empirical distribution, confirming that both the level of interest rates and the size of the nominal value of the transaction vary greatly.

Taking into account the market situation resulting from the nature of the processes taking place on December 29, 2023, the loss of information from a given segment will, in accordance with the characteristics of the indicator, significantly affect the determination of the index, especially if it is a segment with average extremely high (interbank market) or average extremely low interest rates (Large enterprises segment).

¹² See [Transactions based Interest Rate Benchmarks Consultation Paper May 2022 \(gpwbenchmark.pl\)](#) page 19

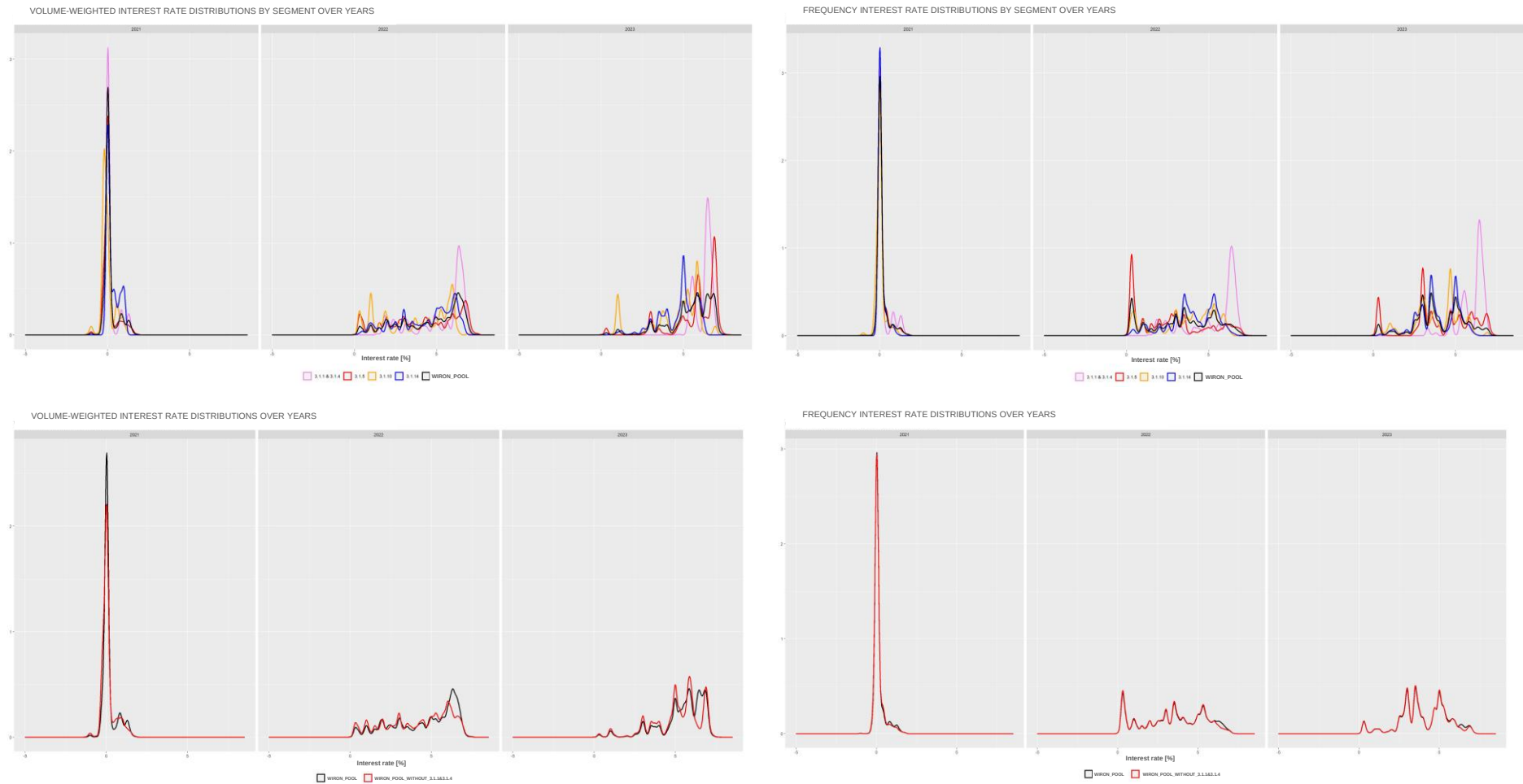


Figure 1 Partial distributions of the interest rate within the Eligible Transactions Pool for WIRON

4. The impact of a single determination of WIRON on the behaviour of WIRON compound indices on the example of a simulation of the hypothetical value of WIRON as of December 29, 2023 determined by fallback procedure

In the scope of the impact of changes in the level of the WIRON and WIRON compound indices, it is proposed to conduct a comparative analysis to verify, based on the proposed scenario, how a single and non-standard value of WIRON affects the performance of the selected compound index.

The administrator has carried out an analysis of the behaviour of WIRON and WIRON 1M Compound Rate if a fallback procedure was used to determine the index value on December 29, 2023. The conditions for applying the fallback procedure are alternatively: (1) a decrease in the total volume for the Eligible Transactions Pool below PLN 1 billion, (2) a drop in the minimum number of contributors below three or (3) the maximum share of a single contributor in the Eligible Transactions Pool at a level exceeding 75%. None of the above-mentioned conditions were met, so in fact the index for December 29, 2023 was determined on a dataset that, in accordance with the regulations, met the criteria of sufficiency of input data in the Eligible Transactions Pool. The actual and hypothetical trajectory of the WIRON and WIRON 1M Compound Rate index are presented in Charts 4 and 5.

If a fallback procedure had been applied to the WIRON index, its value on 29 December 2023 would have been 4.896% (compared to 2.043%, i.e. the value determined in accordance with the standard method). In accordance with the Rules of WIRON Interest Rate Index, this results from averaging the spreads between WIRON values and the NBP reference rate from five preceding business days and adding such an averaged spread to the current value of the NBP reference rate converted to the ACT/365 interest base.

In accordance with the rules for the determination of compound indices, in the case of the determination of the WIRON using the standard method, based on which WIRON was calculated at the level of 2.043%, the WIRON 1M Compound Rate of January 2, 2024 recorded a decrease in value by over 30 bp relative to values that did not yet include the WIRON value for of December 29, 2023. Determining WIRON on the basis of the fallback procedure would make the trajectory of the WIRON 1M Compound Rate incomparably more stable compared to its actual values due to the fact that the level of WIRON determined on the basis of the fallback procedure would be similar to previously taken values.

From the point of view of the methodology for determining backward-looking indices based on the compound rate, an important observation is the fact that if an outlier observation of the O/N index refers to the index date falling on a Friday or a business day preceding a holiday, the impact on compound indices of such an observation will be greater than in other cases. December 29, 2023 is a Friday, which means that the weight for WIRON observation for this date as part of the compound rate calculation should be 3 calendar days¹³, and due to the fact that January 1, 2024 was a public holiday, the weight for the WIRON for December 29, 2023 was 4 calendar days, which increases the scale of the impact of observation at the level of 2.043%.

¹³ Cf. [The Rules of WIRON Compound Indices Family](#), pts. 3.4.1 b).

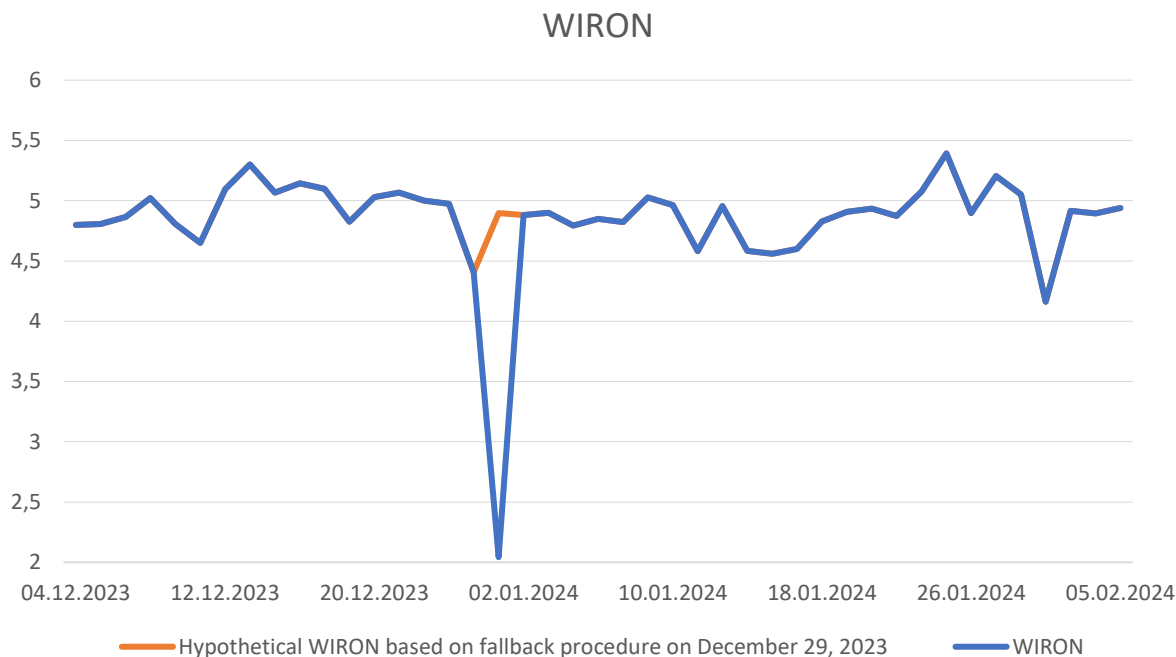


Chart 4 WIRON and the hypothetical WIRON based on the fallback procedure on December 29, 2023.

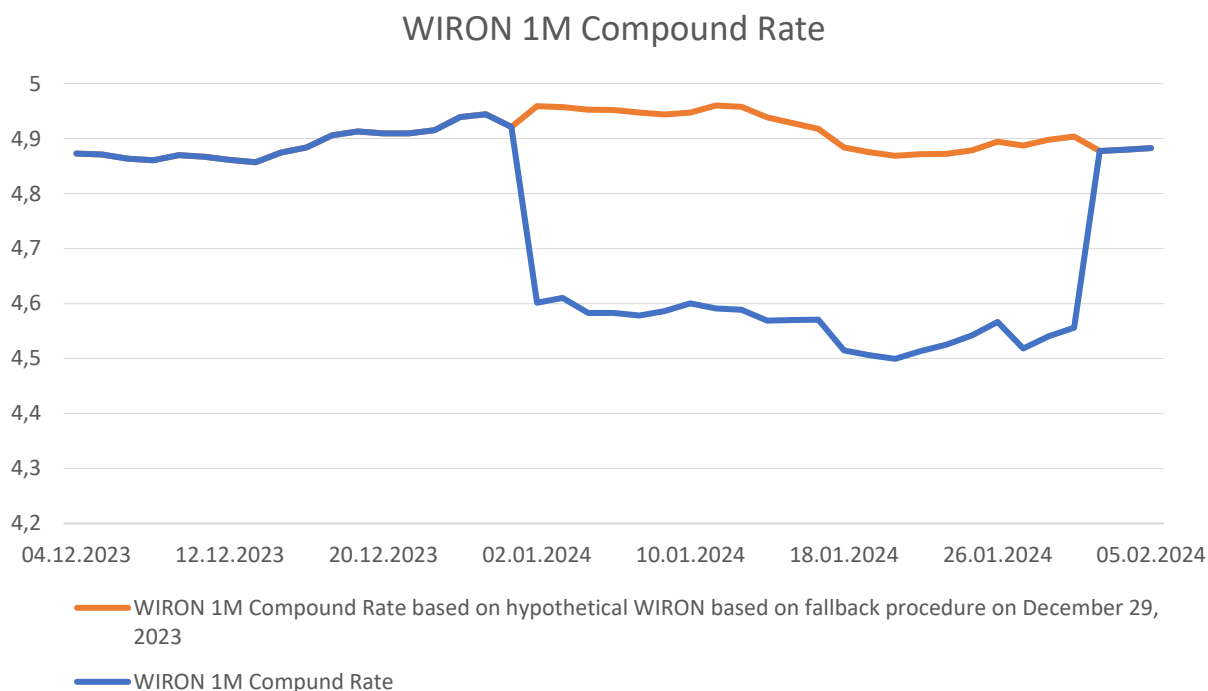


Chart 5 WIRON 1M Compound Rate and the hypothetical WIRON 1M Compound Rate based on fallback procedure as of December 29, 2023 for the WIRON benchmark.

The downward impact of this observation on the WIRON 1M Compound Rate ended on February 1, 2024, when the value of the WIRON for the index date of December 29, 2023 was no longer included in the calculation of the WIRON 1M Compound Rate. Then the value of WIRON 1M Compound Rate returned to levels close to 4.90%.

Obviously, the values of compound indices for longer periods (i.e. WIRON 3M Compound Rate and WIRON 6M Compound Rate) remain influenced by this outlier observation of WIRON of December 29, 2023 until their observation period (i.e. reference period) covers this date, which translates into a lower level of these indices, and in the case of indices with longer predefined backward periods, the impact of a single outlier is smaller due to the greater number of index days included in the corresponding reference periods.

The values of WIRON and WIRON compound indices therefore reflect the market conditions prevailing on the money market at the turn of 2023 and 2024. The specificity and systemic nature of some factors influencing the appearance of such strongly outlying observations may justify initiating a dialogue with the financial market and public institutions to effectively address the issue under consideration in order to promote the use of a new benchmark.