FEBRABAN FEDERAÇÃO BRASILEIRA DE BANCOS

OFÍCIO FB-0380/2024 São Paulo, March 28, 2024

Basel Committee on Banking Supervision
Bank for International Settlements
Centralbahnplatz 2, CH-4002 Basel, Switzerland

Ref: *"*Recalibration of shocks for IRRBB - consultative document"

Febraban welcomes the opportunity to provide comments and suggestions to the BCBS on the Consultative Document (CD) "*Recalibration of shocks for interest rate risk in the banking book*".

We present our analysis, comments and suggestions of the following aspects of the new shock methodology proposal presented in the CD:

- **Proposed Historical Time Series of Analysis:**
  - Parameter value of the proposed methodology in the CD: 01/2000 to 12/2022 (23 years)
  - **Our proposal: adopt a dynamic approach, periodically updated every 5 years, considering a period corresponding to a total of two Economic Cycles on average (seven years each Cycle): Jan 2009 to De 2022 (14 years); or at least preserving the 16-year time interval observed in the current methodology: Jan 2007 to Dec 2022**
- **Proposed Confidence Interval (CI):**
  - Parameter value of the proposed methodology in the CD: Confidence Interval (CI) at 99.9%
  - **Our proposal: it would be more appropriate to keep the Confidence Interval (CI) at 99th percentile**
- **Furthermore, we have considerations on two topics:**
  - **The potential asymmetry generated by the possibility of local jurisdictions adopting shocks different from those defined by the BCBS**
  - **Alternative methodology for adopting instant interest rate shocks considering the "carry-forward" effect**

I-) Proposed Historical Time Series of Analysis and Confidence Interval:

Our main proposal is to maintain the Confidence Interval value at 99% and for the Historical Analysis Period to be reviewed to reflect more recent periods of the current interest rate and currency profile. We propose a dynamic approach that adopts a period corresponding to 2 Economic Cycles on average, which is equivalent to 14

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years (2 x 7 years) or at least maintaining the 16-year interval of the current methodology, starting to consider the period from January 2007 to December 2022. We also believe to be relevant to update the observation window every five years.

The use of moving time windows is justified by the advances observed in the countries, both in macroeconomic terms and in the financial system prudential regulation, which, if successful, contribute to reducing the uncertainties and volatility present in the historical series. If there is no progress, the crises observed later will have proportionally similar volatility and impacts and will not harm the current methodology. We can mention the evolution of Brazilian maturity in terms of macroeconomic stability, as well as the evolution of global regulatory standards with the definition of Basel rules and their adoption by countries. Economic and banking crises are intrinsically related, as observed in the vast literature on this topic. Moreover, developments in these variables will certainly reduce the volatility recorded in markets and indicators between the observed periods.

Specifically in the Brazilian case, the Plano Real (Real Plan), which led to the end of the hyperinflationary cycle in Brazil, was introduced in mid-1994 and gradually, year after year, the Brazilian economy evolved in term of maturity and robustness of economic indicators. In 1999, Brazil implemented the second major macroeconomic change, with the definitive adoption of the floating exchange rate system, supported by the tax discipline adopted at the time and which not only preserved the stability of inflation, but also resulted in a significant growth in Brazilian foreign exchange reserves. To give an example, Brazilian international reserves grew from US$37 billion in 2000 to US$370 billion in 2015, causing Brazil's explosive net external debt to go from a net external debtor position of 27% of GDP to being net external creditor, at a level that has fluctuated between 2.5% and 4.5% of GDP since 2009.

This economic evolution broke the previous vicious circle in which exchange rate depreciations increased and brought huge uncertainty about public debt, which in turn resulted in new currency devaluations and increased inflation and interest rates. The end

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of this vicious circle led to a significant strengthening of the domestic economy and was clearly reflected in the volatility levels observed until then in the currency and interest markets, which we seek to demonstrate herein.

Regarding the financial industry, Brazil formally joined the Basel Accord in 2004, which definitively consolidated a milestone of growth and solidity for the national financial system, which has been improved since then with Brazil's adherence in time and form to the Basel recommendations, including the Basel 3 Agreement, after the international financial crisis of 2008/2009.

Thus, we believe that the fairest and most appropriate way to reflect the economic and financial evolution of countries is to use a dynamic approach and observe moving windows over time.

We emphasize that the Basel Committee already uses this concept in other regulations. We can mention the Operational Risk standard, which uses a 10-year moving window as a reference to operational losses to calculate the Internal Loss Component (ILM). It is clear that institutions, regulation and economies are constantly changing and an evolution needs to be reflected when defining the capital to be required, whether individually or for the financial system as a whole. In the case of operational losses, an evolution of labor legislation in Brazil has contributed to an effective reduction in said losses, which will be reflected in a dynamic approach, such as the 10-year moving window, resulting in a future prospect of lower capital requirements for the entire system. The dynamic approach rewards institutions that adopt best practices and jurisdictions that have evolved in economic and prudential terms.

This Brazilian evolution in economic and financial terms is clear when we observe the behavior of interest rate and currency indicators in the sample period of the BIS methodology and is what we intend to technically support below.

i) Analysis of the Proposed Methodology for the 2000 to 2022 Period

Our objective is to analyze the new methodology proposed in the CD without the effect of Floors & Caps, focusing on the adequacy of the parameters proposed in the new methodology for calibrating IRRBB shocks for the Brazilian environment using the Brazilian Real (BRL) currency as a benchmark. We believe that the analyses, comments and questions also serve as a reference for other jurisdictions and currencies. For further on the data used to construct the Shocks and the analyzes performed, consult Appendix 1.

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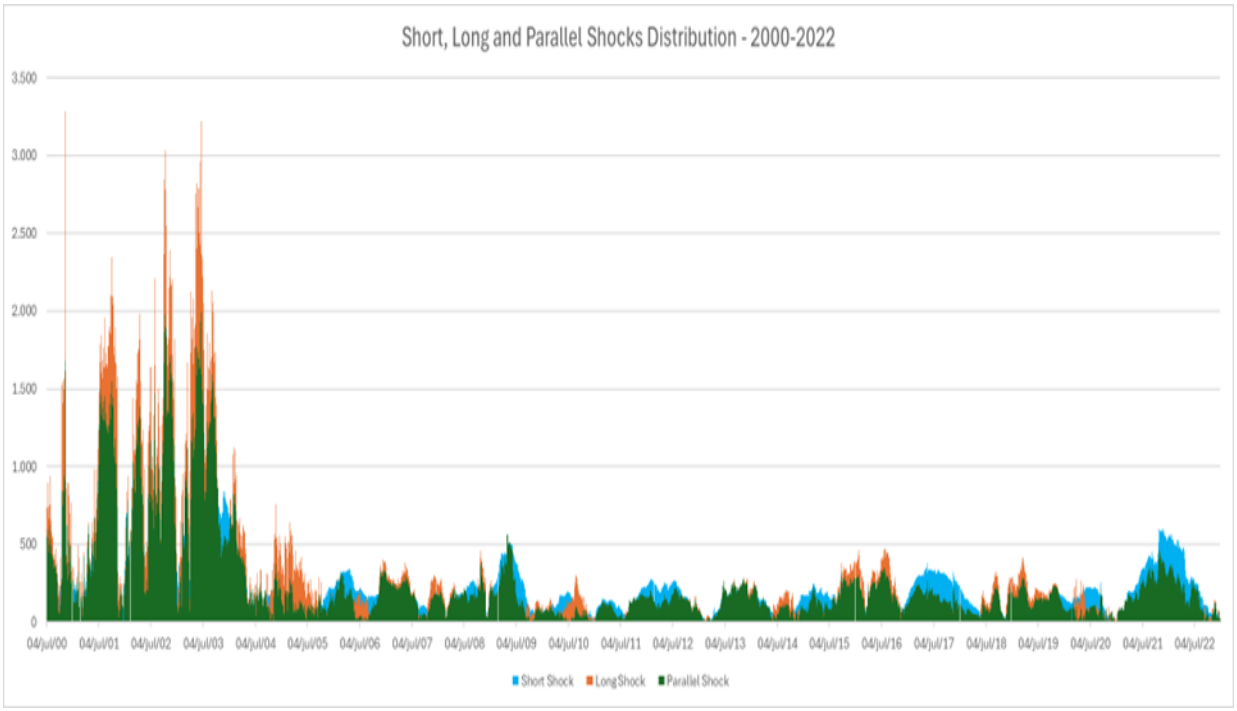
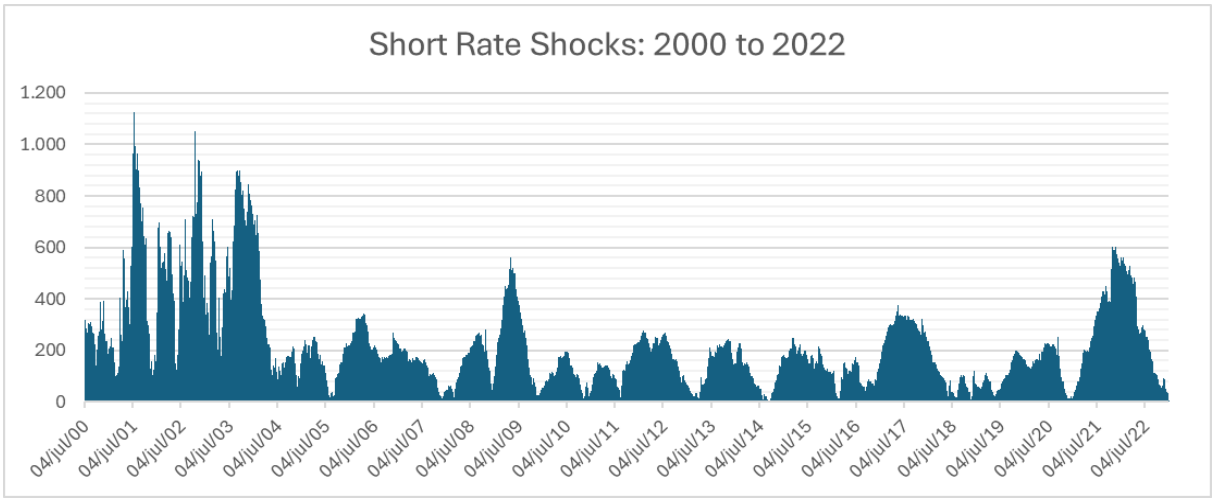
In Appendix 1, we detail the process of obtaining Short, Long and Parallel Shocks, which are presented in the following chart:



The time series referring to Short, Long and Parallel Shocks exhibits an initial period, from July 2000 to September 2003, whose profile is very different from the following period, as shown in the chart above. To better visualize the differences between them, we display the charts for each of the three Shocks separately.

Charts of Short Shocks for each date t:



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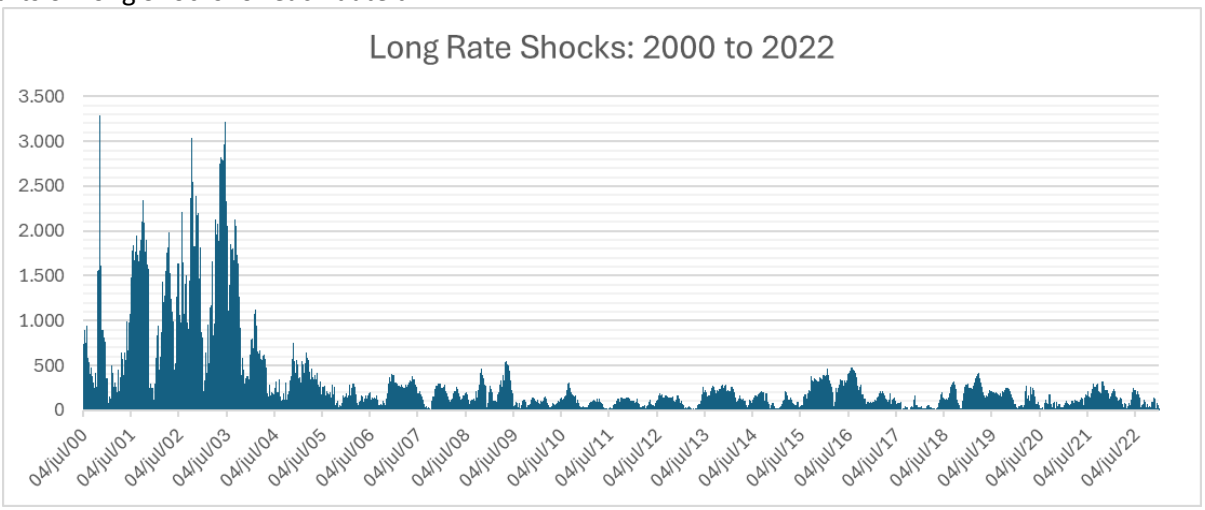
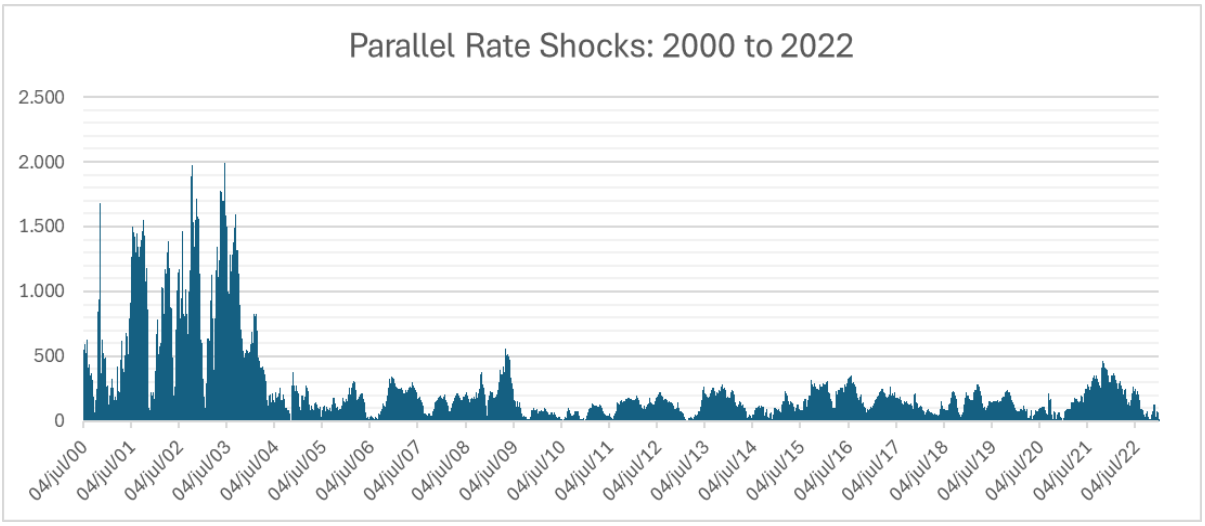
Charts of Long Shocks for each date t:



Charts of Parallel Shocks for each date t:



The 3 charts above display a behavior for the period 2000-2003 that is clearly different from the behavior for the remaining period (2004−2022), especially in the case of the Long and Parallel Shocks.

The time series from 2000 to 2022 for the Short, Long and Parallel Shocks, for each date, show that the behavior of interest rate changes until the end of 2003 is significantly different from the subsequent period, with a much greater range of variations.

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For a better visualization of values and dates, the table below displays the 30 largest shock values and some examples of CI's:

	30 largest Short, Long and Parallel Shocks: 07/2000 to 12/2022						
# shock	Date	Short Shock	Date	Long Shock	Date	Parallel Shock	CI
1	12/jul/01	1.124	08/nov/00	3.286	18/jun/03	1.995	
2	13/jul/01	1.090	18/jun/03	3.222	09/out/02	1.974	
3	11/jul/01	1.064	07/nov/00	3.160	10/out/02	1.961	
4	15/out/02	1.052	09/out/02	3.034	16/jun/03	1.931	
5	10/jul/01	1.049	10/out/02	2.969	11/out/02	1.897	99,9%
6	16/jul/01	993	16/jun/03	2.962	07/out/02	1.891	
7	18/jul/01	969	07/out/02	2.929	15/out/02	1.888	
8	01/ago/01	966	04/out/02	2.846	04/out/02	1.862	
9	05/jul/01	963	20/mai/03	2.821	16/out/02	1.854	
10	03/ago/01	961	30/mai/03	2.795	14/out/02	1.801	
11	02/ago/01	955	02/jun/03	2.788	14/mai/03	1.778	
12	31/jul/01	952	11/out/02	2.779	20/mai/03	1.763	
13	19/jul/01	950	29/mai/03	2.779	22/mai/03	1.759	
14	13/nov/02	939	14/mai/03	2.753	08/out/02	1.752	
15	14/nov/02	936	03/jun/03	2.748	23/mai/03	1.735	
16	17/jul/01	924	22/mai/03	2.676	12/nov/02	1.712	99,7%
17	20/jul/01	910	23/mai/03	2.666	13/jun/03	1.699	
18	24/jul/01	902	08/out/02	2.643	29/mai/03	1.696	
19	27/jul/01	902	16/out/02	2.545	17/jun/03	1.696	
20	14/ago/01	901	21/mai/03	2.536	02/jun/03	1.692	
21	01/set/03	899	04/jun/03	2.521	30/mai/03	1.688	
22	18/set/03	898	05/jun/03	2.502	21/mai/03	1.685	
23	30/jul/01	896	13/jun/03	2.497	08/nov/00	1.683	
24	04/dez/02	896	28/mai/03	2.494	03/jun/03	1.677	
25	02/set/03	894	17/jun/03	2.477	03/out/02	1.676	
26	27/ago/03	893	20/jun/03	2.435	14/nov/02	1.667	
27	14/out/02	892	12/jun/03	2.427	30/set/02	1.664	99,5%
28	12/nov/02	888	14/out/02	2.421	20/jun/03	1.641	
29	16/out/02	887	15/out/02	2.417	12/jun/03	1.638	
30	05/set/03	887	15/mai/03	2.403	11/jun/03	1.637	
50	22/ago/03	858	25/nov/02	2.204	17/out/02	1.531	
55	13/ago/01	846	18/nov/02	2.162	10/set/03	1.506	99%
56	15/ago/01	845	03/out/01	2.160	02/jul/03	1.497	

The behavior from 2000 to 2003 is substantially different from the one presented 2004 onwards – the 50 major shocks present several extreme values that do not occur after 2004:

- Above 850 bps for Short Shocks
- Above 2150 bps for Long Shocks
- Above 1500 bps for Parallel Shocks

As an example, we display the chart of the 514 highest values of Parallel Shocks, with the first 513 occurring before 02/11/2004 and the 514th occurring on 04/30/2009, five years later. Said events occurred long ago, over 20 years ago, corresponding to an economic reality very distant from the current one and their effect in determining the IRRBB Shock could remain a determining factor for decades. This indicates that the Analysis Period should not grow indefinitely, tied to a fixed starting date, but that it should adopt a dynamic approach and be transitioned over time, like a moving window.

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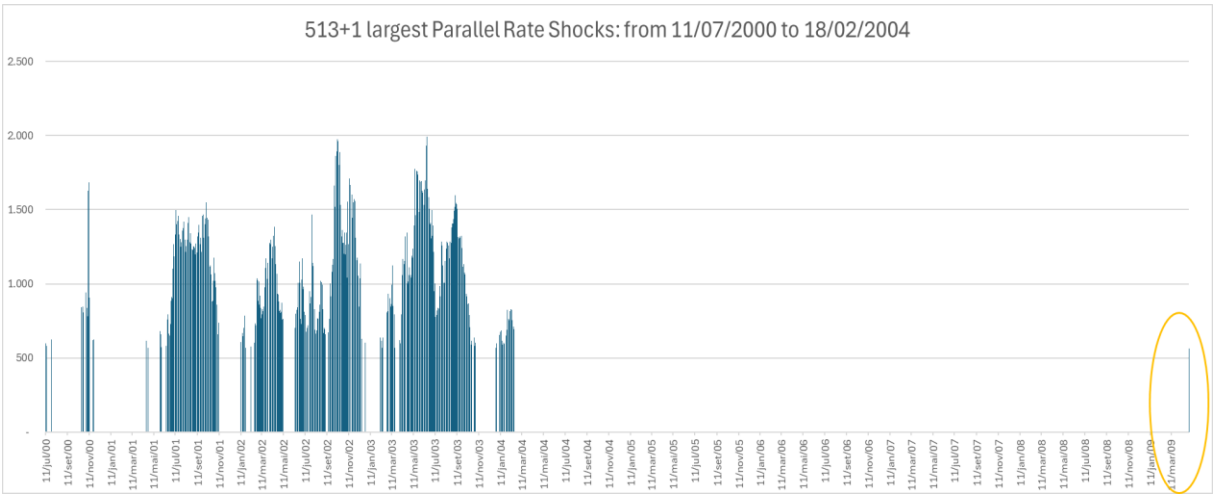
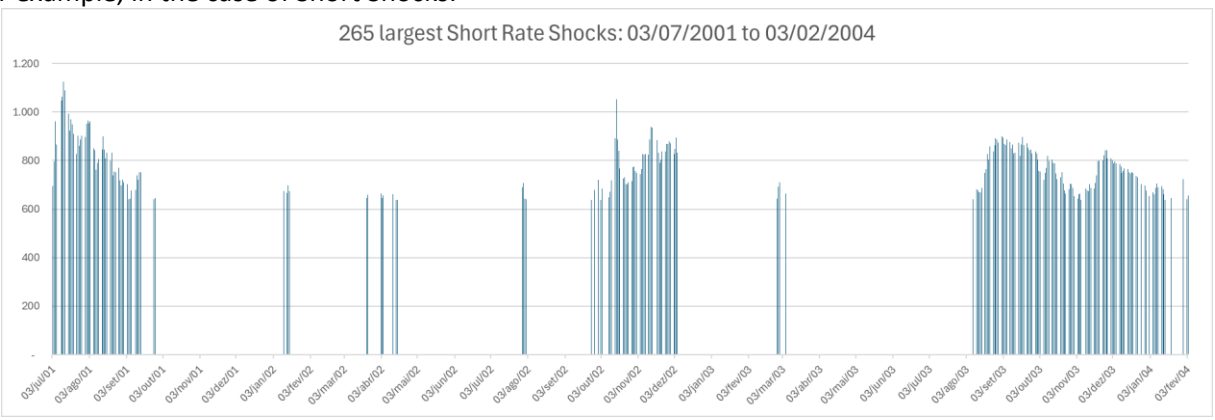


ii) CI analysis for the period from July 2000 to December 2022

The effect of the initial sample period of 2000−2022 is so large that all shock values affecting up to the 96% percentile occurred by February 2004.

For example, in the case of Short Shocks:



We compare below the Maximum Value and 5 CI values, value and date of occurrence:

CI	Date	Short Shock	Date	Long Shock	Date	Parallel Shock
Maximum Value	12/07/2001	1.124,4	08/11/2000	3.285,9	18/06/2003	1.994,6
99,90%	16/07/2001	1.017,1	16/06/2003	2.964,7	07/10/2002	1.893,8
99,70%	20/07/2001	913,8	23/05/2003	2.669,0	13/06/2003	1.702,9
99,50%	12/11/2002	888,4	14/10/2002	2.421,8	20/06/2003	1.644,6
99%	15/08/2001	845,5	03/10/2001	2.160,3	02/07/2003	1.499,3
95%	09/02/2004	591,7	02/10/2003	1.403,2	06/08/2003	1.006,8

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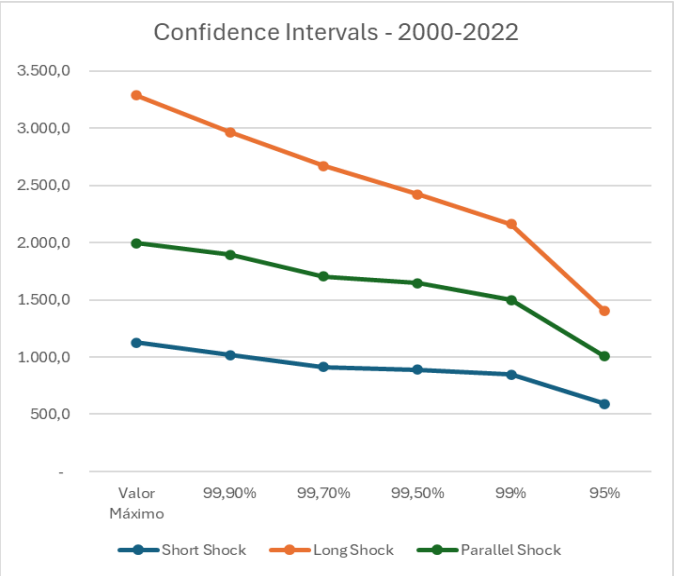
Graphical presentation of CI's:



Note the increase in the value of Shocks when varying CI from 99% to 99.9% - the Shock for the 99.9% CI is 37% greater than the 99% percentile in the case of Long Shock and 26% in the case of Parallel Shock.

	Comparison between Shocks in bps		
CI	**Short Shock**	**Long Shock**	**Parallel Shock**
99,90%	1017	2965	1894
99%	846	2160	1499

Comparison CI: 99% versus 99,9%		
Short Shock	Long Shock	Parallel Shock
20,3%	**37,2%**	**26,3%**

This shows how increasing the Confidence Interval can lead to a relevant increase in the value of Shocks, as very high percentiles rely on very few outliers (outliers of the outliers).

Comparing our results obtained by applying the new CD methodology proposal with the results obtained by the current methodology (see Table 4 of the CD), which are reproduced in the Table below, we observe the huge difference in the values obtained for the Long and Parallel Shocks.

	Comparison of Methodologies		
	Short Shock	**Long Shock**	**Parallel Shock**
Proposed CD	1017	2965	1894
Current BCBS	980	461	692

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The new proposed methodology causes large distortions in the values of IRRBB shocks for the BRL currency without anything relevant happening due to the extension of the current period, from January 2000 to December 2015, for the new period proposed in the CD.

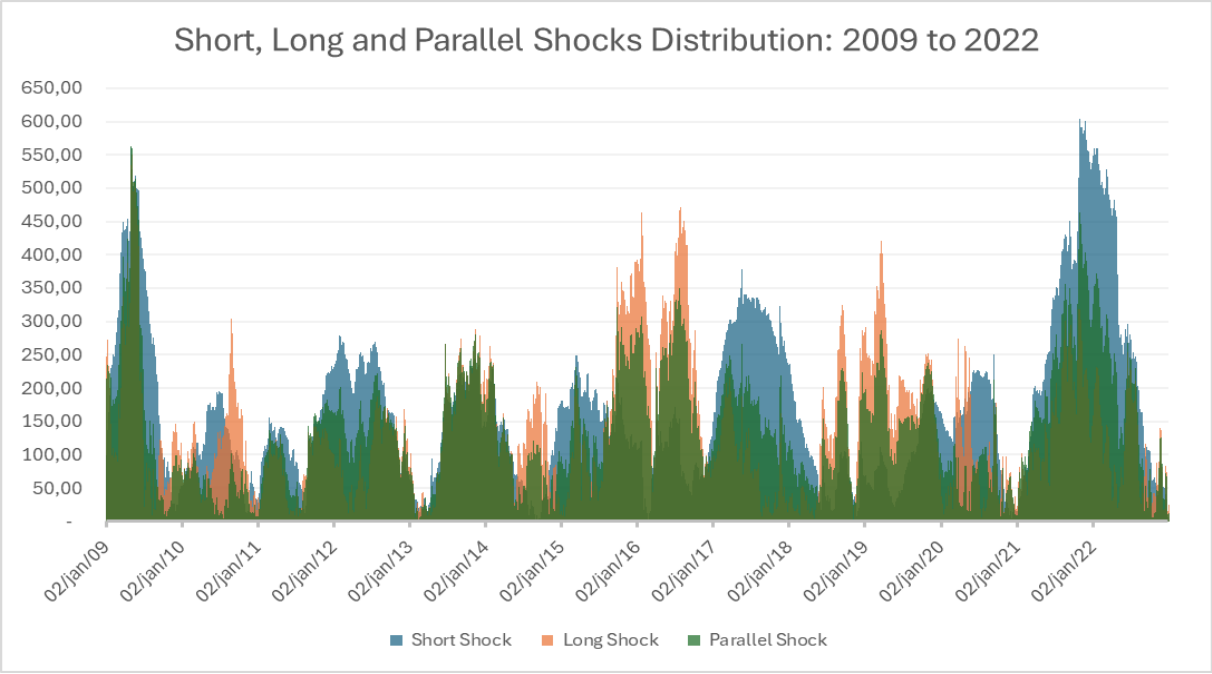
Thus, we propose that the CI value be maintained at 99% and that the Historical Analysis Period be reviewed to reflect more recent periods of the current interest rate profile. We present below the analysis of the Period that we propose to be adopted, corresponding to 2 Economic Cycles on average, which is equivalent to 14 years (2 x 7 years), referring to the period from January 2009 to December 2022. It is worth noting that this period comprises a number of observations compatible with the period used in the current methodology.

Alternatively, the update of the proposed period should at least comprise the same range of years present in the current methodology, i.e., 16 years, starting to be observed between January 2007 to December 2022.

iii) Analysis of the proposed period from 01/2009 to 12/2022

As a proposal for the historical period of analysis to be used to determine interest rate shocks, we propose to consider a period of two Economic Cycles, equivalent to a period of 7 years on average each (total of 14 years).

The distribution of interest rate variations for Short, Long and Parallel Shocks for the period from January 2009 to December 2022 is presented below, both for positive and negative shocks and for shocks in absolute value:



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We display the Short, Long, and Parallel shocks individually in Appendix 1.
Table with the highest Shock values in the period 2009 to 2022:

30 Largest Shocs: 2009-2022		
Short Shock	**Long Shock**	**Parallel Shock**
603,8	550,0	550,0
600,7	534,5	534,5
596,1	508,1	508,1
592,3	500,5	500,5
591,9	495,7	495,7
591,2	495,0	495,0
590,6	492,0	492,0
587,7	490,8	490,8
587,6	490,3	490,3
586,0	484,0	484,0
585,9	479,9	479,9
584,7	477,4	477,4
584,2	476,9	476,9
584,1	471,2	471,2
582,8	470,9	470,9
581,5	470,4	470,4
580,2	467,2	467,2
577,4	466,5	466,5
574,2	463,7	463,7
573,6	461,5	461,5
571,7	461,0	461,0
571,2	455,5	455,5
571,2	452,3	452,3
567,1	451,1	451,1
562,7	450,6	450,6
561,2	448,8	448,8
560,3	447,6	447,6
559,7	445,3	445,3
559,6	444,5	444,5
556,5	443,6	443,6

Regarding the complete period, we can verify that:

- For the period from 2009 to 2022, the Shock values are much lower:
  - Between 550 bps and 604 bps for Short Shocks
  - Between 430 bps and 550 bps for Long Shocks
  - Between 400 bps and 563 bps for Parallel Shocks

The longer period, from 2000 to 2022, covers several outliers that are representative of situations that occurred more than 2 economic cycles ago and do not reflect the nature and size of the outliers observed from 2004 to 2024.

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iv) Analysis of Confidence Intervals for the period from January 2009 to December 2022 and comparison with the Period 2000−2022

To conclude our analyses, we will compare the results obtained using the current and proposed CI's in the new methodology together with the two alternative historical periods of analysis:

- CI: 99.9% versus 99%
- Historical Analysis Period: 01/2000 - 12/2022 versus 01/2009 – 12/2022 ("2 Economic Cycles")

The Table below summarizes the results found for each of the three Shocks, indicating the relevant effects of varying the Historical Analysis Period and changing the CI in determining the Shock values:

	Short Shock		Long Shock		Parallel Shock	
CI	2000-2022	2009-2022	2000-2022	2009-2022	2000-2022	2009-2022
Maximum	1.124,4	603,8	3.285,9	550,0	1.994,6	562,6
99,90%	1.017,1	594,3	2.964,7	504,6	1.893,8	512,3
99,70%	913,8	586,0	2.669,0	482,4	1.702,9	501,4
99,50%	888,4	579,3	2.421,8	466,9	1.644,6	473,4
99%	845,5	552,4	2.160,3	437,4	1.499,3	421,3
95%	591,7	429,6	1.403,2	323,0	1.006,8	300,8
99,9% X 99%	**20,3%**	**7,6%**	**37,2%**	**15,3%**	**26,3%**	**21,6%**

Focusing on cases of CI equal to 99% and 99.9%, the table below indicates the increase in percentage and in basis points of Shocks when moving from the 2009-2022 period to the 2000-2022 period:

	Short Shock			Long Shock			Parallel Shock		
CI	2009-2022	2000-2022	Increase	2009-2022	2000-2022	Increase	2009-2022	2000-2022	Increase
99,90%	594	1017	71%	505	2965	488%	512	1894	270%
99%	552	846	53%	437	2160	394%	421	1499	256%

For CI = 99.9%, these are the values obtained for the two historical periods of analysis:

- Short Shock: difference of 410bps (71%)
  - 2009-2022: 594 bps
  - 2000-2022: 1017 bps
- Long Shock: difference of 2400 bps (488%)
  - 2009-2022: 505 bps
  - 2000-2022: 2965 bps
- Parallel Shock: difference of 1300 bps (270%)
  - 2009-2022: 512 bps
  - 2000-2022: 1894 bps

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The size of the difference between the figures above suggests that the CD recalibration proposal could generate serious distortions. Therefore, we suggest considering periods that better reflect the most current conditions of the interest rate environment.

Considering each of the two Historical Periods, we see the difference obtained by changing the 99% CI versus the 99.9% CI in red:

CI: 99,9% X 99%	Short Shock		Long Shock		Parallel Shock	
CI	2009-2022	2000-2022	2009-2022	2000-2022	2009-2022	2000-2022
99,90%	594,3	1.017,1	504,6	2.964,7	512,3	1.893,8
99%	552,4	845,5	437,4	2.160,3	421,3	1.499,3
Shock Variation per CI:	42	172	67	804	91	395
bps X %	7,6%	20,3%	15,3%	37,2%	21,6%	26,3%

For the historical 2000-2022 period, the percentage changes obtained were:

- 20% for Short Shock
- 37% for Long Shock
- 26% for Parallel Shock

Said values are lower in the case of the sample from 2009 to 2022: 7.6%, 15.3% and 21.6%, respectively, but still with a relevant impact.

Finally, we present a comparison between the current BCBS methodology ("Current"), the new methodology proposed in the CD according to our calculations ("Proposed CD") or according to the results presented in the CD ("Table 4 (CD)"), and our proposal to parameterize the Historical Analysis Period and the CI of the methodology proposed in the CD for the BRL currency ("Proposed Febraban"):

	Comparison of Methodologies		
	Short Shock	Long Shock	Parallel Shock
Proposed CD	1017	2965	1894
Proposed Febraban	552	437	421
Current	980	461	692

The Table shows that the change in the Shocks calibration methodology causes a major change in the value of the Shocks, which does not seem to be the objective of the CD proposal and does not seem to be a reasonable change.

Conclusion: **It does not seem adequate to consider historical periods of analysis that have a fixed starting date and are added to by recent periods in each review. We consider more adequate in economic and financial terms to consider moving windows, of a fixed size, covering a recent period equivalent to two economic cycles, and maintaining the confidence interval of the current methodology to prevent very few outliers from entirely determining the value of the Shocks, with the potential to**

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produce relevant distortions, as we saw in the analyzes presented. Moreover, we consider that the moving window period must be updated every five years.

II-) Potential asymmetries between jurisdictions in the adoption of shocks other than those defined by the BCBS

Below are the texts and changes (items 1,2 and 3) proposed by BIS that are the subject of our analyses, observations, and questions:

1. Page 10
   "31.93 The Committee acknowledges that shock sizes of different currencies should reflect local conditions in a timely manner. For this reason, the Committee will review the calibration of the interest rate shock sizes (e.g. every five years). National supervisors may, at their discretion, set floors for the post-shock interest rates under the six interest rate shock scenarios, provided the floors are not greater than zero."

   Page 12
   "98.63 Supervisors may, applying national discretion, set a higher floor under the local interest rate shock scenarios for their home currency, or a higher cap, resulting in more conservative shocks. Supervisors may also, applying national discretion, set a zero or negative lower bound for the post-shock $\overline{R}_{j,c}$, interest rates where j represents the six interest rate shock scenarios set out in [SRP31.91]:" …….

2. Page 8
   "31.90 Banks should apply six prescribed interest rate shock scenarios to capture parallel and non-parallel gap risks for EVE and two prescribed interest rate shock scenarios for NII. The derivation of these shocks is explained in [SRP98.56] to [SRP98.63]. These scenarios are applied to IRRBB exposures in each currency for which the bank has material positions. In order to accommodate heterogeneous economic environments across jurisdictions, the six shock scenarios reflect currency-specific absolute shocks as specified in Table 2 below. For the purposes of capturing the local rate environment, a historical time series ranging from January 2000 to ~~2015~~ December 2022 for various maturities [7] was used to derive each scenario for a given currency."

Specified size of interest rate shocks, $\overline{R}_{shocktype,c}$ Table 2

	ARS	AUD	BRL	CAD	CHF	CNY	EUR	GBP	HKD	IDR	INR
Parallel	400	~~300~~350	400	200	~~100~~150	~~250~~300	~~200~~250	~~250~~300	200	400	~~400~~350
Short	500	450	500	~~300~~250	~~150~~250	300	~~250~~350	~~300~~400	~~250~~350	500	~~500~~450
Long	300	~~200~~300	300	~~150~~200	~~100~~200	~~150~~300	~~100~~200	~~150~~250	~~100~~200	300	~~300~~250

	JPY	KRW	MXN	RUB	SAR	SEK	SGD	TRY	USD	ZAR
Parallel	100	~~300~~250	400	400	~~200~~300	~~200~~300	150	400	200	~~400~~350
Short	100	~~400~~350	500	500	~~300~~350	~~300~~400	~~200~~250	500	300	500
Long	100	~~200~~250	~~300~~200	300	~~150~~250	~~150~~200	~~100~~200	300	~~150~~250	300

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"Footnotes
[7] Jurisdictions may, under national discretion, recalculate the shocks in Table 2 for their domestic currencies using a time period that deviates from the ~~initial~~ 2316 ~~-~~year period if it better reflects their idiosyncratic circumstances."

3. Page 3
"The floor is set at 100bp and the caps are set at 400bp for the parallel shock, 500bp for the short-term shock and 300bp for the long-term shock."

Page 6
"Currencies that are subject to the cap under the current and proposed new methodology will experience no change in shock factors, even if interest rates have been more volatile in the additional period used in the recalibration (ie January 2016 to December 2022). To address this issue, and to strengthen the option of local jurisdictions to apply more conservative shocks than the ones specified in the standard the Committee proposes the following amendment to SRP98.63: "Supervisors may, applying national discretion, set a higher floor under the local interest rate shock scenarios for their home currency, or a higher cap, resulting in more conservative shocks. […]".

Page 12
"98.63 Supervisors may, applying national discretion, set a higher floor under the local interest rate shock scenarios for their home currency, or a higher cap, resulting in more conservative shocks. Supervisors may also, applying national discretion, set a zero or negative lower bound for the post-shock $\overline{R}_{j,c}$, interest rates where j represents the six interest rate shock scenarios set out in [SRP31.91]:" …….

Observing items 1, 2 and 3, we would appreciate clarification on how the process of changing shocks and/or interest rates would occur for each jurisdiction and how these changes affect all other jurisdictions.

As an example, we will illustrate the situation described above using the prerogative of item 3 (set a higher floor under the local interest rate shock scenarios for their home currency, or a higher cap, resulting in more conservative shocks. […]").

For this example, we will use 3 (three) jurisdictions and their respective home currencies (A$, B$ and C$).

Local Banks in each of the 3 (three) jurisdictions have positions with Interest Rate Risk in the Banking Book (IRRBB) in all these currencies (A$, B$ and C$).
The Shocks Tables that will be the subject of our example are described below:

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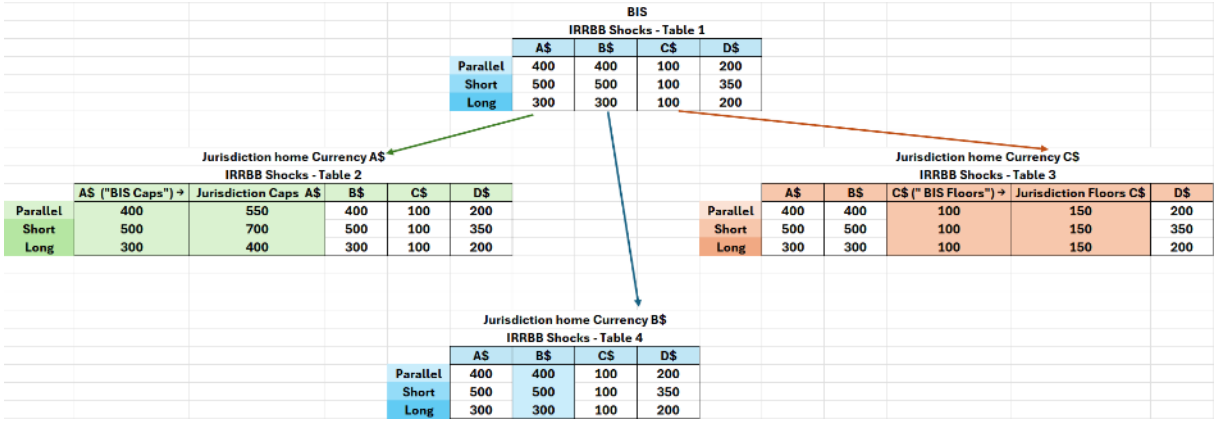
1. The shocks proposed by BIS for these Currencies (A$, B$ and C$) are in Table below.

2. The jurisdiction home Currency B$ decided to adopt the BIS Shocks Table (Table 4 = Table 1).

3. The Jurisdiction home Currency A$ has decided to adopt the BIS Shocks Table (Table 1) and use its prerogative to raise the Caps for its Currency A$ (Table 2)

4. The Jurisdiction home Currency C$ decided to adopt the BIS Shocks Table (Table 1) and use the prerogative to raise the Floors for its Currency C$ (Table 3).



BIS
IRRBB Shocks - Table 1

	A$	B$	C$	D$
Parallel	400	400	100	200
Short	500	500	100	350
Long	300	300	100	200

Jurisdiction home Currency A$
IRRBB Shocks - Table 2

	A$ ("BIS Caps") →	Jurisdiction Caps A$	B$	C$	D$
Parallel	400	550	400	100	200
Short	500	700	500	100	350
Long	300	400	300	100	200

Jurisdiction home Currency C$
IRRBB Shocks - Table 3

	A$	B$	C$ (" BIS Floors") →	Jurisdiction Floors C$	D$
Parallel	400	400	100	150	200
Short	500	500	100	150	350
Long	300	300	100	150	200

Jurisdiction home Currency B$
IRRBB Shocks - Table 4

	A$	B$	C$	D$
Parallel	400	400	100	200
Short	500	500	100	350
Long	300	300	100	200

In our view, the following effects can occur:

1. Banks in Jurisdiction home Currency B$ - When calculating IRRBB, they will use smaller shocks for Currency A$ comparing to Banks in Jurisdiction home Currency A$ and for Currency C$ comparing to Banks in Jurisdiction home Currency C$.

2. Banks in Jurisdiction home Currency A$ - When calculating IRRBB, they will use larger shocks for Currency A$ (home) comparing to Banks in Jurisdiction home Currency C$ and for Banks in Jurisdiction home Currency B$ and smaller shocks for Currency C$ comparing to Banks in Jurisdiction home Currency C$.

3. Banks in Jurisdiction home Currency C$ - When calculating IRRBB, they will use larger shocks for Currency C$ (local) comparing to Banks in Jurisdiction home Currency A$ and Banks in Jurisdiction home Currency B$ and smaller shocks for Currency A$ comparing to Banks in Jurisdiction home Currency A$.

As per our example, we can have different Shocks/IRRBB Results for the same Currency in different Jurisdictions.

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III-) The Fair-Value Perspective on Interest Rate Shocks

The Basel Committee on Banking Supervision introduced its standard on IRRBB in its documents "Interest Rate Risk in the Banking Book" and "Standards: Interest Rate Risk in the Banking Book", later incorporating it into chapters SRP31 and SRP98 of the consolidated Basel Framework.[1] The Committee stated its intention to periodically review the specified shock sizes and proposed methodological adjustments for calculating the specified interest rate shocks in the IRRBB standard in its document "Recalibration of Shocks for Interest Rate Risk in the Banking Book" (BIS-BCBS, 2023).

Despite the proposed adjustments for calculating the shocks, two key features of the Basel Framework persist in the current methodology. Firstly, it relies on simple historical interest rates as the foundation for obtaining the shocks, which are derived from a series of rolling six-month changes in interest rates.[2] Secondly, it applies instantaneous interest rate shocks for a six-month holding period without considering the effect of the "carry-forward" factor (current forward interest rate projection) on the magnitude of the shocks applied to banking book instruments.

By considering the "carry-forward" factor, the generation of interest rate shocks associated with a specific tenor in the yield curve between two moments in time (e.g., t and t+1) would incorporate the expected movement of the interest rate over time, which is already reflected in the yield curve. The interest rate shock thus consists of two parts: the deviation (the "surprise") from the expected forward rate and the realized rate between these two moments. Consequently, the adjusted interest rate shock, while net of the forward interest rate projection at t, accounts for the realization of the interest rate between t and t+1 when compared with the implied interest rate observed in the yield curve at t.

In the following section, we analyse an alternative methodology to the traditional approach of using simple historical interest rate percentage changes. This methodology incorporates the instantaneous nature and six-month holding period features of the Basel Committee's methodology, along with an adjustment for the "carry-forward" factor. Importantly, this methodology directly applies the Fair-Value principle by considering the expected Profit and Loss (P&L) of the banking book instruments.

Fair value is a principle widely utilized in accounting and economics. In economics, it denotes the estimated value of an asset or security based on market conditions and investor behavior, influenced by factors such as scarcity, utility, and potential returns. In accounting, fair value reflects the market value of an asset (or liability) when the price on an active market may or may not be determinable. According to US Generally Accepted Accounting Principles (ASC 820) and International Financial Reporting Standards (IFRS 13), fair value is the price that would be received to sell an asset or paid to transfer a liability in an orderly transaction between market participants at the measurement date. This valuation method is used for assets whose carrying value is based on mark-to-market valuations.

[1] See *https* : *//www.bis.org/basel framework/* for details.
[2] In the current methodology, the Committee uses relative percentage changes in interest rates, while in the newly proposed methodology, it applies absolute changes (BIS-BCBS, 2015, 2016, 2023).

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In the banking sector, the fair value principle is crucial for computing mark-to-market and P&L for various financial instruments, enabling banks to accurately assess asset and liability performance, manage risks, and make informed financial decisions.[3] The Bank for International Settlements has issued several documents related to fair value used by banks, including the "Principles for the Management and Supervision of Interest Rate Risk" (BIS-BCBS, 2004), which outlines principles for managing and supervising interest rate risk, and the "Supervisory Guidance on the Use of the Fair Value Option by Banks under International Financial Reporting Standards" (BIS-BCBS, 2005), which provides supervisors with guidance on the fair value option under International Financial Reporting Standards, outlining its objectives, conditions for use, and supervisory expectations. Additionally, the "Principles for Sound Stress Testing Practices and Supervision" (BIS-BCBS, 2009) provides guidance on stress testing, including fair value measurements.

A concept closely related to fair value is economic value. While fair value represents the current market worth of an asset or liability, economic value is the present value of its future cash flows, discounted at a suitable interest rate. These concepts are linked through their reliance on cash flow analysis and the use of discounted cash flow methodologies. Fair value provides a snapshot of an asset or liability's market value at a specific time, whereas economic value considers its long-term worth based on expected cash flows.[4] In the banking context, economic value serves as a crucial metric for assessing IRRBB. Changes in interest rates impact the present value and timing of a bank's future cash flows, affecting assets, liabilities, and off-balance sheet items. This alteration directly influences the economic value of a bank's financial instruments. For instance, cash flows from deposits and loans are discounted using a risk-free market interest rate to determine their economic value.

The importance of this methodology is underscored in the Bank for International Settlements document "Interest Rate Risk in the Banking Book," which highlights the significance of discounting cash flows appropriately to evaluate interest rate risk in the banking sector. The document emphasizes the importance of banks calculating the present value of future cash flows using a discount rate that accurately reflects current market conditions. This approach ensures that banks gain a precise understanding of their exposure to interest rate risk, enabling them to make well-informed decisions for effective risk management.

i) Implicit Shock from Expected P&L Calculation

To illustrate our Fair-Value methodology, we provide an example using a fictitious financial derivative position. We apply the fair value principle to compute the mark-to-market value of this position, which is then used to calculate the expected Profit and Loss (P&L) and its corresponding implied interest rate shock. This example demonstrates the practical application of our methodology.

[3] For a general discussion on fair value, see Penman (2007), Laux and Leuz (2009), and Heaton et al. (2010). For a more specific examination related to the banking industry, see Barth et al. (1995), Landsman (2006), and Schwarz et al. (2015).
[4] For a comprehensive discussion on these concepts in security valuation, refer to Penman (2013).

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Shock From Expected P&L Calculation. Consider a scenario where a bank assumes a fixed-rate short position in a "Swap Pre x CDI"[5] on date *t*, with maturity at *T*. If the transaction takes place at the market price at time *t*, the initial P&L is zero. Changes in the P&L arise from two sources: i) if, between *t* and *t* + *h*, the realized implicit CDI differs from the expected CDI derived from the yield curve at date *t* (where *h* is the holding period considered) and; ii) if the expectation regarding the yield curve interest rates between *t* + *h* and *T* changes. Essentially, the shock is defined by the "surprise" between the implicit CDI from the yield curve at date *t* for a horizon *h*, compared to the future realized CDI during this period, along with any changes in the expected future interest rates. Under these circumstances, the P&L would reflect an instantaneous interest rate shock.

Let MtM_{t+h} denote the mark-to-market value observed at *t*+*h* (representing the fix-interest-rate leg of the swap) of a monetary unit contracted at a fixed rate on *t* for maturity *T*:

$$MtM_{t+h} = \frac{(1 + r_{t,T})^{(T-t)}}{(1 + r_{t+h,T})^{(T-(t+h))}}, \tag{1}$$

where $r_{i,j}$ is the fixed rate observed at *i* for maturity *j*. The financial result of this position, or the P&L, is determined by the difference between the observed MtM_{t+h} at the end of the holding period and the CDI accrued in the same period (the CDI or floating leg of the swap), as follows:

$$P\&L_{t+h} = MtM_{t+h} - \prod_{i=t}^{t+h}(1 + CDI_i)^{\frac{1}{252}}. \tag{2}$$

The change in Economic Value of Equity ($\Delta EV\,E$) for this monetary unit is defined as:

$$\Delta EV\,E_t = \frac{(1 + r_{t,T})^{(T-t)}}{(1 + r_{t,T} + \delta_T)^{(T-t)}} - 1, \tag{3}$$

where δ_T represents the instantaneous interest rate shock. Therefore, the shock is defined as the value that equates the $P\&L_{t+h}$ to the $\Delta EV\,E_t$, which can be expressed as

[5] The "Swap Pre x CDI" is a type of fixed-float swap contract where one party exchanges fixed interest rate payments for CDI rate (Interbank Deposit Certificate) variation. The CDI serves as a benchmark interest rate in the Brazilian interbank market, calculated from interbank uncollateralized lending trades, or equals the SELIC rate (the benchmark for prevailing interest rates in the Brazilian economy) if certain liquidity criteria are not met. The CDI rate influences interest rates on various financial products in the domestic market and is also traded on a standardized and liquid market through DI futures contracts. For ease of interpretation, we use a swap contract instead of a futures contract, with daily adjustments accrued and paid at maturity. Trading a fixed-rate swap means that one party agrees to pay float rate (CDI, for example) and receive fixed rate and vice versa.

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$$P\&L_{t+h} = \frac{(1+r_{t,T})^{(T-t)}}{(1+r_{t,T}+\delta_T)^{(T-t)}} - 1.$$

Thus, the shock for a given holding period applied instantaneously is given by:

$$\delta_T = \left(\frac{(1+r_{t,T})}{(1+P\&L_{t+h})^{\frac{1}{(T-t)}}} \right) - (1+r_{t,T}). \tag{4}$$

The δ_T obtained implicitly from the P&L calculation represents the interest rate shock from the Fair-Value perspective. Importantly, the magnitude and direction of the shock are associated with the P&L value: if $P\&L > 0$, then $\delta_T < 0$; if $P\&L < 0$, then $\delta_T > 0$; otherwise, if $P\&L = \delta_T = 0$. It is worth noting that, according to this methodology, only tenors greater than or equal to the holding period, h, are included in the calculation, as tenors shorter than the holding period are considered expired within the horizon.

Adjusted Shock from P&L Calculation. One could argue that $P\&L_{t+h}$ and $\Delta EV\ E_t$ are at different time points, making them not directly comparable. To align them at the same date, $\Delta EV\ E_t$ can be adjusted forward in time. Since the "carry" period equals the holding period, we first find the shock applied for the holding period, δ_{HP}, by equating $P\&L_{t+h}$ with the future value of $\Delta EV\ E$ as follows:

$$P\&L_{t+h} = \Delta EVE_t \times (1+r_{t,h}+\delta_h)^h = \left[\frac{(1+r_{t,h})^h}{(1+r_{t,h}+\delta_h)^h} - 1 \right] \times (1+r_{t,h}+\delta_h)^h,$$

$$\delta_h = \left[(1+r_{t,h})^h - P\&L_{t+h} \right]^{\frac{1}{h}} - (1+r_{t,h}). \tag{5}$$

The remaining shocks are derived as follows:

$$P\&L_{t+h} = \Delta EVE_t \times (1+r_{t,h}+\delta_h)^h = \left[\frac{(1+r_{t,T})^{(T-t)}}{(1+r_{t,T}+\delta_T)^{(T-t)}} - 1 \right] \times (1+r_{t,h}+\delta_h)^h,$$

$$\delta_T = \frac{(1+r_{t,T})}{\left(1+\frac{P\&L_{t+h}}{(1+r_{t,h}+\delta_h)^h}\right)^{\frac{1}{(T-t)}}} - (1+r_{t,T}). \tag{6}$$

As discussed in the following section, this adjusted shock, while potentially more precise, yields results very similar to those obtained from the unadjusted implicit shock from the expected P&L calculation.

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ii) Fair-Value Plausibility Analysis

Date. We use historical data from the Brazilian Real-denominated risk-free interest rate yield curve, encompassing tenors ranging from 63 days to 20 years. The dataset covers the period from 02/Jan/2000 to 31/Dec/2022. However, our analysis focuses on two specific intervals: from 02/Jan/2004 to 31/Dec/2022 and from 02/Jan/2013 to 31/Dec/2022. We selected these intervals because between 2000 and 2004, the Brazilian economy underwent unprecedented macroeconomic volatility, characterized by significant interest rate changes and volatility, as will be discussed in the following. We compare the results of interest rate shocks calculated using two approaches. First, we replicate the methodology employed by the Basel Committee, which involves computing the six-month rolling window difference between interest rates for each vertex of the yield curve. Second, we calculate the shock by applying our proposed methodology (from the P&L calculation and the adjusted P&L calculation) at each vertex of the yield curve. The results are presented in basis points and labeled as “Basel,” “Simple P&L,” and “Adjusted P&L,” respectively.

Fair-Value Perspective Results. We begin with an overview of the Brazilian economy in the early 2000s. Between 2000 and 2004, the Brazilian economy underwent structural changes characterized by drastic shifts in the sovereign risk premium, significant inflation rate shocks, and high currency fluctuation, accompanied by substantial oscillations in interest rates. This period was marked by the adoption of a floating exchange rate (dirty floating regime) and the implementation of an inflation-targeting regime. Other factors, both domestic and external, also influenced the economy, including a domestic energy crisis, a slowdown in the global economy, and the September 11 terrorist attacks in the US. Notably, the 2001 currency crisis in Argentina led to sudden stops and flight episodes in the Brazilian economy. The domestically driven shocks, coupled with the contagion from Argentina, were compounded by escalating uncertainty regarding the new administration’s commitment after the 2002 presidential election. The scrutiny intensified over the administration’s commitment to the economic policies implemented by the prior government, especially concerning fiscal adjustment and the monetary policy framework. During the 2000-2004 period, the Brazilian monetary authority responded promptly by adjusting the SELIC rate, leading to drastic changes in the interest rates across the yield curve.[6]

Figure (1) displays the behavior of interest rate shocks and volatility of the 1Y interest rate of the yield curve. Three features of panel (a) of the figure are worth noting. Firstly, there is a significant decrease in the level of interest rate shocks computed from the Basel and Simple P&L methodologies from 2004 onwards. Secondly, the daily changes in interest rates corroborate this observed reduction in shocks. Thirdly, there is a considerable difference in the behavior of interest rate shocks between the two methodologies. Similar considerations apply to panel (b) of the figure regarding the behavior of interest rate shock volatilities. These results support our choice of the sample period and highlight the potential differences in results brought about by the Basel and our proposed methodology.

[6] For further discussion on the challenges faced by the Brazilian economy during the early 2000s, refer to Minella et al. (2003), Calvo et al. (2003), and Tombini et al. (2006).

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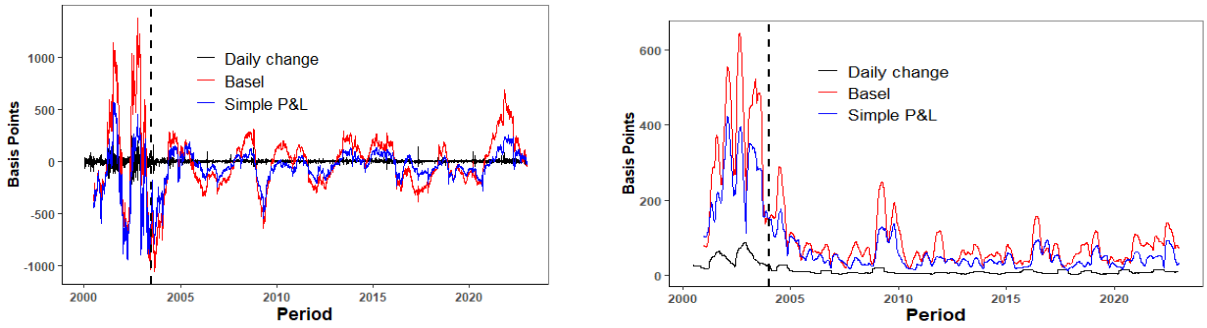

(a) Interest Rate Changes **(b) Interest Rate Volatility**

Figure 1: Interest Rate Behavior. The figure illustrates the shocks (Panel (a)) and volatility (Panel (b)) of the 1Y interest rate of the yield curve. The red and blue lines represent the six-month interest rate shocks computed from the Basel and Simple P&L methodologies, respectively. Volatility is calculated as the standard deviation of the six-month rolling window of interest rate shocks. The dashed line indicates the beginning of 2004. Additionally, the black line depicts daily changes in interest rates. The sample period spans from 02/Jan/2000 to 31/Dec/2022.

Tables 1 to 4 provide a comprehensive summary of descriptive statistics for the Simple P&L and the Basel methodologies, respectively, in accordance with the Bank of International Settlement's document "Recalibration of Shocks for Interest Rate Risk in the Banking Book" (BIS-BCBS, 2023). Time buckets of 3M, 6M, 1Y, 2Y, 5Y, 7Y, 10Y, 15Y, and 20Y are used. Additionally, statistics for the absolute values of the calculated interest rate shock series are reported. The sample period for Tables 1 and 2 spans from 02/Jan/2004 to 31/Dec/2022, while for Tables 3 and 4, it spans from 02/Jan/2013 to 31/Dec/2022. Upon closer examination of the tables, three key observations arise:

i) In comparing the statistics for different interest rate tenors, we observe that the absolute values of the Basel methodology tend to be higher than those of the "Simple P&L" for shorter-term vertices (6M, 1Y, and 2Y). However, for longer-term vertices (5Y, 7Y, 10Y, 15Y, and 20Y), the trend reverses. It's essential to interpret these longer-term results cautiously due to the limited liquidity in the interest rate market for these tenors during the 2000s. This lack of liquidity makes it challenging to obtain accurate trading values for the associated interest rates and extrapolated values for non-traded tenors of the yield curve. Daily data from B3 indicates reduced trading volume for DI future interest rate contracts, especially for longer tenors, during the 2000s;[7]

ii) When comparing the average interest rate shocks denoted by "All - M," "10Y - M," and "5Y - M," we observe that, except for the 1% percentile (Perc 1%), all the statistics in absolute terms from the Basel methodology exceed those calculated from the Simple P&L;

[7] B3, formerly known as the São Paulo Stock Exchange, is a Brazilian company that serves as a financial market infrastructure provider. It is responsible for a range of activities, including registering transactions involving financial instruments such as DI contracts, which are used for trading future interest rates. Additionally, B3 offers trading platforms, clearing, settlement, and custody services for a diverse array of financial assets.

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iii) A comparison of tables (1) and (2) with (3) and (4) reveals a significant decrease in the values of negative interest rate shocks during the 2013-2022 sample period. Consequently, the percentiles and expected shortfall for the 0.1% and 1% values decreased in absolute terms for both the Simple P&L and Basel methodologies. The results for the other statistics remained relatively stable;

Table 1

Interest Rate Shocks: Simple P&L

The table presents the six-month interest rate shocks computed from the Simple P&L methodology. The mnemonic names represent the following: i) Min and Max - the highest and lowest values, respectively; ii) Perc - the corresponding percentile values; iii) Abs - the absolute value used to compute the statistics; iv) ES - the corresponding expected shortfall values. The expected shortfall is computed as the simple average of the values for a specific percentile. The bottom three rows show statistics for the simple average of subsets of interest tenors denoted by "ALL - M" (all vertices), "10Y - M" (for vertices with tenors lower or equal to 10Y), and "5Y - M" (for vertices with tenors lower or equal to 5Y). The data in parentheses indicate negative values. All values are reported in basis points. The sample period spans from 02/Jan/2004 to 31/Dec/2022.

Vertex	Min	Max	Perc 0.1%	Perc 1%	Perc 99.9%	Perc 99%	Perc 99.9% Abs	ES 0.1%	ES 1%	ES 99.9%	ES 99%	ES 99.9% Abs	ES 99% Abs
3M	-	-	-	-	-	-	-	-	-	-	-	-	-
6M	(288)	117	(227)	(150)	111	74	227	(249)	(202)	115	90	249	202
1Y	(554)	248	(465)	(336)	232	210	465	(504)	(408)	240	221	504	408
2Y	(692)	394	(597)	(417)	345	283	597	(637)	(519)	360	316	637	519
5Y	(627)	450	(559)	(449)	401	332	559	(595)	(502)	424	370	595	502
7Y	(634)	462	(580)	(461)	415	343	580	(599)	(503)	439	381	599	503
10Y	(737)	467	(572)	(474)	430	354	572	(625)	(527)	453	393	625	527
15Y	(813)	482	(620)	(489)	440	367	620	(678)	(555)	469	405	678	555
20Y	(849)	491	(646)	(492)	447	372	646	(710)	(571)	478	412	710	571
All - M	(545)	339	(490)	(360)	301	257	490	(519)	(435)	322	281	519	435
10Y - M	(548)	290	(476)	(332)	269	227	476	(508)	(415)	277	244	508	415
5Y - M	(537)	251	(458)	(303)	224	192	458	(491)	(393)	233	209	491	393

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Table 2
Interest Rate Shocks: Basel

The table presents a set of statistical measures of interest rate shocks calculated using the Basel methodology. The mnemonic names and other descriptions from table (1) apply here as well. All values are in basis points. The sample period spans from 02/Jan/2004 to 31/Dec/2022.

Vertex	Min	Max	Perc 0.1%	Perc 1%	Perc 99.9%	Perc 99%	Perc 99.9% Abs	ES 0.1%	ES 1%	ES 99.9%	ES 99%	ES 99.9% Abs	ES 99% Abs
3M	(462)	575	(451)	(421)	566	542	566	(458)	(437)	573	556	573	556
6M	(558)	632	(507)	(440)	620	557	620	(527)	(480)	625	589	625	589
1Y	(648)	689	(574)	(464)	648	519	648	(604)	(526)	663	583	663	600
2Y	(665)	591	(576)	(422)	528	382	528	(615)	(508)	552	460	618	536
5Y	(590)	448	(516)	(432)	412	348	412	(552)	(476)	432	380	552	476
7Y	(584)	456	(530)	(439)	410	340	410	(556)	(479)	435	377	556	479
10Y	(689)	462	(546)	(455)	415	341	415	(588)	(502)	438	378	588	502
15Y	(771)	462	(599)	(468)	416	346	416	(650)	(531)	442	382	630	531
20Y	(812)	462	(624)	(476)	416	347	416	(683)	(548)	442	382	683	548
All - M	(556)	463	(511)	(348)	426	346	511	(530)	(440)	441	383	530	457
10Y - M	(559)	507	(516)	(367)	468	382	516	(537)	(451)	483	427	537	478
5Y - M	(581)	566	(523)	(404)	531	451	540	(545)	(470)	543	493	560	515

Table 3
Interest Rate Shocks: Simple P&L

The table presents a set of statistical measures of interest rate shocks calculated using the Simple P&L methodology. The mnemonic names and other descriptions from table (1) apply here as well. All values are in basis points. The sample period spans from 02/Jan/2013 to 31/Dec/2022.

Vertex	Min	Max	Perc 0.1%	Perc 1%	Perc 99.9%	Perc 99%	Perc 99.9% Abs	ES 0.1%	ES 1%	ES 99.9%	ES 99%	ES 99.9% Abs	ES 99% Abs
3M	-	-	-	-	-	-	-	-	-	-	-	-	-
6M	(191)	117	(139)	(112)	115	71	139	(158)	(124)	116	92	158	124
1Y	(283)	248	(221)	(193)	238	218	242	(246)	(209)	244	227	259	230
2Y	(392)	394	(376)	(335)	352	313	383	(386)	(357)	370	335	391	361
5Y	(489)	450	(470)	(423)	411	362	470	(481)	(445)	434	387	481	446
7Y	(492)	462	(478)	(425)	420	370	478	(485)	(446)	444	396	485	448
10Y	(490)	465	(485)	(429)	431	381	485	(488)	(456)	453	404	488	458
15Y	(494)	482	(487)	(430)	442	390	487	(492)	(459)	471	417	492	463
20Y	(493)	491	(487)	(429)	449	396	490	(492)	(458)	479	423	492	464
All - M	(375)	339	(364)	(333)	319	272	364	(371)	(349)	329	290	371	349
10Y - M	(340)	290	(337)	(307)	275	238	337	(338)	(321)	281	252	338	321
5Y - M	(287)	251	(282)	(256)	230	205	282	(285)	(269)	238	218	285	269

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Table 4
Interest Rate Shocks: Basel

The table presents a set of statistical measures of interest rate shocks calculated using the Basel methodology. The mnemonic names and other descriptions from table (1) apply here as well. All values are in basis points. The sample period spans from 02/Jan/2013 to 31/Dec/2022.

Vertex	Min	Max	Perc 0.1%	Perc 1%	Perc 99.9%	Perc 99%	Perc 99.9% Abs	ES 0.1%	ES 1%	ES 99.9%	ES 99%	ES 99.9% Abs	ES 99% Abs
3M	(377)	575	(371)	(364)	573	553	573	(375)	(367)	574	562	574	562
6M	(407)	632	(379)	(352)	622	582	622	(399)	(362)	627	608	627	608
1Y	(388)	689	(349)	(303)	655	571	655	(373)	(322)	672	625	672	625
2Y	(422)	591	(413)	(371)	641	462	542	(418)	(392)	565	504	565	504
5Y	(483)	444	(465)	(415)	419	366	465	(474)	(439)	433	388	474	441
7Y	(480)	446	(467)	(412)	408	361	467	(472)	(435)	431	386	472	437
10Y	(472)	441	(466)	(409)	409	363	466	(470)	(438)	431	385	470	441
15Y	(477)	449	(471)	(414)	413	366	471	(475)	(443)	439	389	475	446
20Y	(477)	449	(471)	(415)	413	366	471	(475)	(443)	439	389	475	446
All - M	(350)	463	(341)	(300)	441	374	441	(345)	(322)	450	404	450	404
10Y - M	(317)	507	(314)	(273)	482	425	482	(316)	(298)	492	450	492	450
5Y - M	(350)	566	(318)	(267)	540	491	540	(332)	(280)	551	518	551	518

Tables (5) and (6) in Appendix 2 present the results for the Adjusted P&L methodology. The key takeaway from these tables is that all statistics are lower than those reported in (1) and (3) for the Simple P&L methodology. In summary, we observe different results when applying the traditional Basel methodology and our proposed Fair-Value approach to compute interest rate shocks. Additionally, we provide empirical evidence supporting our choice of the evaluation period for analyzing interest rate shocks. Specifically, we demonstrate that abnormal interest rate shocks in the Brazilian economy are confined to the interval between 2000 and 2004.

Once again, we appreciate the opportunity to comment on revisions to the “Recalibration of Shocks for Interest Rate Risk in the Banking Book”. Should you have any questions on the issues raised in this letter, please contact the undersigned com.gestao.riscos@febraban.org.br.

Very truly yours,

Rubens Sardenberg
Director of Prudential Regulation,
Risk and Economic Affairs

Tatiana Grecco
Director of Risk Management Committee

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APPENDIX 1

Descriptive Analysis of Data for the Period 2000–2022

Description of the Data used for the analyses:

The Table below presents the rate changes calculated for each of the 9 buckets by applying a moving window of 6 months, corresponding to 125 business days for the BRL currency. Rate changes were calculated for the nine Buckets provided for in the BIS consultative document, as follows:

$$\Delta R_{k,c}(t) = R_{k,c}(t) - R_{k,c}(t-h)$$

Buckets are given in business days according to:

3M = 63 bd
6M = 126 bd
1Y = 252bd
2Y = 504 bd
5Y = 1260
7Y = 1764
10Y = 2520 bd
15Y = 3780 bd
20Y = 5040 bd

Table of fee changes for each Bucket:

	Rate Changes per Bucket								
Date	**63**	**126**	**252**	**504**	**1.260**	**1.764**	**2.520**	**3.780**	**5.040**
04/jul/00	-235	-275	-321	-446	-521	-531	-539	-545	-548
05/jul/00	-264	-316	-378	-492	-397	-370	-350	-334	-326
06/jul/00	-248	-300	-370	-483	-638	-683	-717	-744	-757
07/jul/00	-243	-306	-374	-477	-635	-680	-713	-740	-753
10/jul/00	-236	-279	-343	-443	-574	-615	-646	-670	-682
11/jul/00	-209	-235	-287	-410	-730	-805	-861	-905	-927
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
26/dez/22	24	0	-33	-24	7	-7	-15	-18	-12
27/dez/22	23	-1	-38	-24	16	5	-4	-6	0
28/dez/22	22	-4	-35	-29	2	-7	-18	-20	-14
29/dez/22	22	4	-29	-24	-4	-13	-22	-27	-24

Temporal Series starts on 04th July 2000 and ends on 29th December 2022.

From this table, the time series of the Buckets' arithmetic averages were generated for each date to construct the three interest rate shock scenarios, Short, Long and Parallel Shocks, according to the proposed methodology of the BIS consultative document:

- Short Shock = Average of the first three Buckets for each date (Short Rate Shocks)
- Long Shock = Average of the last three Buckets for each date (Long Rate Shocks)
- Parallel Shock = Average of all nine Buckets for each date (Parallel Shocks)

The following table shows the first and last shocks of the constructed time series of Short, Long and Parallel Shocks:

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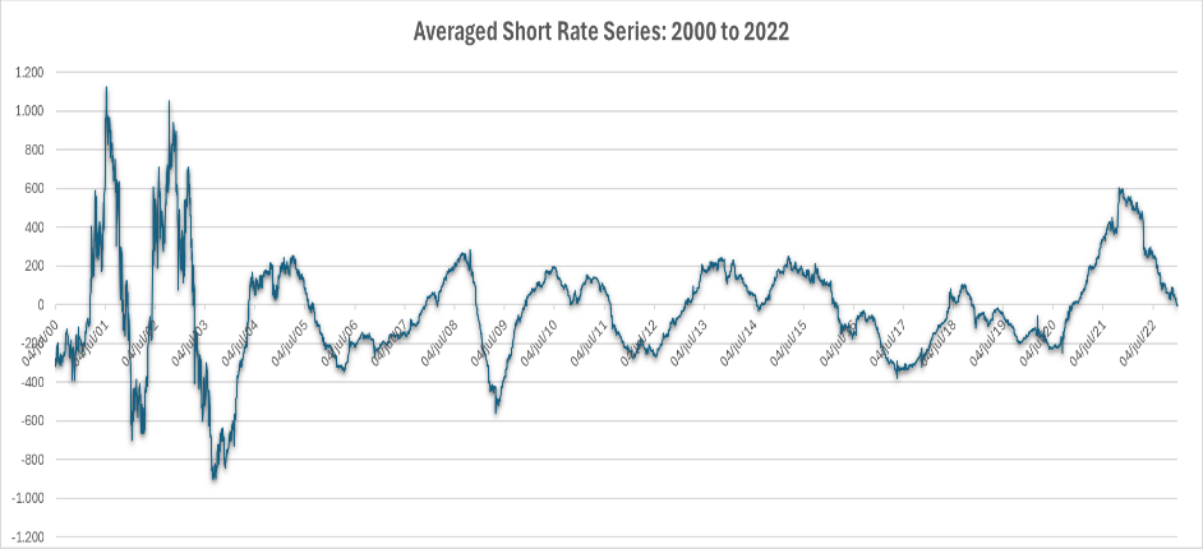
Time Series of Rate Shocks			
Date	Short Shock	Long Shock	Parallel Shock
04/jul/00	-277	-544	-440
05/jul/00	-319	-336	-359
06/jul/00	-306	-739	-549
07/jul/00	-308	-735	-547
10/jul/00	-286	-666	-499
11/jul/00	-244	-898	-597
.....	.....	.....	.....
26/dez/22	-3	-15	-9
27/dez/22	-5	-3	-3
28/dez/22	-5	-17	-11
29/dez/22	-1	-24	-13

The time series of the average Short, Long and Parallel interest rates, given by

$$\Delta R_{i,c}(t) = \frac{1}{N_i}\sum_{k_i} \Delta R_{k_i,c}(t)$$

present an initial period, which goes from July 2000 to September 2003, whose profile is clearly different from the following period, especially from mid-2004 onwards. This can be easily seen in the 3 charts below. In the initial period there are huge variations in average interest rates, both in terms of sign and module, as presented below before taking the absolute value of $\Delta R_{i,c}(t)$:



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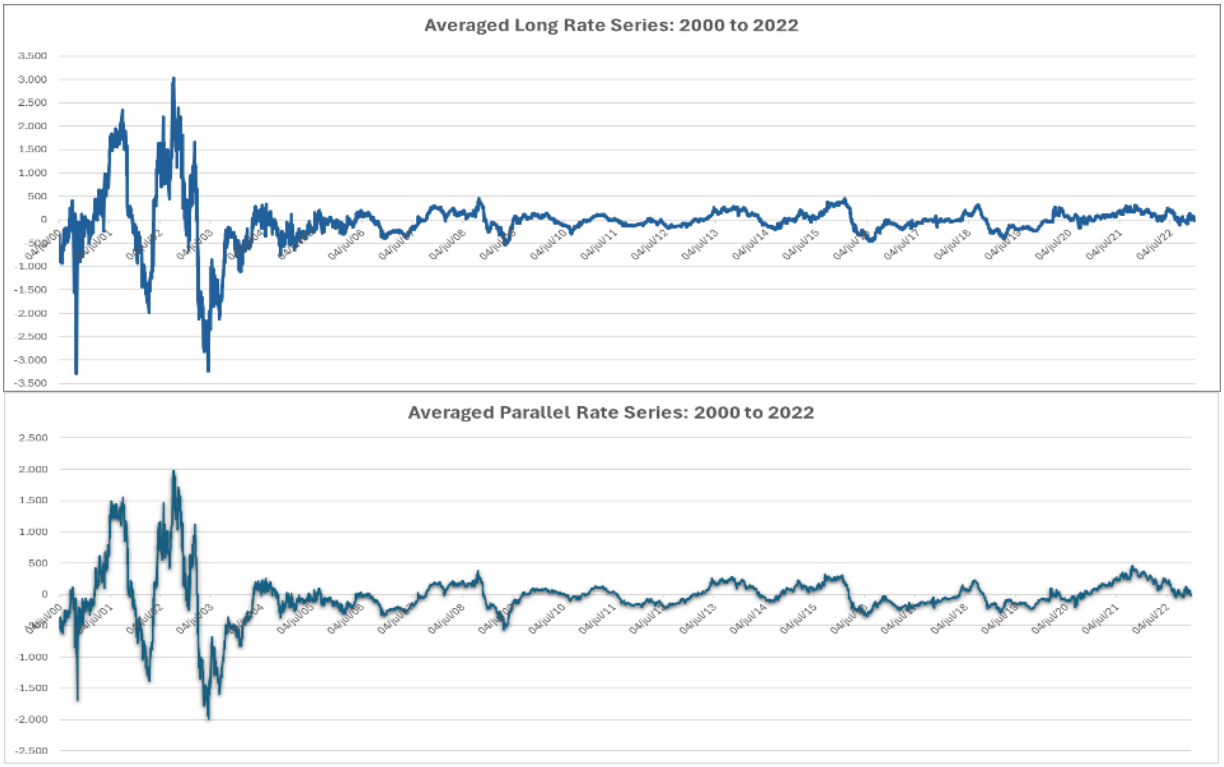

Separating the 20 largest and 20 smallest values of the average interest rate variations for the entire time series, we clearly see their major concentration in small intervals of a few days, especially in July 2001 (positive values) and in September 2003 (negative values) for Short Shocks, October 2002 (positive values) and June 2003 (negative values) for both Long Shocks and Parallel Shocks:

20 largest negative shocks - 2000-2022					
Date	**Short Shock**	**Date**	**Long Shock**	**Date**	**Parallel Shock**
12/jul/01	1.124	09/out/02	3.034	09/out/02	1.974
13/jul/01	1.090	10/out/02	2.969	10/out/02	1.961
11/jul/01	1.064	07/out/02	2.929	11/out/02	1.897
15/out/02	1.052	04/out/02	2.846	07/out/02	1.891
10/jul/01	1.049	11/out/02	2.779	15/out/02	1.888
16/jul/01	993	08/out/02	2.643	04/out/02	1.862
18/jul/01	969	16/out/02	2.545	16/out/02	1.854
01/ago/01	966	14/out/02	2.421	14/out/02	1.801
05/jul/01	963	15/out/02	2.417	08/out/02	1.752
03/ago/01	961	12/nov/02	2.392	12/nov/02	1.712
02/ago/01	955	30/set/02	2.365	03/out/02	1.676
31/jul/01	952	05/out/01	2.346	14/nov/02	1.667
19/jul/01	950	03/out/02	2.295	30/set/02	1.664
13/nov/02	939	14/nov/02	2.217	18/nov/02	1.603
14/nov/02	936	29/jul/02	2.208	26/nov/02	1.573
17/jul/01	924	26/nov/02	2.205	13/nov/02	1.566
20/jul/01	910	25/nov/02	2.204	25/nov/02	1.559
24/jul/01	902	27/nov/02	2.200	27/nov/02	1.558
27/jul/01	902	04/out/01	2.181	06/nov/02	1.554
14/ago/01	901	22/nov/02	2.177	05/out/01	1.552

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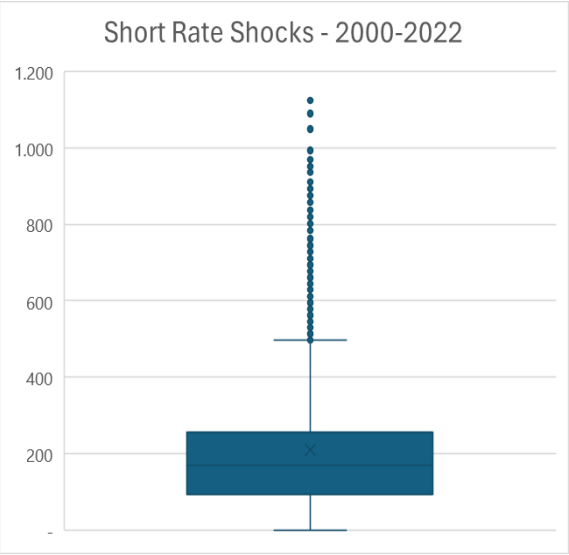
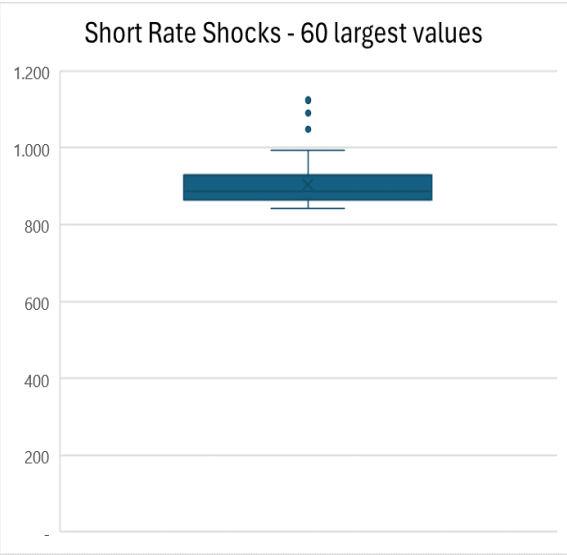
20 smallest negative shocks - 2000-2022					
Date	Short Shock	Date	Long Shock	Date	Parallel Shock
25/set/03	-845	12/jun/03	-2.427	05/jun/03	-1.614
09/set/03	-851	20/jun/03	-2.435	04/jun/03	-1.627
23/set/03	-853	17/jun/03	-2.477	07/nov/00	-1.628
22/ago/03	-858	28/mai/03	-2.494	11/jun/03	-1.637
26/ago/03	-862	13/jun/03	-2.497	12/jun/03	-1.638
19/set/03	-864	05/jun/03	-2.502	20/jun/03	-1.641
04/set/03	-864	04/jun/03	-2.521	03/jun/03	-1.677
10/set/03	-866	21/mai/03	-2.536	08/nov/00	-1.683
17/set/03	-867	23/mai/03	-2.666	21/mai/03	-1.685
03/set/03	-870	22/mai/03	-2.676	30/mai/03	-1.688
22/set/03	-871	03/jun/03	-2.748	02/jun/03	-1.692
15/set/03	-875	14/mai/03	-2.753	17/jun/03	-1.696
29/ago/03	-875	29/mai/03	-2.779	29/mai/03	-1.696
08/set/03	-877	02/jun/03	-2.788	13/jun/03	-1.699
28/ago/03	-886	30/mai/03	-2.795	23/mai/03	-1.735
05/set/03	-887	20/mai/03	-2.821	22/mai/03	-1.759
27/ago/03	-893	16/jun/03	-2.962	20/mai/03	-1.763
02/set/03	-894	07/nov/00	-3.160	14/mai/03	-1.778
18/set/03	-898	18/jun/03	-3.222	16/jun/03	-1.931
01/set/03	-899	08/nov/00	-3.286	18/jun/03	-1.995

The box-plots of all shocks versus the box plot referring to the 60 highest Shock values for each of the three types of shocks show the extent of the outliers related to the period from 2000 to 2003 and their effect on determining the values of the highest CI percentiles.

These box plots indicate that the highest percentiles, and not just the 99.9%, are fully determined by outliers, so there is great uncertainty about their value, as the result depends on very few historical events of interest rate changes. We will also see that these box plots show very different behavior for periods after 2003.

Short Rate Shocks:





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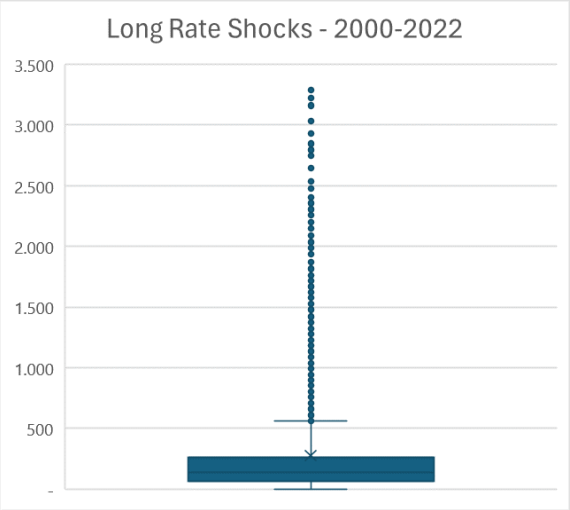
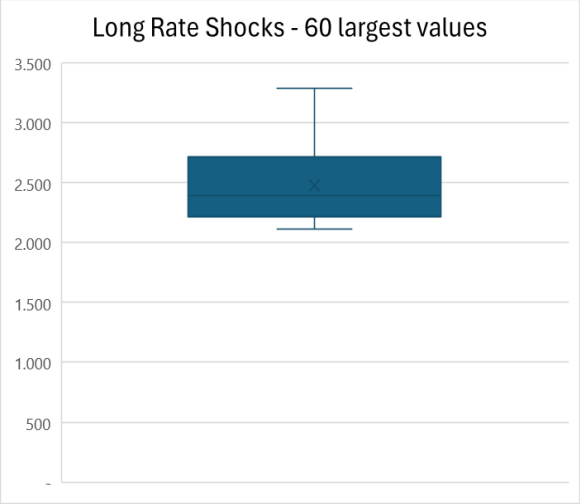
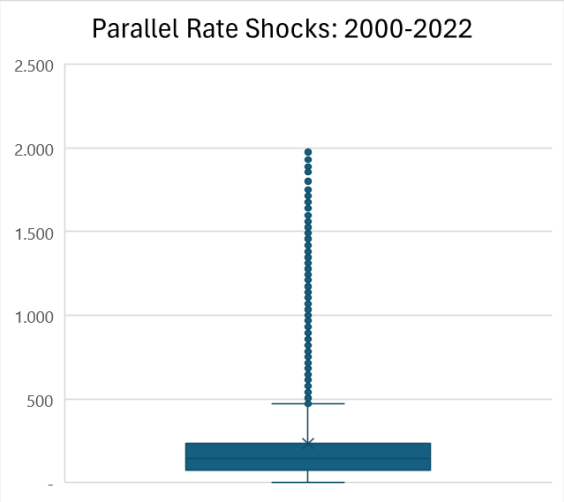
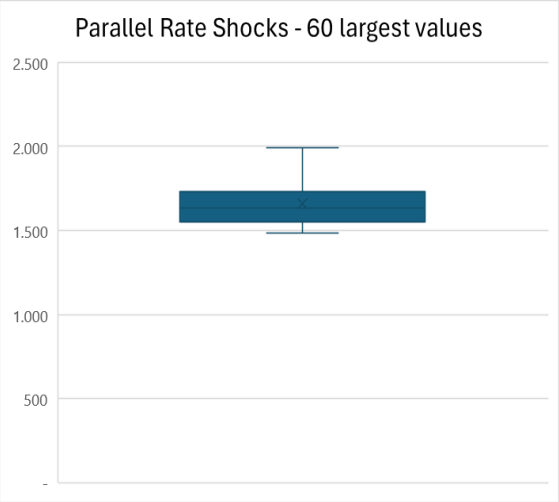
Long Rate Shocks:





Parallel Rate Shocks:





Distribution of the Highest Shock Values

Complementing the analysis of the box plots, we present the charts with the highest values of the shocks and their dates of occurrence.

Although the interest herein is centered on outliers, we will show that the regions where these events occur are very concentrated and occurred long ago, at the beginning of the period proposed in the consultative document, i.e., more than 20 years ago. Particularly, the distribution of these shocks over time shows a large concentration in the period from July 2000 to November 2003, as presented in the charts below.

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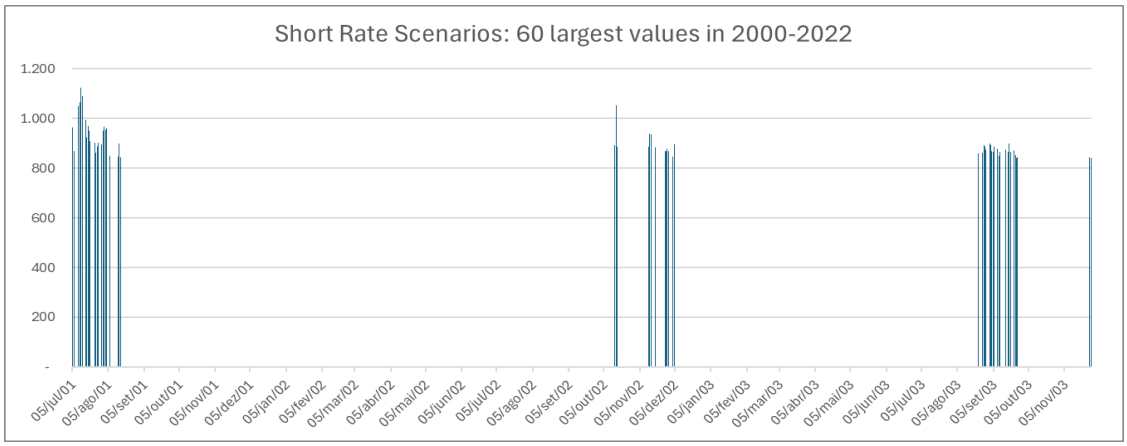
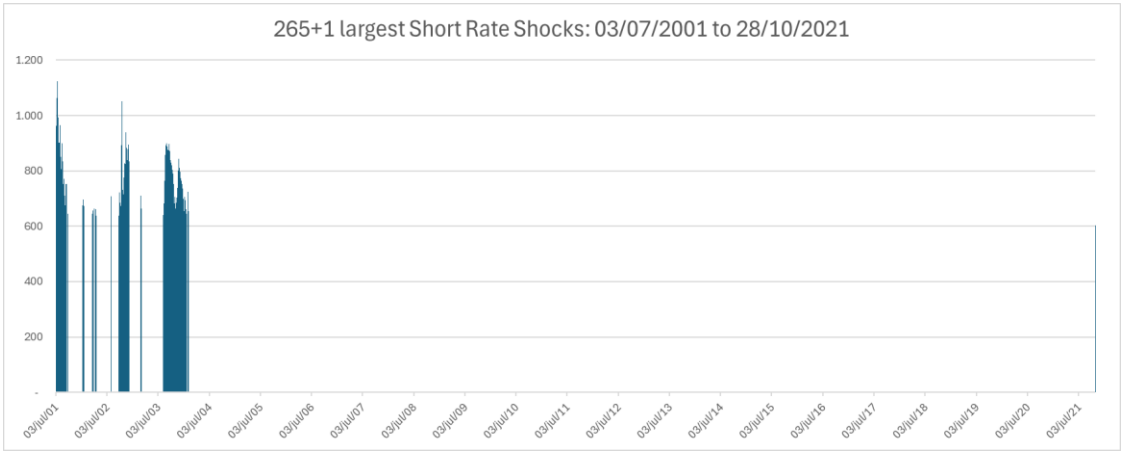
Short Shocks:

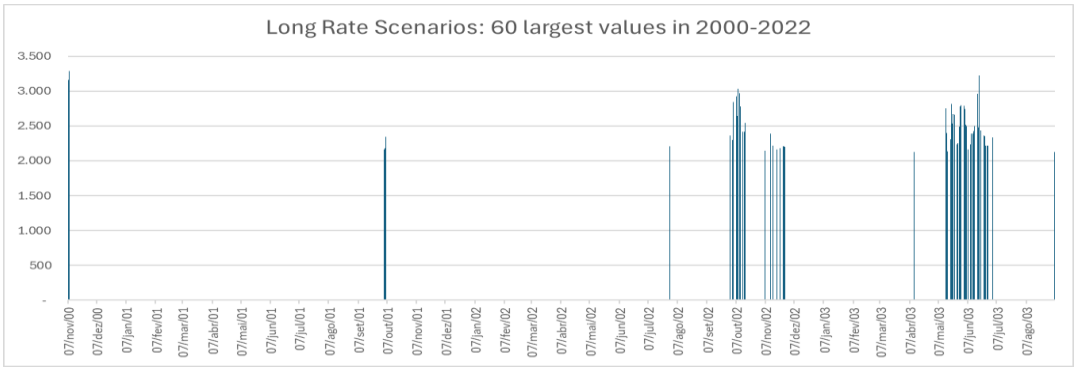


Extending this analysis to a larger number of the major shocks, we can see their extreme concentration between 2000 and 2003. In the chart below, we show that the 266th highest value in the series of short shocks occurs in 2021, very far from the 264th, which occurs in February 2024.



In the case of Long and Parallel Shocks, the situation is even more radical, where approximately the first 500 largest values occur before the end of 2003, while the following values are of much lower magnitude, as shown in the following charts:

Long Shocks:



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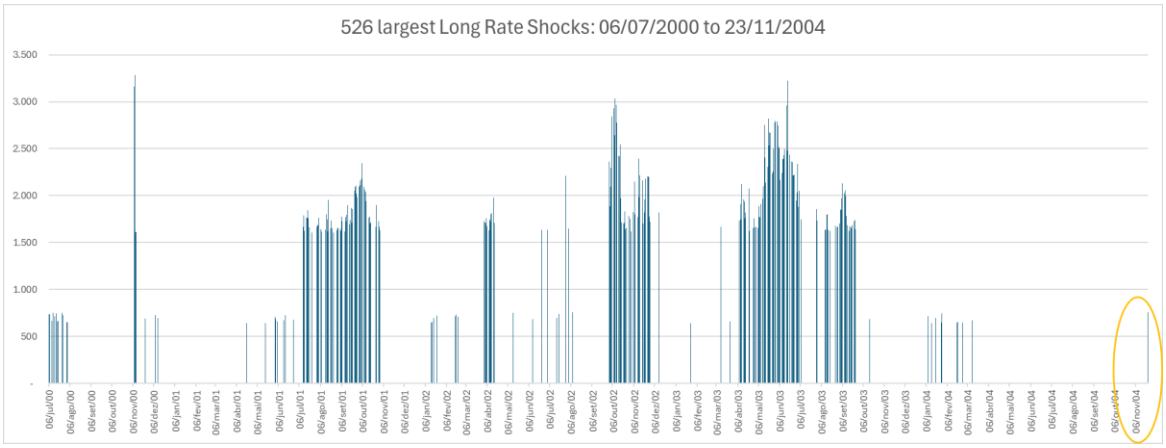
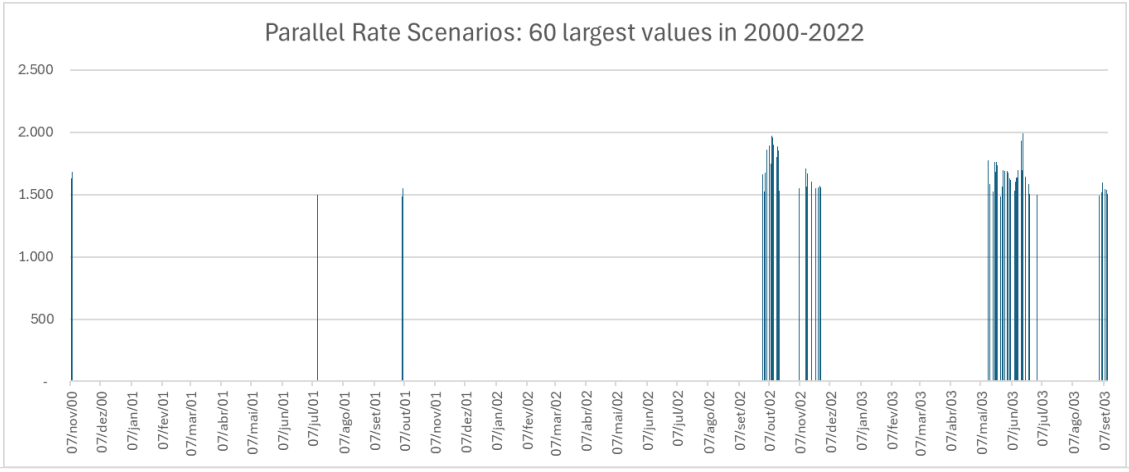
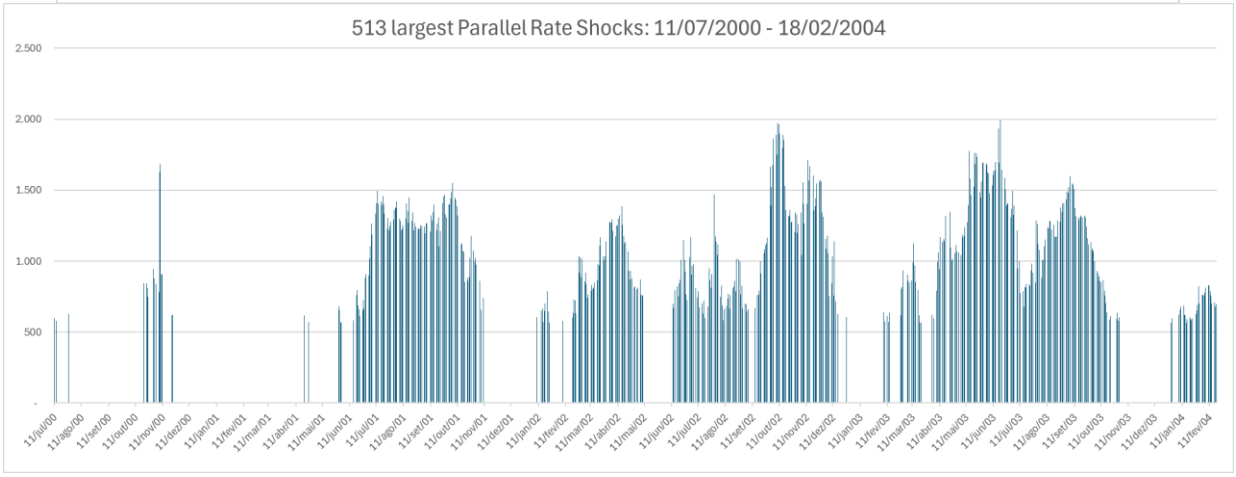


Parallel Shocks:





Data Analysis for the Historical Period from January 2009 to December 2022

As a proposal for the analysis period to be used to determine interest rate shocks, a period of 2 Economic Cycles can be considered, which is equivalent on average to a period of 14 years.

The following tables show the distribution of the highest values of interest rate changes, indicating the date of their occurrence and the value:

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20 largest positive Shocks - 2009-2022					
Date	Short Shock	Date	Long Shock	Date	Parallel Shock
28/out/21	604	22/jan/16	464	28/out/21	463
22/nov/21	601	21/jan/16	439	01/nov/21	446
23/nov/21	596	26/jan/16	429	29/out/21	441
24/nov/21	592	20/jan/16	421	26/out/21	430
01/nov/21	592	19/jan/16	410	27/out/21	426
25/nov/21	591	15/jan/16	394	04/nov/21	423
09/nov/21	591	30/dez/15	392	03/nov/21	420
08/nov/21	588	18/jan/16	391	05/nov/21	416
10/nov/21	588	22/dez/15	390	25/out/21	411
29/out/21	586	29/dez/15	389	08/nov/21	411
18/nov/21	586	21/dez/15	389	22/out/21	409
04/nov/21	585	27/jan/16	387	22/nov/21	404
19/nov/21	584	04/jan/16	386	09/nov/21	398
03/nov/21	584	14/jan/16	384	21/out/21	397
16/nov/21	583	23/set/15	382	25/nov/21	395
12/nov/21	581	23/dez/15	381	26/nov/21	391
17/nov/21	580	11/jan/16	375	29/nov/21	387
05/nov/21	577	28/dez/15	373	17/nov/21	387
26/nov/21	574	30/nov/15	372	16/nov/21	386
11/nov/21	574	13/jan/16	372	18/nov/21	386

20 smallest negative shocks - 2009-2022					
Date	Short Shock	Date	Long Shock	Date	Parallel Shock
02/jun/09	-493	07/mai/09	-461	26/mai/09	-470
01/jun/09	-497	20/jul/16	-461	01/jun/09	-473
04/jun/09	-497	22/jul/16	-467	29/abr/09	-473
03/jun/09	-497	21/jul/16	-467	12/mai/09	-473
15/mai/09	-499	25/mai/09	-470	07/mai/09	-486
05/mai/09	-499	27/jul/16	-471	11/mai/09	-490
25/mai/09	-499	25/jul/16	-471	25/mai/09	-494
13/mai/09	-499	13/mai/09	-477	13/mai/09	-494
07/mai/09	-501	28/abr/09	-477	22/mai/09	-500
19/mai/09	-502	05/mai/09	-480	15/mai/09	-501
18/mai/09	-502	22/mai/09	-484	05/mai/09	-502
22/mai/09	-503	14/mai/09	-490	19/mai/09	-508
08/mai/09	-503	15/mai/09	-491	14/mai/09	-509
11/mai/09	-504	21/mai/09	-492	08/mai/09	-509
14/mai/09	-511	08/mai/09	-495	20/mai/09	-510
20/mai/09	-511	20/mai/09	-496	21/mai/09	-510
28/abr/09	-515	19/mai/09	-500	28/abr/09	-511
21/mai/09	-518	18/mai/09	-508	18/mai/09	-514
04/mai/09	-528	30/abr/09	-534	04/mai/09	-560
30/abr/09	-561	04/mai/09	-550	30/abr/09	-563

Regarding the complete period, we can verify that:

- For the period from 2009 to 2022, the changes are much smaller:
  - Between 550 bps and 604 bps in the module for Short Shocks
  - Between 430 bps and 550 bps in the module for Long Shocks
  - Between 400 bps and 563 bps in the module for Parallel Shocks
- Concentration of dates
  - The largest Short Shocks (in module) are concentrated in November 2021
  - The largest Long Shocks are concentrated in May 2009 and July 2016
  - The largest Parallel Shocks are concentrated in May 2009 and October 2021

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The longer period, from 2000 to 2022, covers several outliers that are representative of situations that occurred more than 2 economic cycles ago and do not reflect the nature and size of the outliers observed since 2009.

Charts of temporal distributions of shocks:

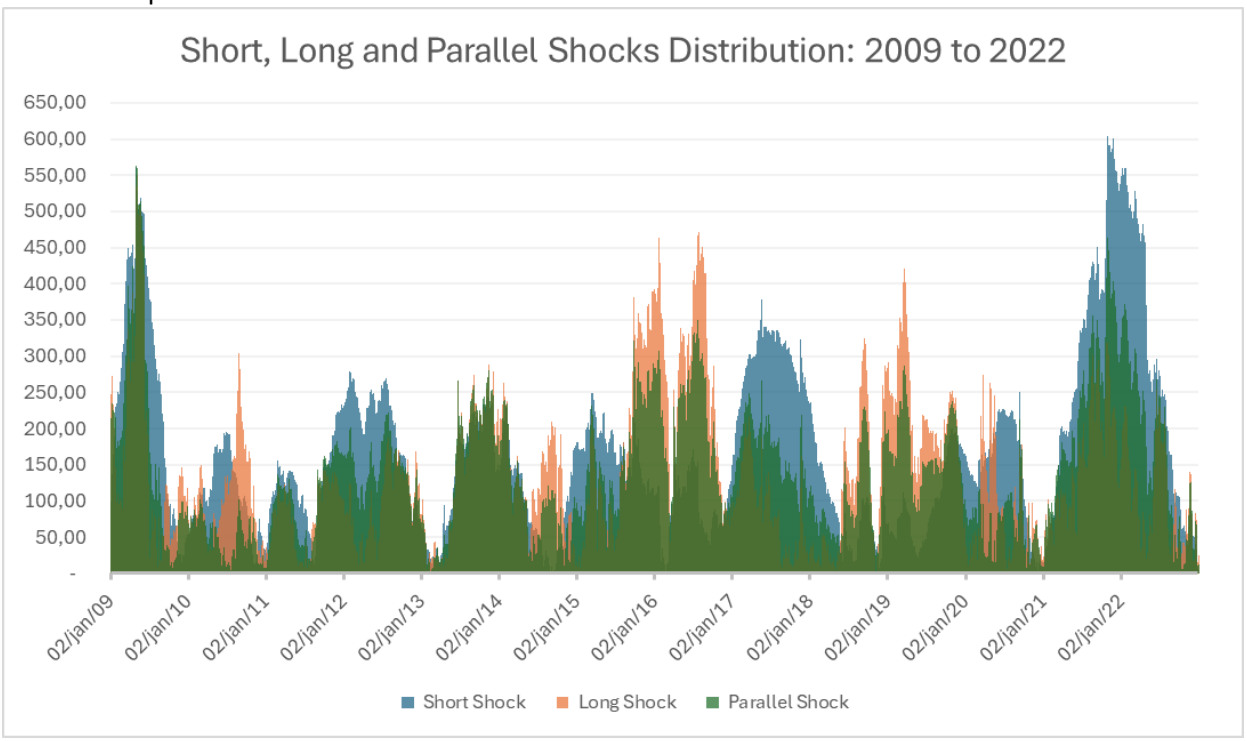
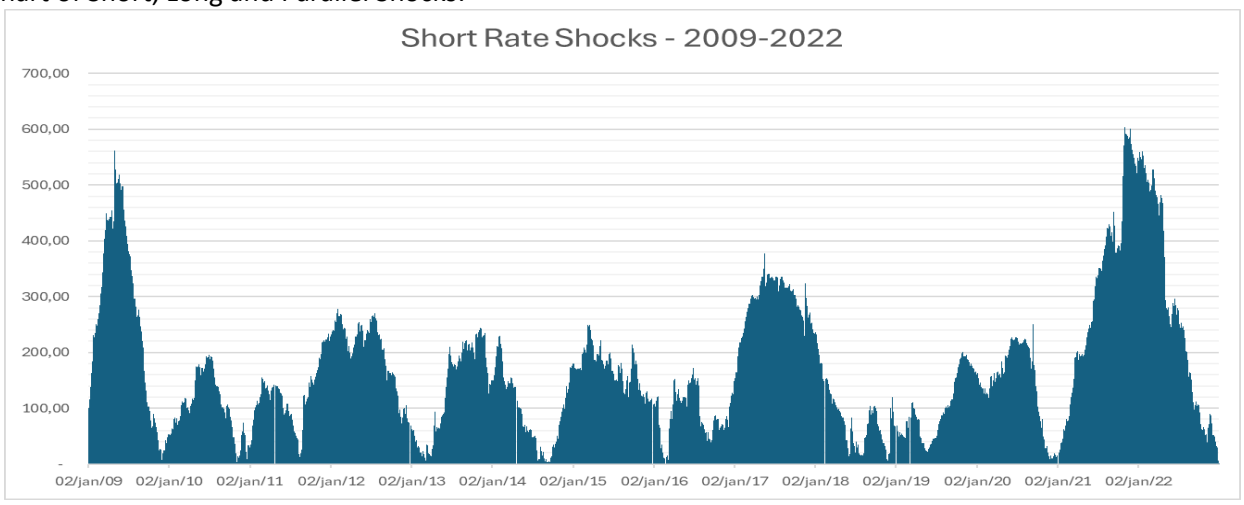


Chart of Short, Long and Parallel Shocks:



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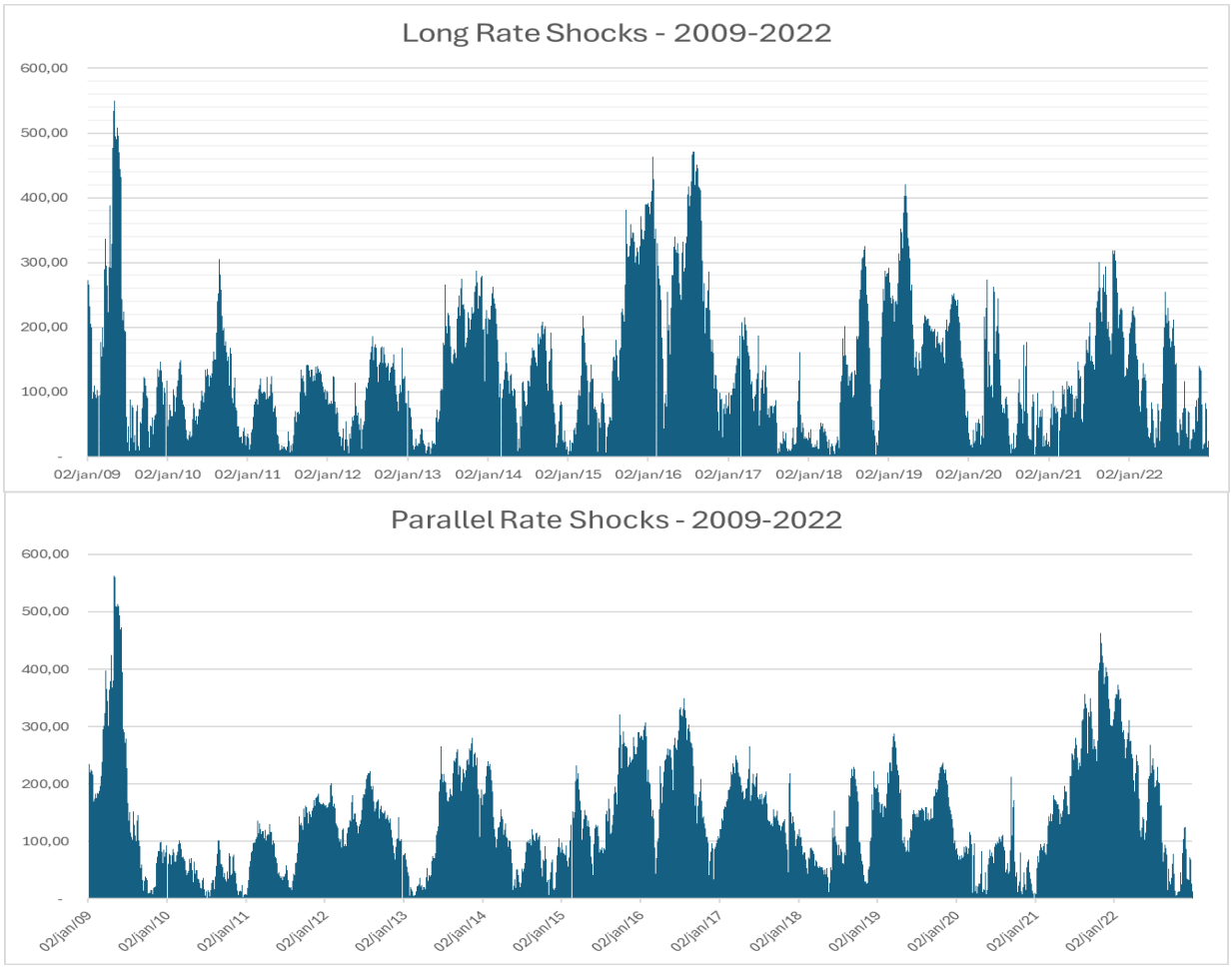
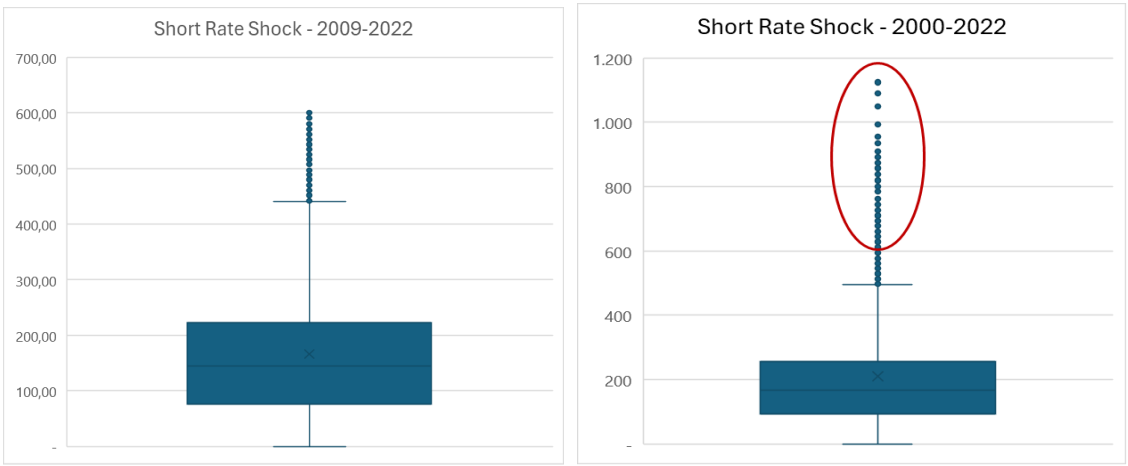


Next, we compare the profile of outliers for the two periods 2000-2022 and 2009-2022 by viewing the respective box plots, indicating very different behavior in the two periods.



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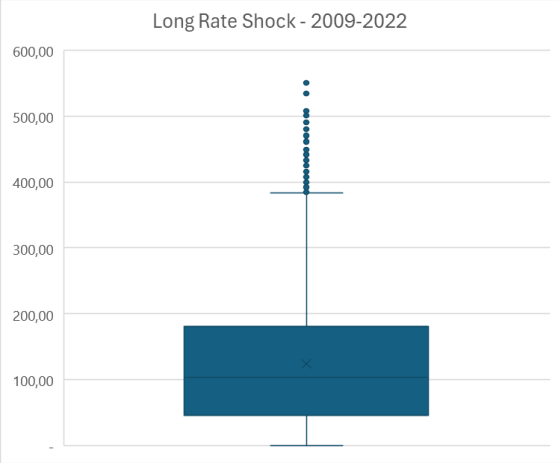

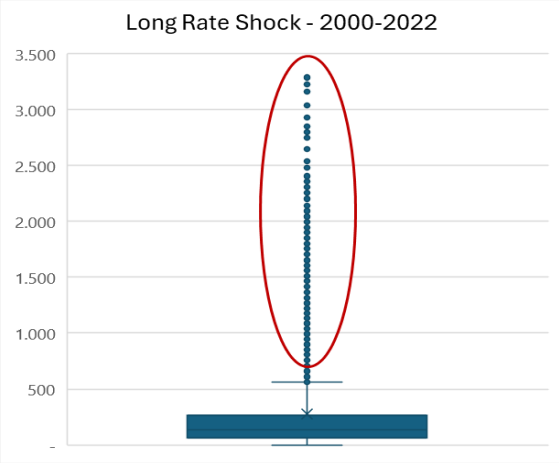

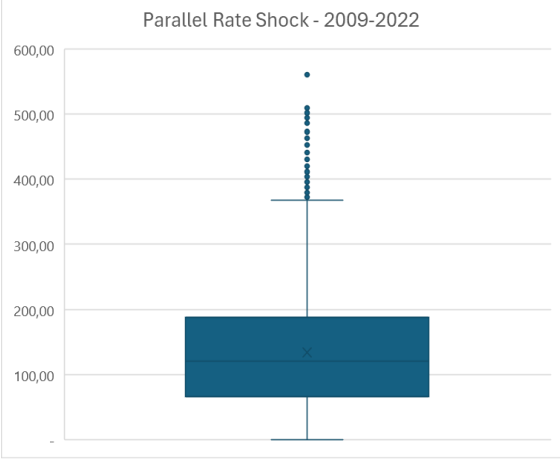

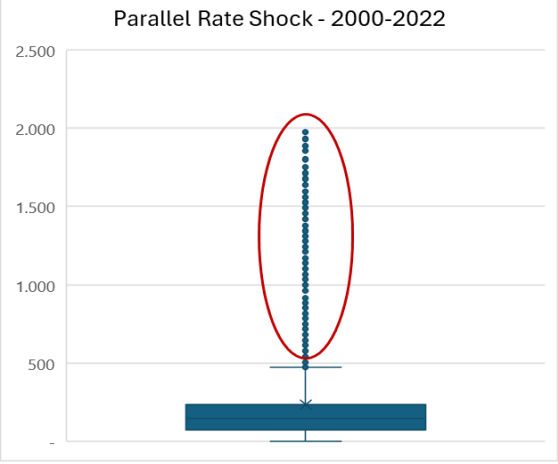

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APPENDIX 2

Interest Rate Shock: Fair-Value Perspective

Table 5
Interest Rate Shocks: Adjusted P&L

The table presents a set of statistical measures of interest rate shocks calculated using the Simple P&L methodology. The mnemonic names and other descriptions from table (1) apply here as well. All values are in basis points. The sample period spans from 02/Jan/2004 to 31/Dec/2022.

Vertex	Min	Max	Perc 0.1%	Perc 1%	Perc 99.9%	Perc 99%	Perc 99.9% Abs	ES 0.1%	ES 1%	ES 99.9%	ES 99%	ES 99.9% Abs	ES 99% Abs
3M	-	-	-	-	-	-	-	-	-	-	-	-	-
6M	(271)	112	(214)	(142)	106	69	117	(235)	(190)	110	85	235	190
1Y	(523)	240	(439)	(316)	224	204	248	(476)	(386)	232	215	476	386
2Y	(655)	385	(565)	(393)	337	272	394	(603)	(491)	352	308	603	491
5Y	(596)	418	(528)	(422)	373	311	394	(562)	(475)	395	345	563	475
7Y	(597)	427	(547)	(435)	386	320	462	(566)	(476)	408	355	566	476
10Y	(698)	434	(541)	(449)	396	329	467	(592)	(499)	419	364	592	499
15Y	(777)	443	(587)	(467)	403	337	482	(645)	(528)	430	372	645	527
20Y	(817)	448	(616)	(471)	405	339	491	(680)	(545)	433	375	680	545
All	(519)	312	(467)	(341)	278	240	467	(494)	(413)	297	261	494	413
10Y	(519)	312	(467)	(341)	278	240	467	(494)	(413)	297	261	494	413
5Y	(519)	312	(467)	(341)	278	240	467	(494)	(413)	297	261	494	413

Table 6
Interest Rate Shocks: Adjusted P&L

The table presents a set of statistical measures of interest rate shocks calculated using the Simple P&L methodology. The mnemonic names and other descriptions from table (1) apply here as well. All values are in basis points. The sample period spans from 02/Jan/2013 to 31/Dec/2022.

Vertex	Min	Max	Perc 0.1%	Perc 1%	Perc 99.9%	Perc 99%	Perc 99.9% Abs	ES 0.1%	ES 1%	ES 99.9%	ES 99%	ES 99.9% Abs	ES 99% Abs
3M	-	-	-	-	-	-	-	-	-	-	-	-	-
6M	(189)	112	(134)	(108)	110	69	134	(154)	(120)	111	88	154	120
1Y	(279)	240	(213)	(186)	230	212	234	(238)	(200)	236	221	252	224
2Y	(368)	385	(353)	(315)	343	304	360	(363)	(336)	362	326	372	344
5Y	(462)	418	(443)	(499)	382	338	443	(453)	(420)	403	360	453	421
7Y	(465)	427	(452)	(404)	389	344	452	(458)	(423)	412	367	458	424
10Y	(465)	429	(460)	(411)	397	352	460	(463)	(434)	418	373	463	435
15Y	(471)	440	(464)	(412)	404	358	464	(469)	(438)	430	382	469	440
20Y	(472)	442	(466)	(414)	407	360	466	(471)	(439)	432	384	471	441
All - M	(355)	312	(345)	(319)	294	253	345	(351)	(332)	303	269	351	332
10Y - M	(355)	312	(345)	(319)	294	253	345	(351)	(332)	303	269	351	332
5Y - M	(355)	312	(345)	(319)	294	253	345	(351)	(332)	303	269	351	332

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