

The Delphi Method and Scientific Research

*Juan Gaytán Cortés**Universidad de Guadalajara, México*

jgaytan@cucea.udg.mx

 <https://orcid.org/0000-0002-4388-0138>

Acceso abierto diamante

Science has evolved to think about space, time and the relations of subject and object, as a highly abstract regulatory idea and not just as a synonym for models and norms to be followed. The paths of science must guarantee all agreements, those based on procedures using philosophy and mathematical concepts for the explanation of reality (positivism) and also those based on principles to understand and interpret social phenomena in their reality, relationships, values, attitudes, beliefs, habits and representations.

Qualitative research deals with the level of reality that cannot or should not be quantified, it works with the universe of meanings, motives, aspirations, values and attitudes. This level of reality is not visible, it must be exposed by the researcher, (Minayo, 2009).

In the exact sciences, future events can be predicted objectively from existing explanations: explanation and prediction have the same logical structure. The future depends not only on the past, but also on the image of the future formed in the present by those who carry out actions. The Delphi method has been used for predictions in topics or areas that require the flexibility of well-informed human judgment, to process diverse and unstructured information.

The Delphi method has been used in various fields in defense, health, tourism, education, and business. Science in general requires a prediction methodology different from the one used to make explanations in the exact sciences, thus justifying the consideration of some methodological innovations for the realization of predictions, such as the systematic use of expert judgment, simulation processes and operational games.

The subjective judgment of experts in non-exact disciplines is justified in situations of uncertainty, when the problem is very complex, when the evidence is insufficient, unpublished, or when objective information is lacking (Jones & Hunter, 1995). The Delphi technique seeks to obtain the degree of consensus or agreement of specialists on the problem posed, using the results of previous research, instead of leaving the decision to a single professional, (Varela-Ruiz, Díaz-Bravo & García-Durán, 2012).

The Delphi method is classified as one of the general methods of foresight, which seeks to approach the consensus of a group of experts based on the analysis and reflection of a defined problem. (Varela-Ruiz, Díaz-Bravo & García-Durán, 2012). The defined problem is presented in a formal proposal that should include a brief description of the project, the objectives it pursues, the expected number of rounds, and the estimated time of the process, (Gordon, 1994).

The Delphi method has proven to be a robust method of scientific research despite some limitations and difficulties being discussed in the literature. The development and dissemination of the Delphi method has been growing and exponential, reaching an outstanding projection in different areas of knowledge, (Cabero & Infante, 2014; Maxey & Kezar, 2015).

The Delphi method is a qualitative technique, although there are authors who argue that it is mixed and others believe that in its final phase it is quantitative (Sekayi & Kennedy, 2017). The method allows you to

know the opinion of a group of experts, which is called a panel, addressing a specific problem in a structured way, the interaction between the different members is carried out through a questionnaire, (McMillan, King & Tully, 2016; Diamond, *et al.* 2014).

In the 1950s, in Santa Monica, United States, experts from the RAND Corporation, an acronym for Research and Development, sponsored by the U.S. Air Force in order to investigate the impact of technology on war, carried out the Delphi project, which consists of using the judgment of experts about specific events or topics. The name Delphi in English translation is Delphi, its name endorses its initial predictive use that alludes to the sanctuary of Apollo, a sacred and famous place, which functioned as an oracle, and where the fortune teller transmitted the answers of the god to the questions that were asked.

The results of the RAND research, presented in the report: On the epistemology of the inexact sciences, published by The Institute of Management Science, in which seven experts were asked about the future of the U.S. arsenal. The report concludes that prediction based on expert opinion is acceptable in disciplines that are not sufficiently developed to have scientific laws (Helmer & Rescher, 1959).

Methodological foundations of Delphi. The development of the Delphi method made its way into a landscape dominated by positivist thinking. The method must guarantee anonymity, establish an iterative process through feedback, and the group's response must be oriented towards a measure. The research carried out by Ernesto López-Gómez, (2018), mentions that the fundamental methodological parameters to be considered in its development are the following:

1. Selection and composition of the panel of experts
2. Number of experts
3. Panel Quality
4. Iterative process in rounds
5. The criteria of consensus and stability for the completion of the process

Selection and shaping. The selection and composition of the panel of experts guarantees the quality of the process and its results. The researcher must identify potential experts under inclusion criteria, since a random or unsubstantiated selection is not acceptable. The research problem and the very nature of the study condition the profile of the experts, specialists, or facilitators in the panel to be formed.

In the research carried out by Pill (1971), he mentions that in order to delimit the requirements and attributes, the possible expert candidate must have background, experience in the subject to be addressed and disposition. Steurer (2011) proposes nominating as experts those who have more than five publications on the chosen topic in a couple of journals during the last three years. However, authors such as Kennedy (2004) & Price (2005) consider it problematic to define an expert only as a specialist in his or her field, so it is also important to take into account practice-based knowledge and up-to-date experience.

Panel quality. Quality can be measured using different techniques, methods or procedures to estimate the level of expert knowledge (Landeta & Landeta Rodriguez, 1999; Blasco, López & Mengual, 2010), taking into account indirect indicators such as publications on the subject, citations received, years of experience, training, positions held, dedication and professional trajectory. The quality of the panel is justified based on the criteria applied in the process of selecting and forming experts. The group that makes up the panel endorses quality with the background of the experts, their professional training, the research carried out and the professional experience (López-Gómez, 2018).

Iterative process in rounds. The iterative process consists of the controlled exchange of information between the person applying the Delphi model and the experts who make up the panel. The iteration is organized in rounds, carrying out the study through interrogations through a questionnaire designed and elaborated, taking into account the object and objectives of the research. In most applications, the Delphi method is developed in two rounds, usually in three, and rarely in more, (Steurer, 2011).

Completion of the Delphi. The criteria for finalizing Delphi must consider the measure of consensus and stability in the panel's responses, which guide data analysis and decision-making. Consensus, in the study

carried out by Esther Martínez Piñero (2003), mentions that consensus responds to the philosophy of the technique itself, since its main objective is, precisely, the convergence between the opinions of the participants. In achieving consensus of expert opinions, there is no universal reference, however, in the research carried out by (Pozo, Gutiérrez & Rodríguez, 2007), the degree of convergence of individual estimates must coincide at a minimum of 80%.

The Internet and the Delphi Method. The use of the internet facilitates the application of the method, eliminating geographical distance, facilitating and allowing the participation of a greater number of experts, maintaining the anonymity of the participants, also, avoiding the influence of the answers of any member of the panel, in addition to being economical, (Humphrey-Murto, *et al.* 2017).

Economic and financial indicators are useful tools that benefit organizations by facilitating timely and appropriate decision-making in relation to their corporate and financial strategies.

Next, the evolution of some economic and financial indicators of the Mexican environment is described and shown to facilitate decision-making related to personal and business strategies in an integral manner.

1. National Consumer Price Index (INPC, Spanish)
2. The Price and Quotation Index of the Mexican Stock Exchange (IPC, Spanish)
3. Exchange rate
4. Equilibrium interbank interest rate (TIIE, Spanish)
5. CETES rate of return
6. Investment units (UDIS, Spanish)

1. NATIONAL CONSUMER PRICE INDEX (INPC)

Born in 1995 and reflecting changes in consumer prices, it measures the general increase in prices in the country. It is calculated fortnightly by the Bank of Mexico and INEGI (2021). INPC is published in the Official Gazette of the Federation on the 10th and 25th of each month. The reference period is the second half of July 2018.

Table 1

Accumulated inflation in the year (Base: 2nd. half of July 2018=100 with data provided by Banco de México)

Period	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
January	0.79	0.90	-0.09	0.38	1.70	0.53	0.09	0.48	0.86	0.59	0.76	0.89
February	1.46	1.15	0.09	0.82	2.29	0.91	0.06	0.90	1.50	1.43	1.24	0.99
March	1.99	1.43	0.51	0.97	2.92	1.24	0.44	0.85	2.34	2.43	1.51	1.28
April	1.81	1.24	0.25	0.65	3.04	0.90	0.50	-0.17	2.67	2.98	1.49	
May	0.95	0.91	-0.26	0.20	2.92	0.73	0.21	0.22	2.88	3.17	1.27	
June	1.12	1.09	-0.09	0.31	3.18	1.12	0.27	0.76	3.43	4.04	1.37	
July	1.14	1.42	0.06	0.57	3.57	1.66	0.65	1.43	4.04	4.81	1.86	
August	1.31	1.73	0.27	0.86	4.08	2.26	0.63	1.82	4.24	5.54	2.42	
September	1.61	2.18	0.27	1.47	4.41	2.69	0.89	2.06	4.88	6.19	2.88	
October	2.77	2.74	1.16	2.09	5.06	3.22	1.44	2.68	5.76	6.79	3.27	
November	4.57	3.57	1.71	2.89	6.15	4.10	2.26	2.76	6.97	7.41	3.93	
December	5.21	4.08	2.13	3.36	6.77	4.83	2.83	3.15	7.35	7.82	4.66	

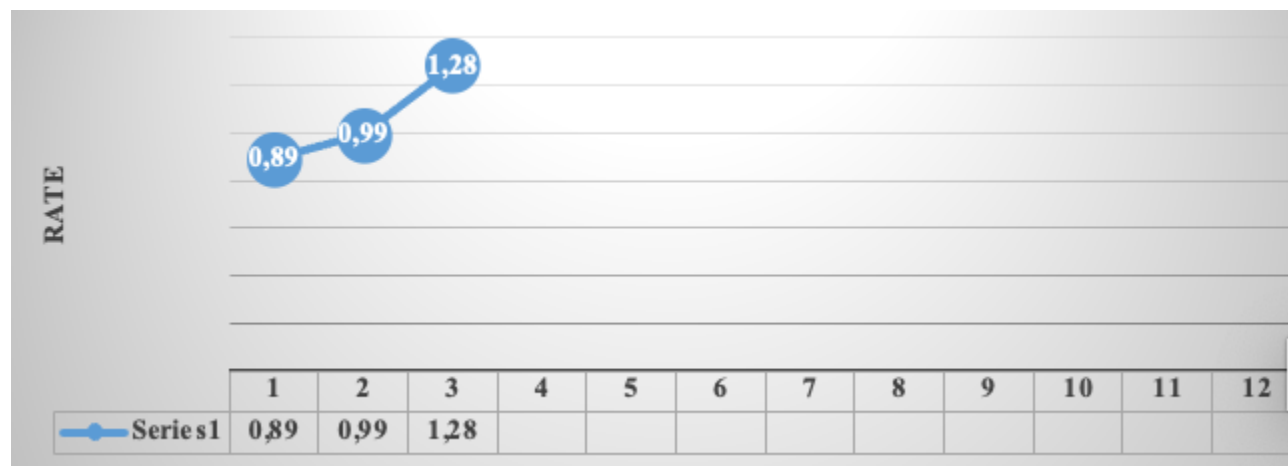
Source: Own elaboration (INEGI, 2024). Route: Indicadores económicos de coyuntura > Índices de precios > Índice nacional de precios al consumidor. Base segunda quincena de julio de 2018=100 > Mensual > Índice > Índice general



Graph 11

Investment units 2013-2023 (At the end of the year)

Source: Own elaboration (BANXICO, 2024). <https://www.banxico.org.mx/SieInternet/consultarDirectorioInternetAction.do?accion=consultarCuadro&idCuadro=CP150&locale=es>



Graph 2

Inflation in Mexico (accumulated January-March 2024)

Source: Own elaboration (INEGI, 2024). Route: Indicadores económicos de coyuntura > Índices de precios > Índice nacional de precios al consumidor. Base segunda quincena de julio de 2018=100 > Mensual > Índice > Índice general

2. THE PRICE AND QUOTATION INDEX OF THE MEXICAN STOCK EXCHANGE (IPC)

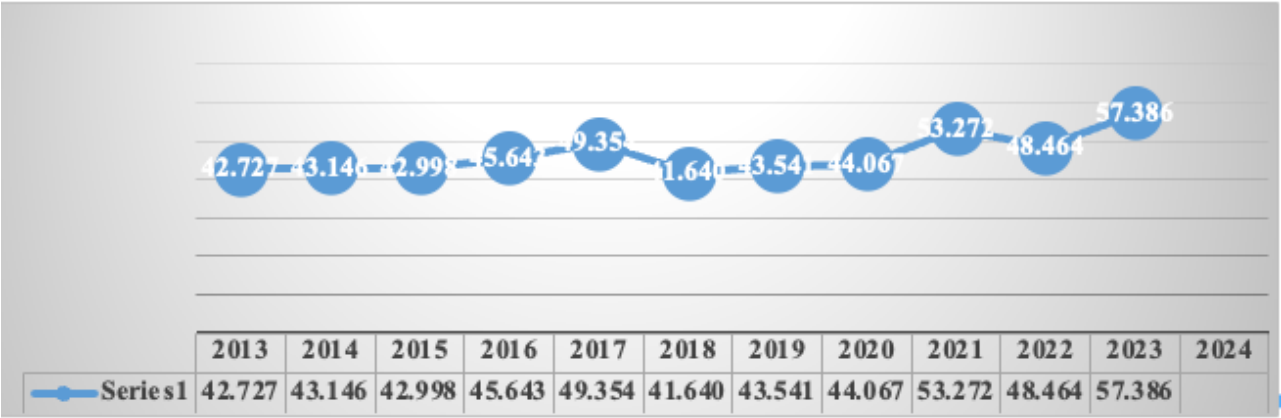
Represents the change in the values traded on the Mexican Stock Exchange concerning the previous day to determine the percentage of rising or falling of the most representative shares of the companies listed therein.

Table 2

The Price and Quotation Index of the Mexican Stock Exchange (Base: October 1978, 0.78=100)

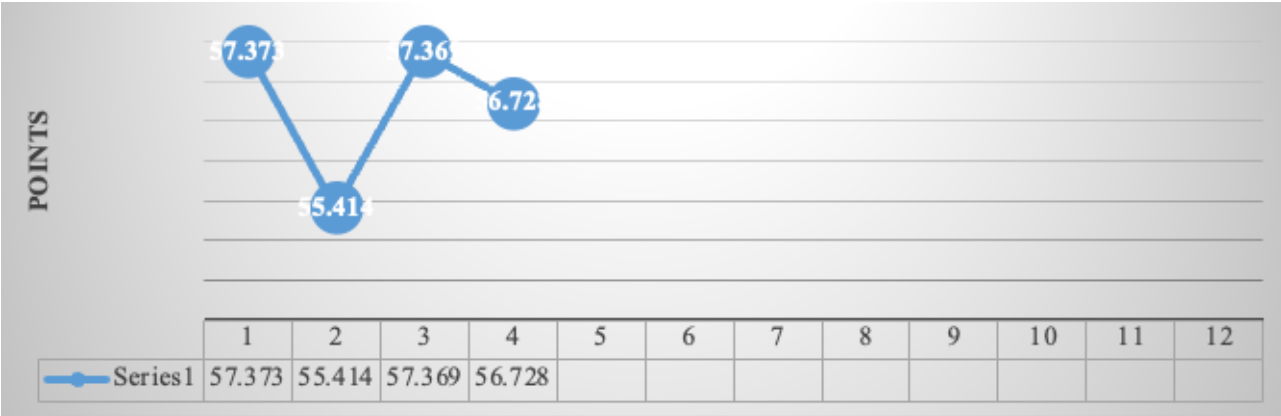
Period	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
January	45,278	40,879	40,951	43,631	47,001	50,456	43,988	44,862	42,986	51,331	54,564	57,373
February	44,121	38,783	44,190	43,715	46,857	47,438	42,824	41,324	44,593	53,401	52,758	55,414
March	44,077	40,462	43,725	45,881	48,542	46,125	43,281	34,554	47,246	56,537	53,904	57,369
April	42,263	40,712	44,582	45,785	49,261	48,354	44,597	36,470	48,010	51,418	55,121	56,728
May	41,588	41,363	44,704	45,459	48,788	44,663	42,749	36,122	50,886	51,753	52,736	
June	40,623	42,737	45,054	45,966	49,857	47,663	43,161	37,716	50,290	47,524	53,526	
July	40,838	43,818	44,753	46,661	51,012	49,698	40,863	37,020	50,868	48,144	54,819	
August	39,492	45,628	43,722	47,541	51,210	49,548	42,623	36,841	53,305	44,919	53,021	
September	40,185	44,986	42,633	47,246	50,346	49,504	43,011	37,459	51,386	44,627	50,875	
October	41,039	45,028	44,543	48,009	48,626	43,943	43,337	36,988	51,310	49,922	49,062	
November	42,499	44,190	43,419	45,286	47,092	41,733	42,820	41,779	49,699	51,685	54,060	
December	42,727	43,146	42,998	45,643	49,354	41,640	43,541	44,067	53,272	48,464	57,386	

Source: Own elaboration (BANXICO, 2024). <https://www.banxico.org.mx/SieInternet/consultarDirectorioInternetAction.do?sector=7&accion=consultarCuadro&idCuadro=CF57&locale=es>



Graph 3

The Price and Quotation Index of the Mexican Stock Exchange, 2013 - 2023 (Score at the end of each year)
Source: Own elaboration (BANXICO, 2024). <https://www.banxico.org.mx/SieInternet/consultarDirectorioInternetAction.do?sector=7&accion=consultarCuadro&idCuadro=CF57&locale=es>



Graph 4

The Price and Quotation Index of the Mexican Stock Exchange, January-April 2024 (Score at the end of each month)
Source: Own elaboration (BANXICO, 2024). <https://www.banxico.org.mx/SieInternet/consultarDirectorioInternetAction.do?sector=7&accion=consultarCuadro&idCuadro=CF57&locale=es>

3. EXCHANGE RATE

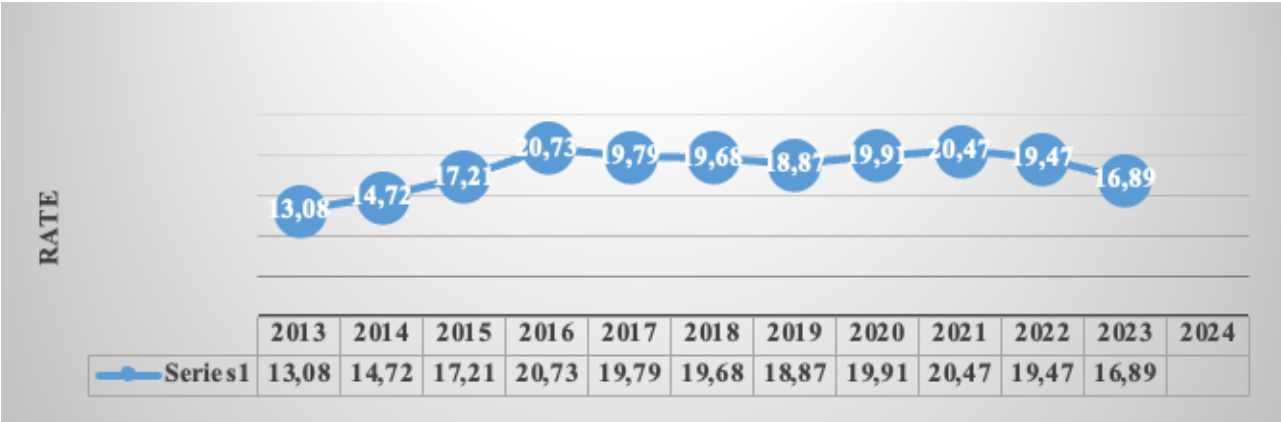
It is the value of the Mexican peso concerning the dollar calculated with the daily average of the five most important banks in the country, which reflects the spot price (cash), negotiated between banks. It is highly related to Inflation, the interest rate, and the Mexican Stock Exchange.

Table 3
Exchange rate (National currency per US dollar, parity at the end of each period)

Period	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
January	12.71	13.37	14.69	18.45	21.02	18.62	19.04	18.91	20.22	20.74	18.79	17.23
February	12.87	13.30	14.92	18.17	19.83	18.65	19.26	19.78	20.94	20.65	18.40	17.06
March	12.36	13.08	15.15	17.40	18.81	18.33	19.38	23.48	20.44	19.99	18.11	16.68
April	12.16	13.14	15.22	19.40	19.11	18.86	19.01	23.93	20.18	20.57	18.07	17.16
May	12.63	12.87	15.36	18.45	18.51	19.75	19.64	22.18	19.92	19.69	17.56	
June	13.19	13.03	15.57	18.91	17.90	20.06	19.21	23.09	19.91	20.13	17.07	
July	12.73	13.06	16.21	18.86	17.69	18.55	19.99	22.20	19.85	20.34	16.73	
August	13.25	13.08	16.89	18.58	17.88	19.07	20.07	21.89	20.06	20.09	16.84	
September	13.01	13.45	17.01	19.50	18.13	18.90	19.68	22.14	20.56	20.09	17.62	
October	12.89	13.42	16.45	18.84	19.15	19.80	19.16	21.25	20.53	19.82	18.08	
November	13.09	13.72	16.55	20.55	18.58	20.41	19.61	20.14	21.45	19.40	17.14	
December	13.08	14.72	17.21	20.73	19.79	19.68	18.87	19.91	20.47	19.47	16.89	

Source: Own elaboration (BANXICO, 2024). <https://www.banxico.org.mx/SieInternet/consultarDirectorioInternetAction.do?sector=6&accion=consultarCuadro&idCuadro=CF102&locale=es>

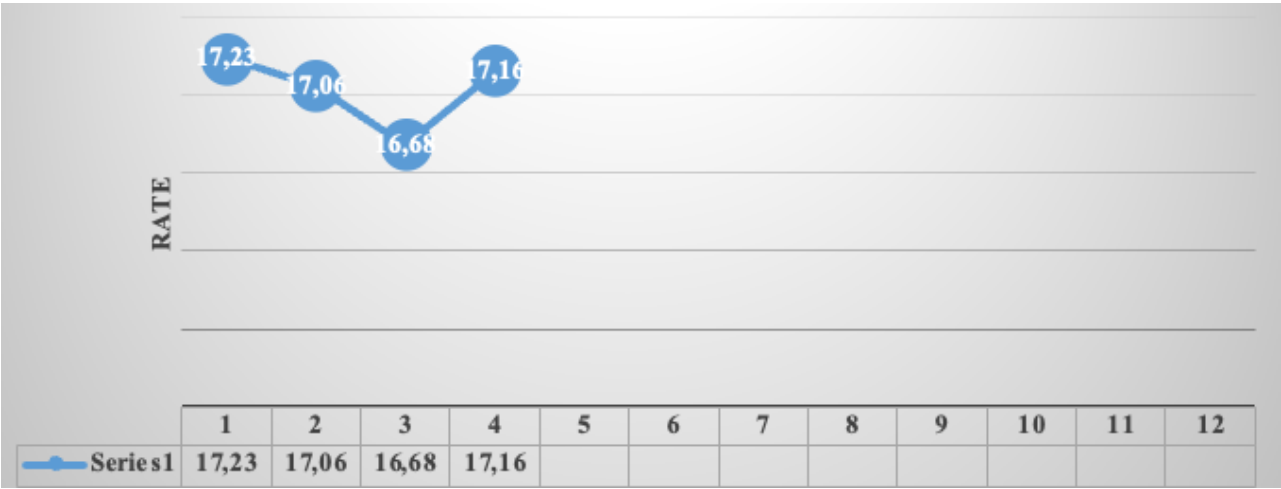
NOTE: Exchange rate FIX by The Banco de México, used for settling obligations denominated in foreign currency. Quote at the end



Graph 5

Exchange rate (National currency per US dollar, 2013-2024, (FIX parity at the end of each year)

Source: Own elaboration (BANXICO, 2024). <https://www.banxico.org.mx/SieInternet/consultarDirectorioInternetAction.do?sector=6&accion=consultarCuadro&idCuadro=CF102&locale=es>



Graph 6

Exchange rate (National currency per US dollar, January-April 2024, FIX parity at the end of each month)

Source: Own elaboration (BANXICO, 2024). <https://www.banxico.org.mx/SieInternet/consultarDirectorioInternetAction.do?sector=6&accion=consultarCuadro&idCuadro=CF102&locale=es>

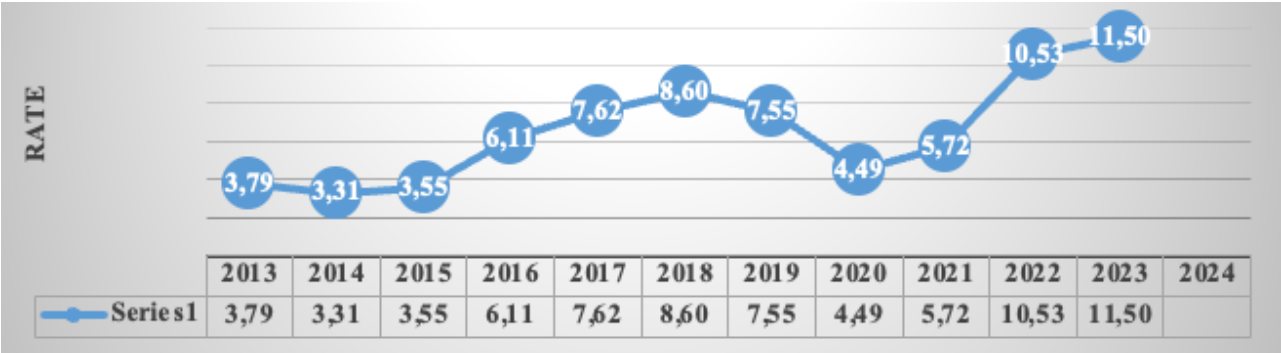
4. EQUILIBRIUM INTERBANK INTEREST RATE (TIEE)

On March 23, 1995, the Bank of Mexico, to establish an interbank interest rate that better reflects market conditions, released the Interbank Equilibrium Interest Rate through the Official Gazette of the Federation.

Table 4
Equilibrium interbank interest rate (28-day quote)

Period	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
January	4.84	3.78	3.29	3.56	6.15	7.66	8.59	7.50	4.47	5.72	10.82	11.50
February	4.80	3.79	3.29	4.05	6.61	7.83	8.54	7.29	4.36	6.02	11.27	11.50
March	4.35	3.81	3.30	4.07	6.68	7.85	8.51	6.74	4.28	6.33	11.43	11.44
April	4.33	3.80	3.30	4.07	6.89	7.85	8.50	6.25	4.28	6.73	11.54	11.25
May	4.30	3.79	3.30	4.10	7.15	7.86	8.51	5.74	4.29	7.01	11.51	
June	4.31	3.31	3.30	4.11	7.36	8.10	8.49	5.28	4.32	7.42	11.49	
July	4.32	3.31	3.31	4.59	7.38	8.11	8.47	5.19	4.52	8.04	11.51	
August	4.30	3.30	3.33	4.60	7.38	8.10	8.26	4.76	4.65	8.50	11.51	
September	4.03	3.29	3.33	4.67	7.38	8.12	8.04	4.55	4.75	8.89	11.50	
October	3.78	3.28	3.30	5.11	7.38	8.15	7.97	4.51	4.98	9.56	11.50	
November	3.80	3.31	3.32	5.57	7.39	8.34	7.78	4.48	5.13	10.00	11.50	
December	3.79	3.31	3.55	6.11	7.62	8.60	7.55	4.49	5.72	10.53	11.50	

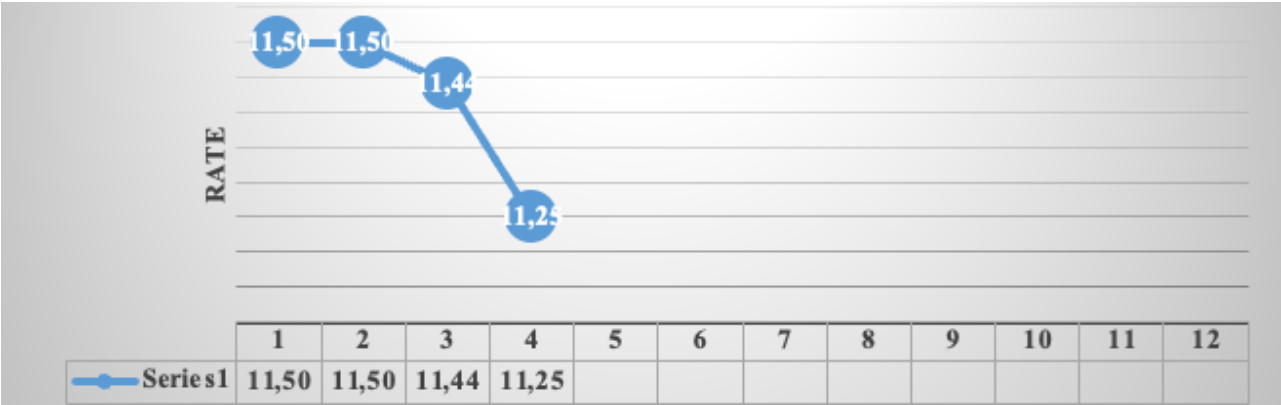
Source: Own elaboration (BANXICO, 2024). https://www.banxico.org.mx/SieInternet/consultarDirectorioInternetAction.do?sector=18&accion=c_onsultarCuadro&idCuadro=CF101&locale=es



Graph 7

Equilibrium interbank interest rate, 2013- 2023 (at the end of each year)

Source: Own elaboration (BANXICO, 2024). https://www.banxico.org.mx/SieInternet/consultarDirectorioInternetAction.do?sector=18&accion=c_onsultarCuadro&idCuadro=CF101&locale=es



Graph 8

Equilibrium interbank interest rate, January-April 2024 (28-day quote)

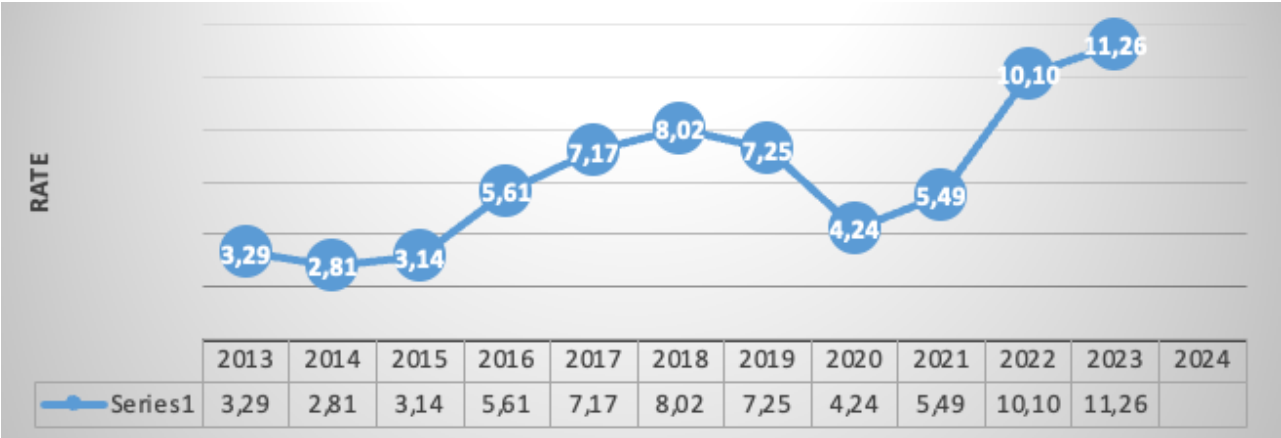
Source: Own elaboration (BANXICO, 2024). https://www.banxico.org.mx/SieInternet/consultarDirectorioInternetAction.do?sector=18&accion=c_onsultarCuadro&idCuadro=CF101&locale=es

5. CETES RATE OF RETURN

Table 5
CETES rate of return (28-day)

Period	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
January	4.15	3.14	2.67	3.08	5.83	7.25	7.95	7.04	4.22	5.50	10.80	11.28
February	4.19	3.16	2.81	3.36	6.06	7.40	7.93	6.91	4.02	5.94	11.04	11.00
March	3.98	3.17	3.04	3.80	6.32	7.47	8.02	6.59	4.08	6.52	11.34	10.90
April	3.82	3.23	2.97	3.74	6.50	7.46	7.78	5.84	4.06	6.68	11.27	11.04
May	3.72	3.28	2.98	3.81	6.56	7.51	8.07	5.38	4.07	6.90	11.25	
June	3.78	3.02	2.96	3.81	6.82	7.64	8.18	4.85	4.03	7.56	11.02	
July	3.85	2.83	2.99	4.21	6.99	7.73	8.15	4.63	4.35	8.05	11.09	
August	3.84	2.77	3.04	4.24	6.94	7.73	7.87	4.50	4.49	8.35	11.07	
September	3.64	2.83	3.10	4.28	6.99	7.69	7.61	4.25	4.69	9.25	11.05	
October	3.39	2.90	3.02	4.69	7.03	7.69	7.62	4.22	4.93	9.00	11.26	
November	3.39	2.85	3.02	5.15	7.02	7.83	7.46	4.28	5.05	9.70	11.78	
December	3.29	2.81	3.14	5.61	7.17	8.02	7.25	4.24	5.49	10.10	11.26	

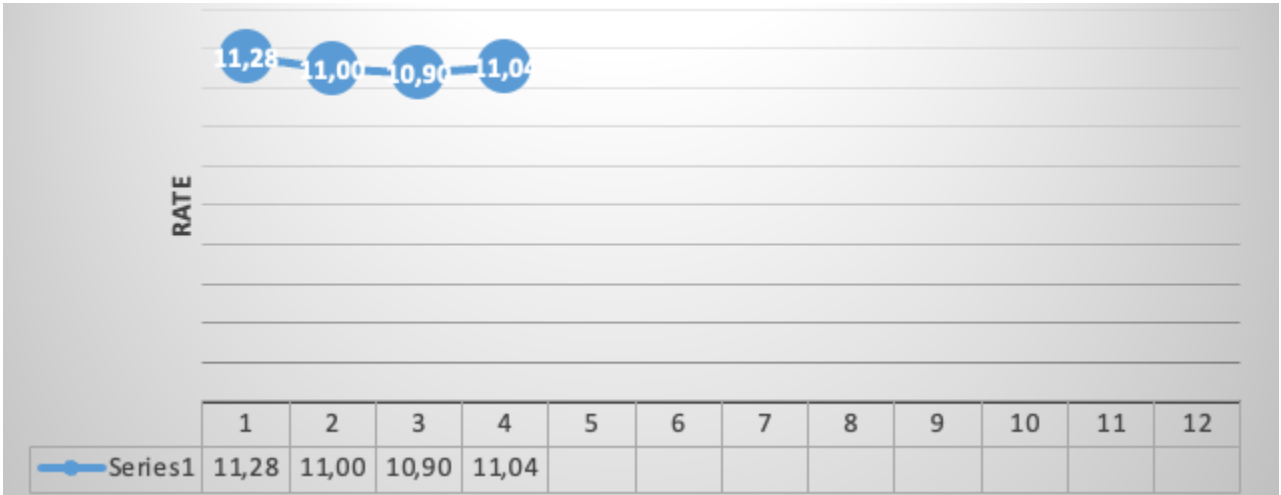
Source: Own elaboration (BANXICO, 2024). <https://www.banxico.org.mx/SieInternet/consultarDirectorioInternetAction.do?sector=22&accion=consultarCuadro&idCuadro=CF107&locale=es>



Graph 9

CETES rate of return 2013- 2023 (at the end of each year)

Source: Own elaboration (BANXICO, 2024). <https://www.banxico.org.mx/SieInternet/consultarDirectorioInternetAction.do?sector=22&accion=consultarCuadro&idCuadro=CF107&locale=es>



Graph 10

CETES rate of return, January-April 2024 (at the end of each month)

Source: Own elaboration (BANXICO, 2024). <https://www.banxico.org.mx/SieInternet/consultarDirectorioInternetAction.do?sector=22&accion=consultarCuadro&idCuadro=CF107&locale=es>

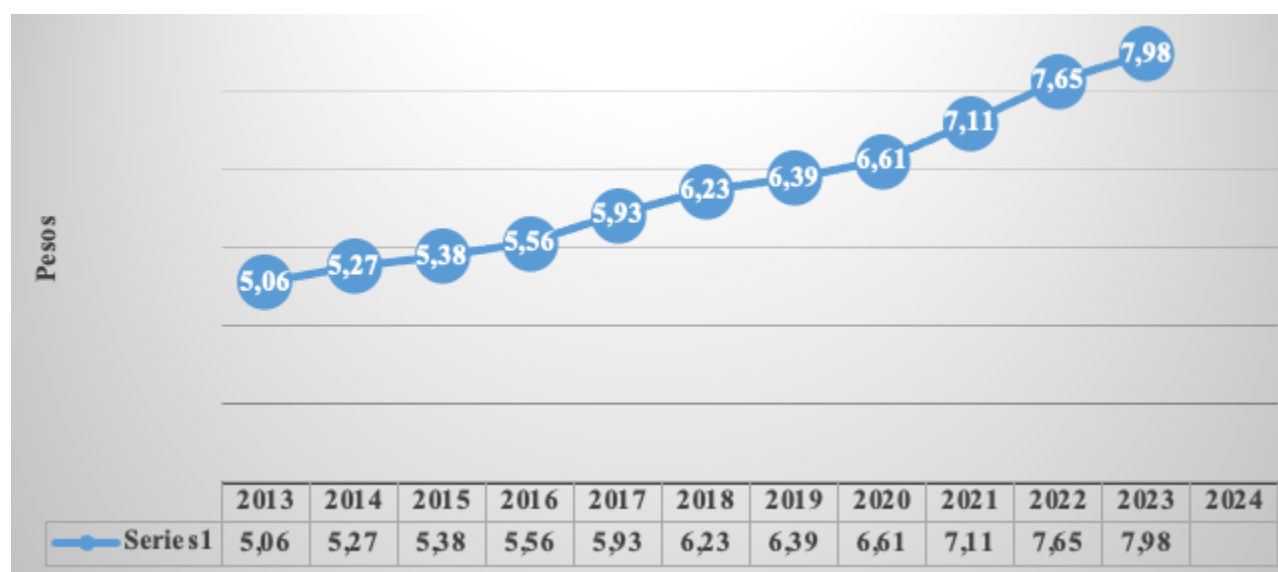
6. INVESTMENT UNITS (UDIS)

The UDI is a unit of account of constant real value to denominate credit titles. It does not apply to checks, commercial contracts, or other acts of commerce.

Table 6
Investment units (value concerning pesos)

Period	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
January	4.89	5.10	5.29	5.41	5.62	5.97	6.25	6.44	6.64	7.12	7.69	8.06
February	4.92	5.13	5.29	5.43	5.69	6.00	6.25	6.46	6.70	7.18	7.74	8.11
March	4.94	5.15	5.30	5.44	5.71	6.02	6.26	6.49	6.75	7.24	7.77	8.11
April	4.97	5.15	5.32	5.45	5.75	6.03	6.28	6.43	6.79	7.31	7.78	8.13
May	4.96	5.13	5.29	5.42	5.75	6.01	6.27	6.42	6.81	7.33	7.78	
June	4.95	5.13	5.28	5.42	5.75	6.01	6.26	6.44	6.83	7.36	7.77	
July	4.95	5.14	5.28	5.42	5.76	6.04	6.27	6.49	6.87	7.43	7.79	
August	4.95	5.16	5.29	5.44	5.79	6.07	6.29	6.52	6.90	7.47	7.83	
Sep.	4.97	5.18	5.31	5.45	5.82	6.11	6.29	6.55	6.92	7.53	7.87	
Oct.	4.99	5.20	5.33	5.49	5.84	6.13	6.31	6.57	6.97	7.57	7.90	
Nov.	5.02	5.23	5.36	5.53	5.89	6.17	6.35	6.60	7.04	7.62	7.94	
Dec.	5.06	5.27	5.38	5.56	5.93	6.23	6.39	6.61	7.11	7.65	7.98	

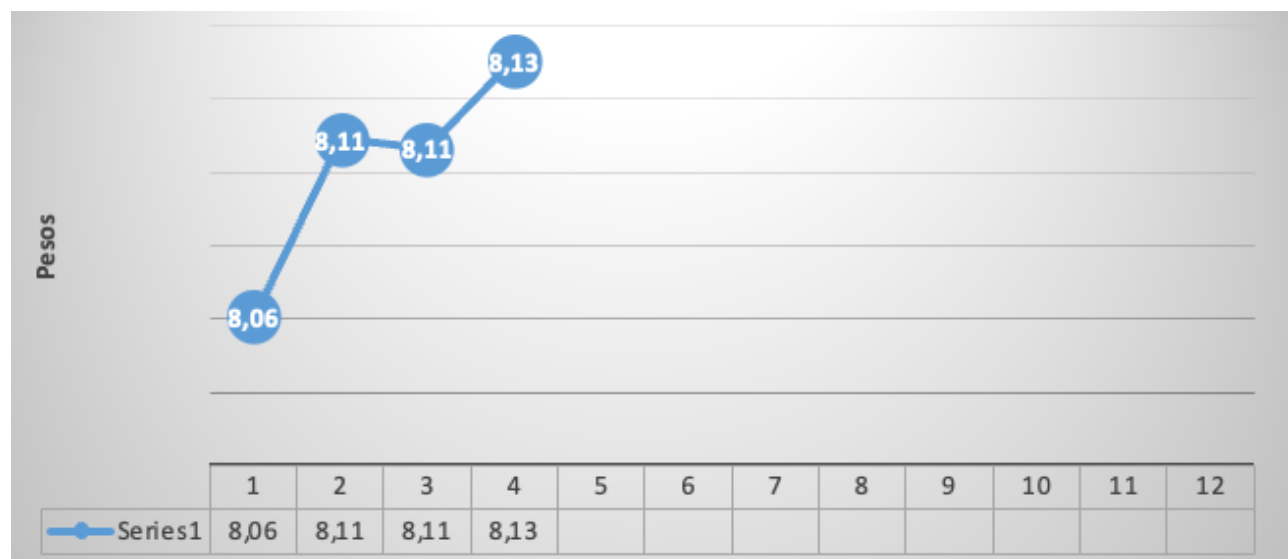
Source: Own elaboration (BANXICO, 2024). <https://www.banxico.org.mx/SieInternet/consultarDirectorioInternetAction.do?accion=consultarCua dro&idCuadro=CP150&locale=es>



Graph 11

Investment units 2013-2023 (At the end of the year)

Source: Own elaboration (BANXICO, 2024). <https://www.banxico.org.mx/SieInternet/consultarDirectorioInternetAction.do?accion=consultarCua dro&idCuadro=CP150&locale=es>



Graph 12

Investment units, January-April 2024

Source: Own elaboration (BANXICO, 2024). <https://www.banxico.org.mx/SieInternet/consultarDirectorioInternetAction.do?accion=consultarCuadro&idCuadro=CP150&locale=es>

The Delphi method has not achieved a standardized consensus on its definitions, nor on the presentation of the final reports. In this method, as in all research methods, the results obtained depend to a large extent on its approach, the adequate review of the literature and the experience of the experts on the panel, which together with the systematization and adequate application of the process, as a whole, allow obtaining a product that facilitates the understanding and interpretation of social phenomena in their reality. relationships, values, attitudes, beliefs, habits, and representations, which cannot be obtained through traditional research methods.

In the social sciences, particularly in business, the application of the Delphi method makes it possible to analyze and carry out prospections that reflect the viability of the company's growth, as well as the trends of the sector to which it belongs and the evolution of its market, managing to anticipate the needs of its customers, allowing them to make better decisions and establishing measures according to the probable future scenarios.

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