

Exploring Across-the-Curve Credit Spread Indices (MXAXI) and Financial Intermediation (MXFXI) for Mexico

Julio A. Cacho-Díaz¹

Quantor Capital and Rice University

José Carlos Rodríguez Pueblita²

IPADE Business School and Quantor Advisors

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This paper establishes the across-the-curve credit spread indices (MXAXI) tailored for the Mexican market and the Financial Condition Credit Spread Index (MXFXI), accounting for specific features of the Mexican corporate bond market. These indices capture the average funding expenses incurred by major Mexican commercial banks and corporations, respectively, and are to be used as benchmarks for credit pricing, risk management, and assessing the financial system's health. Following the approach outlined by Berndt, Duffie, and Zhu (2023), we formulate the long-term credit spread indices by amalgamating credit spreads from bonds with varying maturities issued by Mexican commercial banks. The weights assigned to these spreads account for issuance volumes. The short-term MXAXI index is computed from a mix of short-term funding instruments used by the banking sector in Mexico; the result is compared with the spread of government bonds and the alternative TIIE-28 rate published by Banco de Mexico. This comparison is pertinent as clearing houses and dealers have been preparing to transition away from the 28-plus day TIIE, following a directive from the Mexican central bank banning its use in swap trades starting in 2025.

¹ Julio A. Cacho-Díaz, Lecturer, Department of Economics, Rice University.

Email: julio@quantorcapital.com Webpage: <https://profiles.rice.edu/staff/julio-cacho-diaz>

² José Carlos Rodríguez Pueblita, Department of Business Economics, IPADE Business School.

Email: jcpueblita@ipade.mx Webpage: https://www.ipade.mx/en/faculty/?_sft_academic_area=economic-environment

Introduction

The London Interbank Offered Rate (LIBOR) was a widely used benchmark interest rate, intended to reflect the average interest rates at which major London banks could borrow from each other (Snider and Youle, 2010). However, concerns arose about its reliability and susceptibility to manipulation. Consequently, global authorities decided to phase out LIBOR in favor of alternative reference rates more grounded in observable transactions.

The shift from LIBOR was prompted by several factors. First, LIBOR's determination relied on banks' judgments rather than actual market transactions, diminishing its representativeness as interbank lending declined. Second, revelations of manipulation undermined confidence in LIBOR's integrity. Third, international standard-setting bodies, including the Financial Stability Board (FSB) and the International Organization of Securities Commissions (IOSCO), advocated for more robust and transparent reference rates.

The replacement reference rates in various markets include the Secured Overnight Financing Rate (SOFR) for USD in the United States, the Euro Short-Term Rate (€STR) for the Eurozone, the Sterling Overnight Index Average (SONIA) for GBP in the United Kingdom, and the Tokyo Overnight Average Rate (TONAR) for the Japanese yen, among others³. In Mexico, the central bank has “promoted the use and development of the Overnight Interbank Equilibrium Interest Rate (TIEF)”⁴.

These new rates, generally based on overnight secured or unsecured transactions in their respective repo markets, offer a more transparent and objective basis for interest rate benchmarks. Market participants are actively transitioning contracts tied to LIBOR to these new reference rates, updating legal agreements, systems, and practices in line with LIBOR's discontinuation. The transition presents

³ Liu et al (2021).

⁴ <https://www.banxico.org.mx/markets/mexican-alternative-reference-rates-working-group/d/%7B2D6F5896-CF86-3F28-0C02-98D17B7542B9%7D.pdf>

challenges in applying these rates to broader credit pricing. Key challenges and considerations include:

1. Basis Risk: New benchmark variants introduce risk.
2. Credit Spread Adjustments: Transitioning to risk-free rates necessitates considering credit spread adjustments to account for changes in risk profiles.
3. Market Liquidity: Sufficient liquidity in new benchmark rates and related derivatives markets is essential.
4. Contractual Conventions: Adapting legacy contracts to new conventions poses challenges.
5. Fallback Language: Financial contracts referencing LIBOR require reviewing and possibly amending fallback language.
6. System and Infrastructure Changes: Significant updates are needed in financial systems and infrastructures.
7. Educating Market Participants: Education efforts are crucial for a smooth transition.
8. Global Coordination: International collaboration is essential to minimize fragmentation.

Regulatory bodies, industry groups, and financial institutions are addressing these challenges by developing best practices and guidelines. In Mexico, the Working Group on Alternative Reference Rates (GTTR⁵, coordinated by the Bank of Mexico, facilitates discussions among market participants to promote the adoption of alternative rates like the Overnight Interbank Funding Equilibrium Interest Rate (TIIEF) across various financial instruments. The goal is to establish a robust framework for using risk-free rates in broader credit pricing and ensure an orderly transition from LIBOR.

⁵ <https://www.banxico.org.mx/markets/mexican-alternative-referen.html>

AXI and FXI

US-dollar versions of the AXI (Across-the-Curve Credit Spread Index) and its extension, the Financial Conditions Credit Spread Index (FXI), were launched in 2022 in response to major US banks seeking a SOFR-based lending method.⁶ This method needed to accurately measure assets and liabilities, especially during times of market stress, considering the transition away from LIBOR. The benchmark credit spreads, AXI and FXI, represent a calculated average of credit spreads derived from unsecured funding transactions of US banks and corporations, respectively, spanning overnight to five years. The weights assigned to these spreads consider both transaction volumes and issuances. AXI complements SOFR (and SOFR variants), forming “a credit-sensitive interest rate benchmark” applicable to loans, derivatives, and various financial products for short, medium, and long-term transactions⁷. Its computation involves a substantial dataset of market transactions, ensuring its suitability for underpinning actively traded derivatives instruments used by banks and borrowers to hedge floating-rate exposures, with minimal “risk of statistical corruption or manipulation”⁸. Other countries, such as China (Li et al., 2022), Japan (Okimoto and Takaota, 2023), and the Eurozone (Saroyan and Cont, 2023), have developed their own versions of across-the-curve credit spread and financial conditions credit spread indexes, tailored to the features of their domestic corporate bond markets. These indices could potentially serve as benchmark credit spreads in their respective markets, in line with the Principles for Financial Benchmarks of the International Organization of Securities Commissions (IOSCO) published in July 2013 (IOSCO, 2013).

About the Mexican Bond Market

Mexico boasts one of the most developed bond markets in Latin America, with outstanding domestic debt securities amounting to USD \$677 billion, trailing only

⁶ <https://www.newyorkfed.org/medialibrary/media/newsevents/events/markets/2020/credit-sensitivity-letters.pdf>

⁷ <https://www.invescosofracademyaxi.com/>

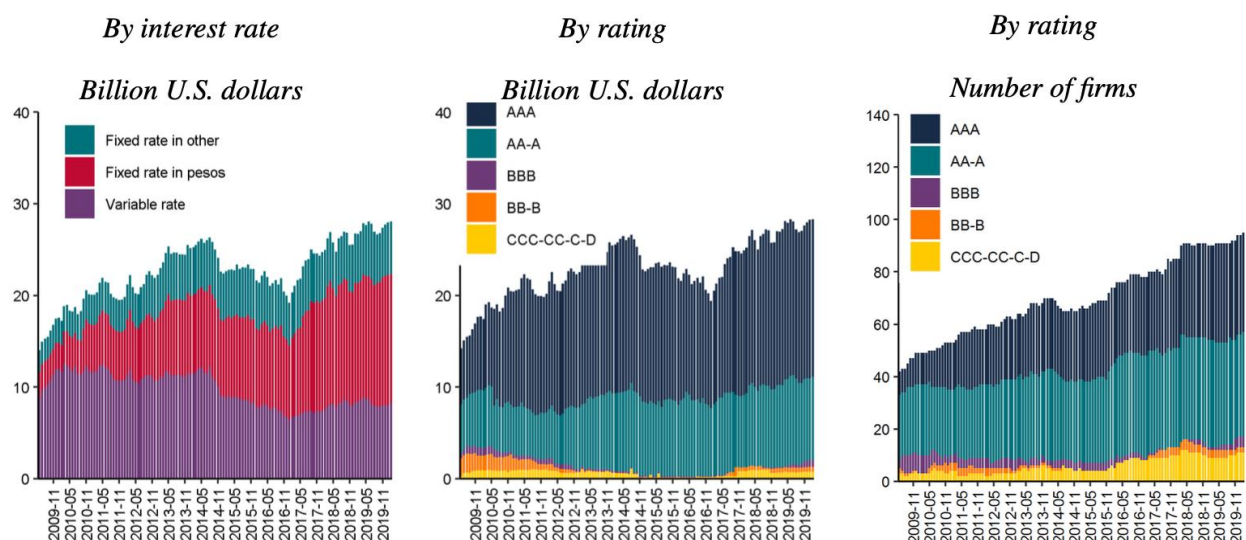
⁸ Idem

Brazil.⁹ The country enjoys macroeconomic stability, attributable to sound public finances, disciplined monetary policy, and the robustness of banks under a modern regulatory and supervisory framework. These factors, along with improved financing conditions, have facilitated a structural transformation of the Mexican economy and its financial markets (Sidaoui and Ramos-Francia, 2008).

The domestic bond market evolved significantly after the banking crisis in the early 20th century, when the economy regained dynamism through stable monetary and fiscal policies. These policies yielded stable inflation rates and low volatility in financial markets, easing the issuance of medium and long-term instruments, both sovereign and corporate. Consequently, domestic business financing through securities more than doubled in the last two decades, reaching approximately \$30 billion as of March 2023. As Carabín and Peláez (2021) noted, “only a small portion of bonds were denominated in Mexican pesos and at a fixed coupon rate” in 2009; by 2020, this type of security had come to dominate the market. Although still highly concentrated, the market has become increasingly heterogeneous; currently, about 100 firms issue debt, more than double the number in 2009. Debt ratings of AAA and AA or A are predominant in the market, but the presence of CCC or lower ratings has grown in market share.

⁹ Mexican Ministry of Finance, 2023.

Figure 1: NFP Sector Internal Securities Issuance



Note: Left and middle panels show quantities in U.S. dollars, transformed from original Mexican peso quantities using the monthly average exchange rate in each month.

Source: Carabín and Peláez (2021)

Notwithstanding the evolution of the debt market, the historical depth of the financial system in Mexico has been notably lower compared to its peers. For instance, as of December 2023, total private financing to the non-financial sector accounted for approximately 37.2% of GDP in Mexico. In contrast, the corresponding figures for the United States, Chile, and Brazil in 2023 were 167.5%, 137.5%, and 85.2%, respectively.¹⁰

Mexican Dataset

To compute the AXI and FXI indexes, we initially utilized Bloomberg’s data on corporate and governmental bonds with fixed coupons issued in Mexican pesos from 2013 to 2023. The raw database contains 285 corporate bonds (CUSIPs), including yield to maturity (YTM), issuance amount and date, bond type (e.g., secured, unsecured, senior unsecured, asset-backed, subordinated, and junior subordinated), and rating. After excluding bonds with missing data points (NaN values) and non-varying YTM, we retained 128 bonds. Consequently, an

¹⁰ Source: Federal Reserve Bank of St. Louis and CEIC

intermediate dataset was compiled, containing 2,835 effective transactional dates and 162,280 observations, corresponding to one data point per YTM of every CUSIP on any date the market was operational during the analyzed period. The following observations were subsequently eliminated from the dataset:

1. Data points with negative YTM.
2. Instances with insufficient data, such as missing maturity dates or bond types (e.g., unsecured or asset-backed).
3. Bonds from state firms or state trusts (e.g., PEMEX, CFE, or FONADIN).
4. Asset-backed and secured bonds.
5. The tails of the YTM distribution (2.5% of each tail) to exclude outliers with very high or low performance.

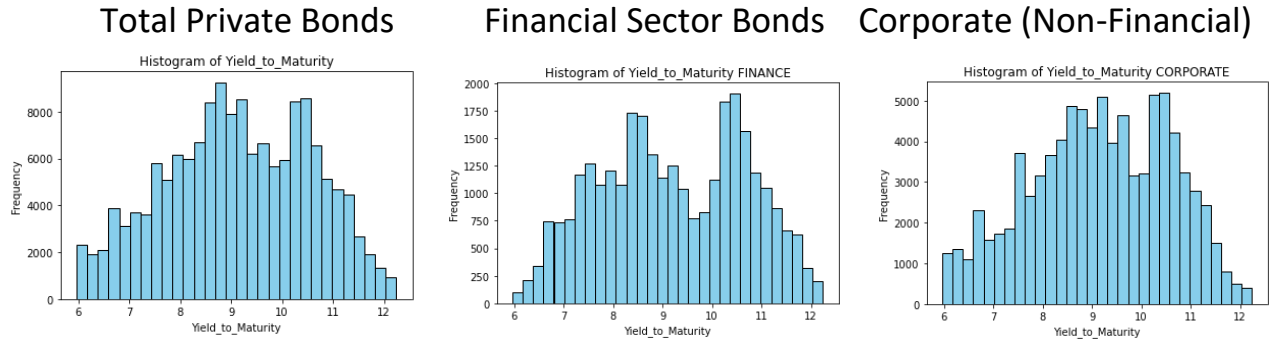
The final database comprises 106 bonds from 61 issuers; 76 are corporate and 30 are financial or banking, totaling 118,636 observations.¹¹ Step 5 was also applied to governmental bonds to remove outliers.

Table 1: Descriptive statistics (YTM)

No. observations	103,058
Mean	9.24
Standard Deviation	1.49
Minimum YTM	5.10
25% percentile YTM	8.12
50% percentile YTM	9.25
75% percentile YTM	10.44
Maximum YTM	14.71

¹¹ As reference, there are 140 Mexican, and 5 foreign stock issuers listed on the Mexican Stock Exchange (BMV) in 2023.

Figure 2: Distribution of YTM private bond market 2013-2023 (basis points)



Source: Authors' calculations.

Illustrative construction of MXAXI and MXFXI

Long-term MXAXI

This section describes the construction of the long-term MXAXI and long-term MXFXI. The former is a credit spread index based on transactions with maturities between one and five years, designed to assess the credit risk of bank holding companies and commercial banks. The latter reflects the financial conditions of the credit market for the same maturity range. Both indices were initially proposed by Berndt et al. (2023) for the United States as long-term AXI and long-term FXI, respectively. As a reference, the long-term bond-market component of AXI or FXI (depending on the sample) at time t is calculated as follows:

$$X_{LT,t} = \sum_{\substack{\text{buckets } m \text{ with} \\ \text{horizons } \geq 1\text{yr}}} q_{m,t} s_{m,t}, \quad (1)$$

where m represents the maturity class and t the period, the volume-weighted median credit spread among all secondary market transactions of instruments of maturity m in period t is defined as $s_{m,t}$; and the fraction in maturity class m of total issuance across all long-term buckets in the previous year is $q_{m,t}$. If the sample includes financial and banking bonds exclusively, the result is the long-term AXI;

while if it includes all corporate bonds, the outcome is the long-term FXI. In the Mexican context, both long-term MXAXI and long-term MXFXI are to be benchmark indices that mirror specific characteristics of the domestic corporate bond market.

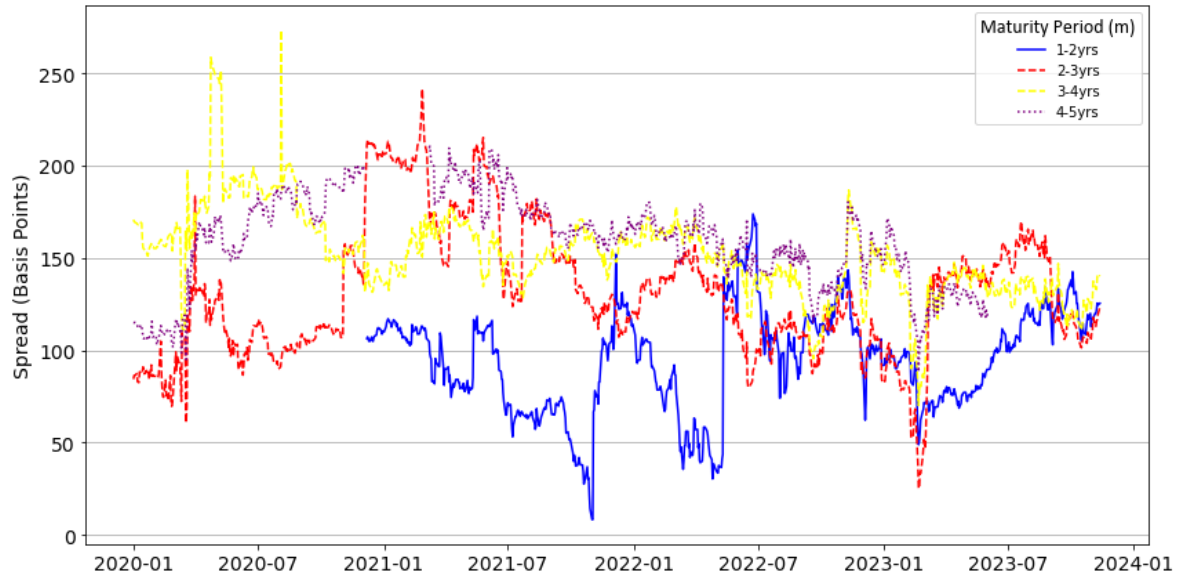
When implementing the original methodology to compute the indexes we encountered several challenges:

- 1) The dataset contains transactions for all targeted maturity class m , namely, 1 to 5 years of days to maturity or DTM, but not all years within the period 2013-2023 include transactions of bonds for each maturity bucket. Therefore, we had to collapse our dataset to the period 2020-2023 that registers transactions for all maturity buckets in every single year.
- 2) Our data set does not contain the volume of each transaction, which is used to compute the indexes since we must weigh the specific importance of each transaction for every maturity class m , namely $s_{m,t}$, according to Berndt et al (2023). To overcome this, we used two approaches:
 - a) Used the amount issued per CUSIP as a reference to estimate the volume traded every day there was a transaction, assuming that the volume traded is uniformly distributed across the period analyzed.
 - b) The previous approach plus a random element to generate variability across time. Both methods provide very similar outcomes.
- 3) The issuance for each maturity m in each year in our sample had several empty buckets, since not all bond-maturities were issued every year. Therefore, we imputed the issuances for those years-maturities where there was no data.

The results are reported in Appendix (Figure A2), comparing the index when using the simple average of spreads (non-weighted) versus the method used to compute $s_{m,t}$ and $q_{m,t}$.

Figure 3 shows the credit spreads of corporate bonds (in basis points) across four one-year maturity ranges, derived from secondary market trading of straight corporate bonds, including subordinated bonds issued by bank holding companies and their commercial banking subsidiaries as in Berndt et al (2023).

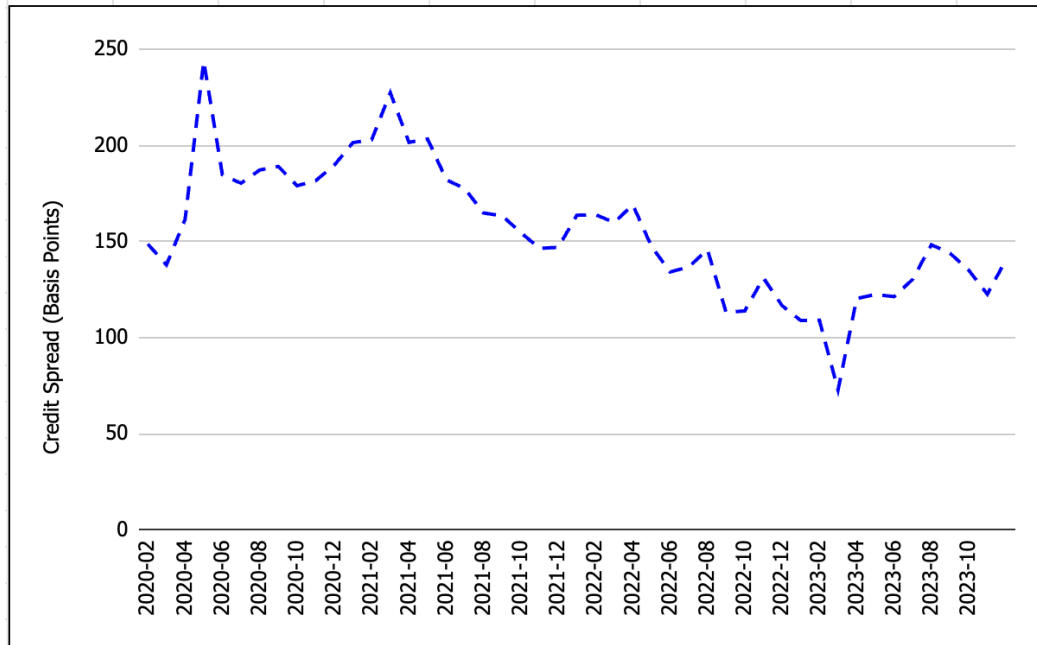
Figure 3: Estimated Credit Spreads for one-year to five-year maturities
(Basis Points, Daily Data)



Source: Authors' calculations.

The estimated long-term AXI is shown in Figure 4. Notice that the original paper by Berndt et al. (2023) chose a one-month observation period t “for illustrative purposes”. For the same purpose, we used a shorter observation window since it represents the actual available data. Although it could reflect a noisier index, we think it is the most appropriate way to present the results. Larger observation periods are always feasible and would provide a “softer” index.

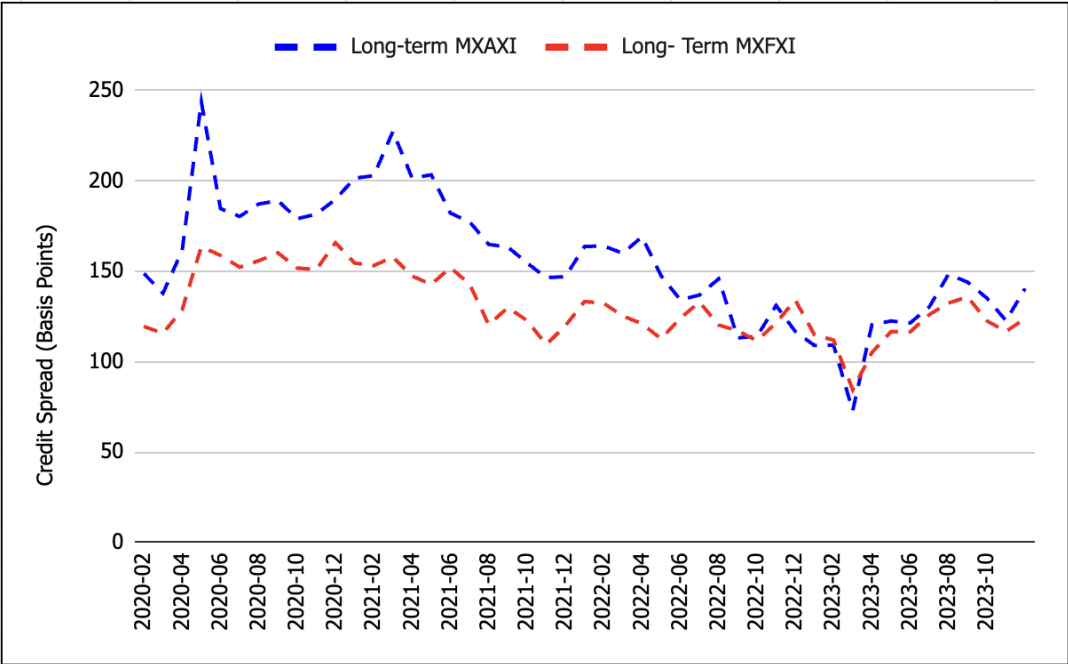
Figure 4: Long-Term MXAXI (Basis points, Monthly Average)



Source: Authors' calculations.

The computation of the long-term FXI follows the same steps as the long-term AXI, but with a broader sample that incorporates data based on transactions of both financial and non-financial corporate debt instruments. Figure 5 compares the long-term yield spreads of Mexican financial and banking companies (MXAXI) with those including other corporations (MXFXI). Therefore, the index construction adheres to the methodology outlined in formula (1) above, factoring in bonds from non-financial issuers in their respective maturity buckets and periods. As noted in the original paper by Berndt et al (2023), the two-bond yield spread indices are highly correlated, serving as a robustness check of the original index (MXAXI).

Figure 5: Long-Term MXAXI and MXFXI (Basis points, Monthly Average)



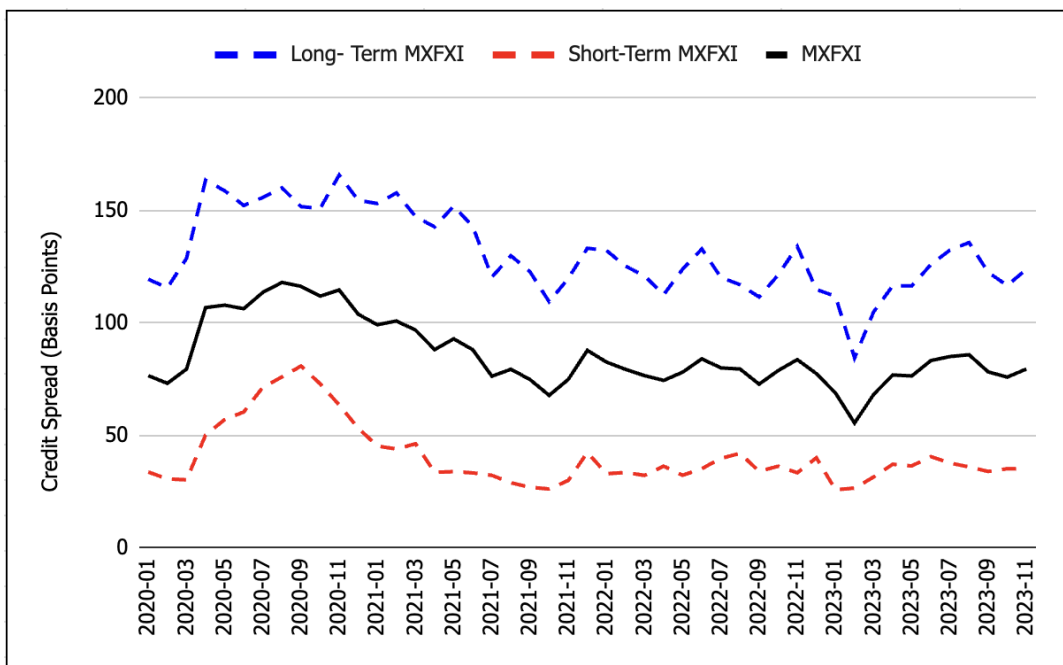
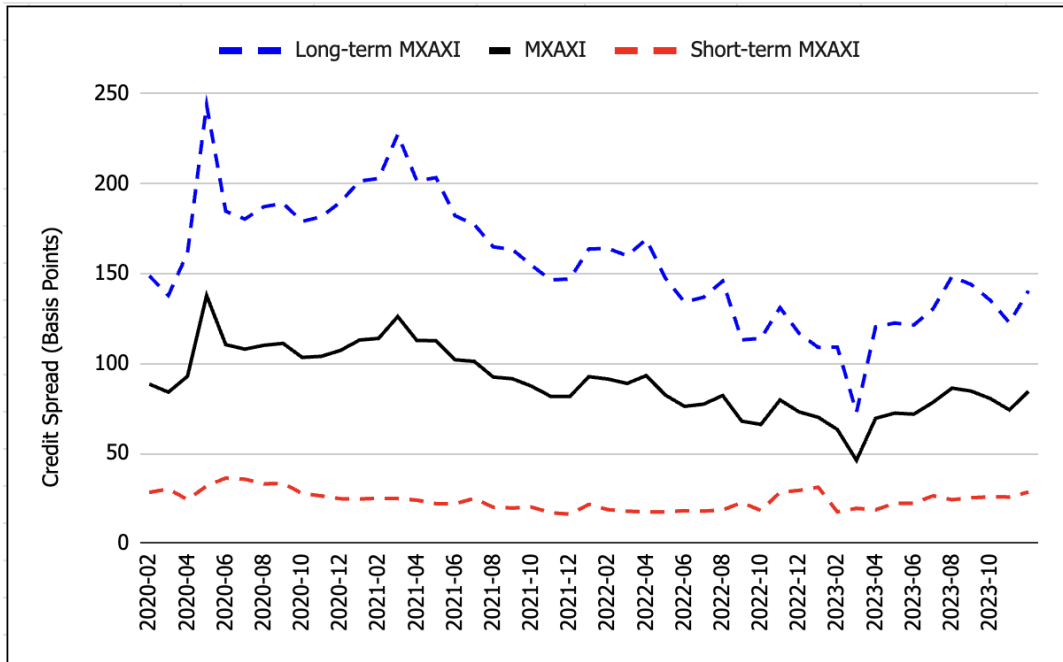
Source: Authors' calculations.

Short-term AXI

In assessing the money-market conditions, we focus on debt with maturities of less than a year. In our dataset, short-term data is predominantly composed of government debt, with corporate bond data being scarce (see Appendix, Figure A3). To compute the short-term AXI, we conducted several experiments. Initially, we utilized data from short-term financial and banking bonds, limiting our analysis to the period 2022-2023, which had a continuous flow of transactions. Alternatively, we referred to the weighted cost of commercial banking paper ('papel bancario') published monthly by Banco de Mexico.¹² This refers to short-term, unsecured promissory notes issued by banks and reflects the volume-weighted average cost of financing for Mexican banking institutions to meet short-term liabilities.

¹² Source: Sistema de Información Económica, Banco de México, <https://www.banxico.org.mx/SieInternet/consultarDirectorioInternetAction.do?sector=18&accion=consultarCuadro&idCuadro=CF113&locale=es>

Figure 6: Illustrative Short and Long-Term MXAXI and MXFXI
(Basis Points, Monthly Average)



Source: Authors' calculations.

Comparing Short-term AXI and TIIE-based Spread

To assess the validity of our computation of the Short-term AXI, we utilized the Interbank Equilibrium Interest Rate, or 'Tasa de Interés Interbancaria de Equilibrio' in Spanish. This rate is a representative benchmark of short-term credit operations between banks, calculated by Banco de México. The TIIE is widely used as a benchmark in the Mexican banking sector for various financial products, including loans and derivatives. It is determined based on the average interest rates at which a group of Mexican banks are willing to lend in short-term interbank loans. The TIIE is quoted for different maturities, including overnight (TIIE 1), one week (TIIE 7), and longer tenors (TIIE 28, 91, and 182 days). Influenced by factors such as the monetary policy of the Bank of Mexico, market conditions, and liquidity in the interbank market, the TIIE inherently incorporates banks' credit risk. Hence, its comparison with government bonds' YTM should yield insights like those provided by the short and long-term AXI, depending on the TIIE maturity used.

The relevance and timeliness of using the TIIE as a reference for our calculations stem from clearing houses and dealers preparing to transition away from the 28-plus day TIIE. This shift is due to a directive from Banco de México, which argued that the methodology for calculating the TIIE is not based on transactions observed in the money market but on quotes received from participating institutions¹³. Consequently, the calculation of TIEs for different terms does not align with new international criteria. As a result, Banco de México has prohibited the use of TIEs for terms longer than one banking business day in new contracts.

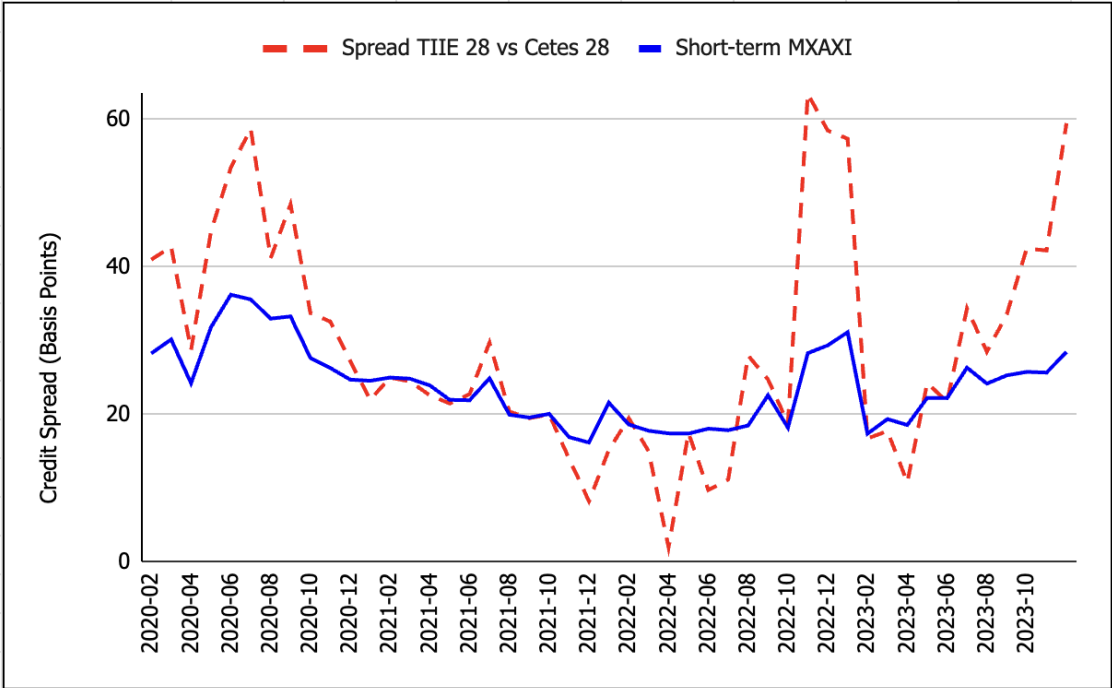
Originally, the ban was scheduled to start as follows:

1. The use of TIEs for terms of 91 and 182 days was to be prohibited in new contracts from January 1, 2024.
2. The use of the TIIE for a period of 28 days was to be prohibited in new contracts formalized after January 1, 2025.

¹³ <https://www.banxico.org.mx/markets/mexican-alternative-reference-rates-working-group/d/%7B2D6F5896-CF86-3F28-0C02-98D17B7542B9%7D.pdf>

However, Banco de México (Banxico) recently adjusted the schedule (as of December 6, 2023), permitting trading in swaps referencing TIIE-91 and -182 until the end of 2025, provided the maturity does not exceed the new deadline. According to the central bank, the only surviving TIIE that will meet the new criteria and replace the others as the reference rate is the overnight TIIE Funding Rate, known as F-TIIE or Fondo.

Figure 7: Spread of TIIE-28 and YTM of government bonds (CETES-28) and Short-term AXI (Basis points)



Source: Authors' calculations.

Robustness

To assess the robustness of the MXAXI and MXFXI indices during periods of financial stability and market stress with low transaction volumes, such as the onset of the Covid impact in March 2020, we examined time series data of issuance volumes. As illustrated in Figure 8 below, the Mexican bond market, particularly the sector of fixed-coupon unsecured and subordinated bonds denominated in pesos, is dynamic.

Figure 8: Amount of Domestic Bonds Issuance by Industry and Maturity Range
2020-2023 (Billions of Mexican Pesos)



Source: Author's calculations with data from Bloomberg

Limitations and Discussion

Like other countries, Mexico is transitioning from the London Interbank Offered Rate (LIBOR) to new reference rates based on principles established by the Financial Stability Board (FSB) and the International Organization of Securities Commissions (IOSCO). To facilitate the adoption of reference rates aligned with international standards and decrease the reliance on LIBOR, Mexican authorities have proactively established the Working Group on Alternative Reference Rates in Mexico (GTTR, its acronym in Spanish). This group, coordinated by the Bank of Mexico, serves as a forum for financial market participants to promote the adoption of the overnight Interbank Funding Equilibrium Interest Rate (TIIE de Funding) as a reference rate in Mexico for the money market, fixed income market, and derivatives markets. Following the methodology proposed by Berndt et al. (2023), we introduce the MXAXI and MXFXI indices as innovative benchmarks. These indices utilize market data, can be calculated using publicly available information - making them easily replicable - and are designed to work in conjunction with the new near-risk-free rate, known as the Overnight TIIE Funding Rate.

In our Mexican feasibility study, we found that this methodology can be applied to Mexican markets due to the diversity and growth of the domestic corporate debt market. Yet, we faced limitations due to data availability, namely, volume traded, and data sufficiency, for instance, observations for all maturity classes in all years. Although the increasing trend of corporate debt issuance could erode the latter problem, the former (data availability) represents a challenge if other researchers and analysts attempt to compute the index or replicate an existing one. Comprehensive data from Indeval¹⁴, the Mexican Stock Exchange¹⁵, and PiP¹⁶ is only available to researchers working to the supervisory agencies or must be acquired from each provider at high costs.

Due to limitations in data variables and availability, we adopted synthetic approaches to estimate the index, measuring the impact of our proposed solution. However, more comprehensive data should be employed in future research to ensure the replicability of the index, particularly if it is to be used as a reference for financial contracts. Our sample is sufficiently large in terms of observations, issuers, and CUSIPs, but it may harbor certain unknown biases since it does not encompass the entire universe of transactions, a limitation stemming from restricted data access. This lack of comprehensive data constrains the use of the proposed indices, as limited replicability might make them susceptible to manipulation if used as a reference in market transactions. Future research and development of the MXAXI and MXFXI benchmark credit spreads should therefore carefully consider the selection and integration of data sources to enhance the indices' robustness.

Our data filters were designed to create a dataset with a comparable set of instruments while preserving the number of issuers, bonds, and overall observations. These filters could be tested and refined using different criteria. Despite the robustness of our results and the high correlation between MXAXI and MXFXI, further checks and analyses are necessary to refine these indices for

¹⁴ Institute for Securities' Deposit, for its acronym in Spanish, <https://www.indeval.com.mx/estadistica-general>

¹⁵ Mexican Stock Exchange, https://www.valmer.com.mx/en/valmer/Tasa_de_Referencia

¹⁶ Market Prices Provider, for its acronym in Spanish. <https://www.piplatam.com/Home/filiales?country=MX>

transactional use. It is worth noting that only the MXFXI index may be viable for commercial use, as it is the more robust of the two indices.

We identify three core benefits of using MXAXI and MXFXI in conjunction with the Overnight TIIE rate, which is endorsed by the Working Group on Alternative Reference Rates in Mexico and promoted by the Mexican Central Bank as a reference rate: (i) Banks could mitigate mismatches between lenders' assets and liabilities during market stress by using these indices as dynamic spreads reflecting changes in banks' cost of funds over forward-looking term periods. (ii) In commercial lending applications, such as revolving lines of credit offered by Mexican banks and other financial institutions to non-financial corporations, these indices will enable closer alignment of borrowing and lending rates, increasing the willingness to extend credit throughout the business cycle. (iii) Derivatives referencing MXAXI and MXFXI could be utilized by hedge funds to take positions on credit conditions in Mexico, thereby benefiting local credit markets.

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Appendix

Figure A1: YTM of Mexican government bonds 2013-2023 for different maturities

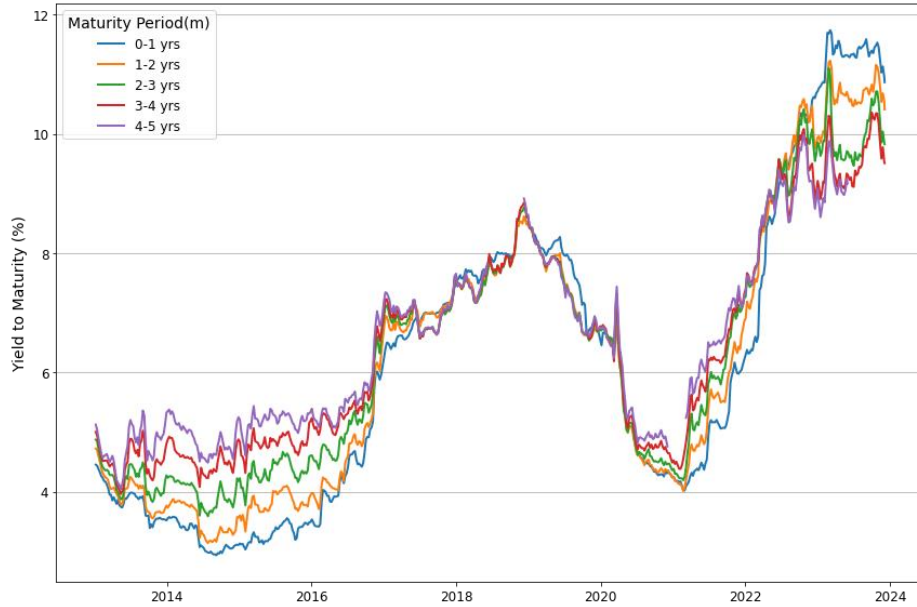


Figure A2. Comparison of spreads using all maturity classes m : Simple average of spreads across all m , volume-weighted average spreads across all m , and volume-issuance-weighted average spreads across all m (namely AXI)

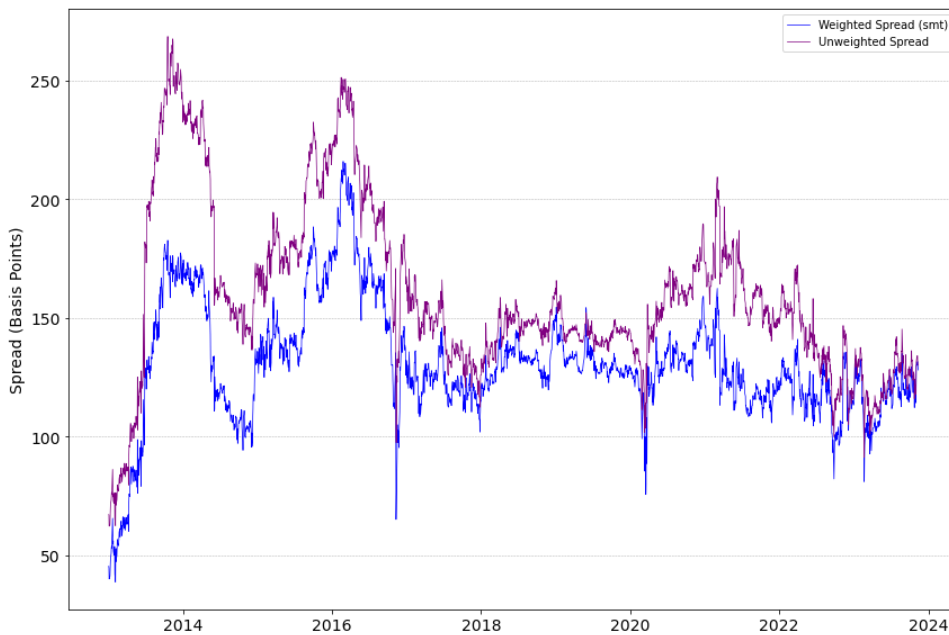


Figure A3. Availability of short-term bond data: Corporate vs Government Bonds

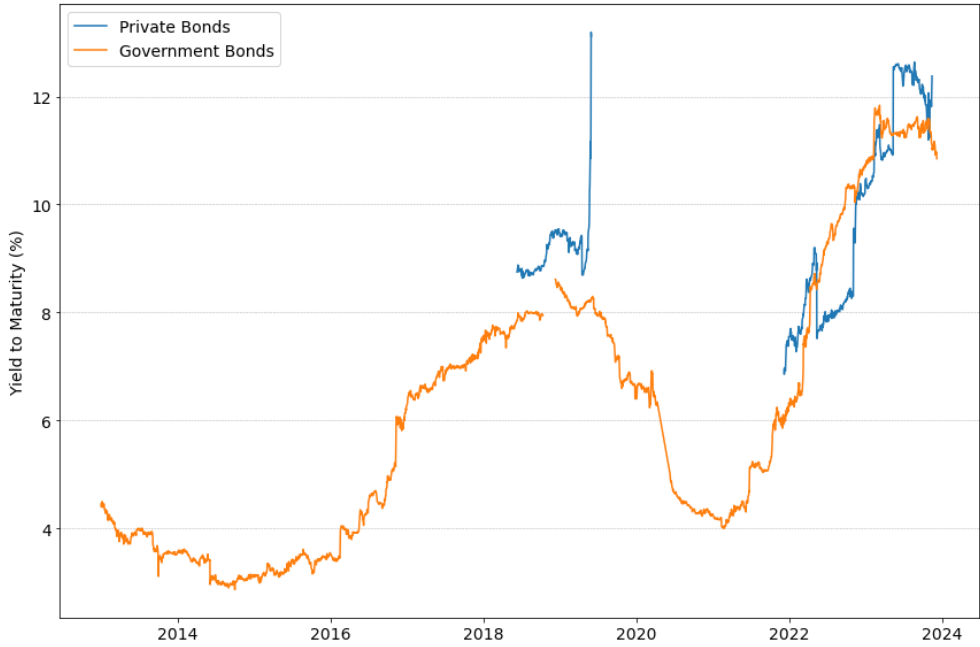


Figure A4. TIIE (Average of all maturities) vs YTM of short-term government bonds

