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Non-Technical Summary

This study examines the factors that influence the risk premium embedded in Brazilian nominal interest rates. The risk premium represents the additional compensation investors require for holding long-term bonds instead of rolling over short-term bonds. Understanding this component is crucial because it affects borrowing costs for governments, companies, and households, and plays an important role in monetary policy decisions.

Using the ACM model developed by Adrian, Crump, and Moench (2013), we estimate the term premium from January 2007 to April 2025 based on Brazilian government bond yields. We then analyze how this premium relates to a broad set of macroeconomic and financial variables, including inflation expectations, domestic interest rates, fiscal indicators, U.S. interest rates, exchange rates, and global risk measures.

Our results show that the term premium is highly volatile and accounts for a significant share of movements in long-term interest rates. Domestic factors, such as the Selic monetary policy rate, long-term financing costs, and inflation expectations, are the main drivers, but external conditions, including U.S. interest rates and global financial volatility, also play an important role, especially during periods of international stress. Fiscal indicators, such as public debt levels, become more relevant in times of political or economic uncertainty.

These findings highlight that changes in long-term interest rates do not solely reflect expectations about future monetary policy but also incorporate risk compensation linked to macroeconomic uncertainty. For policymakers, monitoring these dynamics is essential to monitor financial conditions. For investors, understanding the determinants of the risk premium helps interpret market signals and manage exposure to interest rate risk.

Sumário Não Técnico

Este estudo analisa os fatores que influenciam o prêmio de risco presente nas taxas de juros nominais brasileiras. Esse prêmio representa a compensação adicional exigida pelos investidores para manter títulos de longo prazo em vez de renovar sucessivamente títulos de curto prazo. Compreender o comportamento desse componente é essencial, pois ele afeta os custos de financiamento de governos, empresas e famílias, além de desempenhar papel relevante nas decisões de política monetária.

O modelo desenvolvido por Adrian, Crump e Moench (2013) é utilizado para estimar o prêmio a termo no período de janeiro de 2007 a abril de 2025, com base nos títulos públicos federais brasileiros prefixados. Em seguida, analisa-se a relação desse prêmio com um amplo conjunto de variáveis macroeconômicas e financeiras, incluindo expectativas de inflação, taxas de juros domésticas, indicadores fiscais, taxas de juros dos Estados Unidos, taxa de câmbio e medidas globais de risco.

Os resultados indicam que o prêmio de risco é altamente volátil e responde por parcela significativa das variações nas taxas de juros de longo prazo. Fatores domésticos, como a taxa Selic, os custos de financiamento de longo prazo e as expectativas de inflação, são os principais determinantes. Contudo, condições externas, incluindo as taxas de juros dos Estados Unidos e a volatilidade financeira global, também exercem influência relevante, especialmente em períodos de estresse internacional. Indicadores fiscais, como o nível da dívida pública, ganham importância em momentos de incerteza política ou econômica.

Esses achados evidenciam que as variações nas taxas de juros de longo prazo não refletem apenas expectativas sobre a política monetária futura, mas também incorporam uma compensação pelo risco associada à incerteza macroeconômica. Para os formuladores de política econômica, acompanhar essas dinâmicas é essencial para monitorar as condições financeiras. Para os investidores, compreender os determinantes do prêmio de risco auxilia na interpretação dos sinais de mercado e na gestão da exposição ao risco de taxa de juros.

Determinants of the Risk Premium
in Brazilian Nominal Interest Rates[*]

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Abstract

This article investigates the determinants of the risk premium in Brazilian nominal interest rates. The risk premium reflects the compensation investors require for holding long-term bonds instead of sequentially investing in short-term bonds. The study estimates risk premiums embedded in the Brazilian yield curve and analyzes their relationship with a comprehensive set of domestic and external macroeconomic variables. This is, to our knowledge, the first application of the ACM model to Brazil using such a comprehensive macro-financial variable set. Regression results reveal that the policy rate, long-term public financing cost, inflation expectations, public debt indicators, U.S. interest rates, USD/BRL exchange rate, and global volatility measures are statistically significant drivers. The time-series decomposition highlights the predominance of domestic interest rates and the increasing role of external shocks in periods of heightened global uncertainty. These findings contribute to the understanding of long-term interest rate dynamics in emerging markets.

Keywords: Yield Curve; Risk Premium; Term Premium; Interest Rate Expectations.

JEL Codes: E43; E44; E52; G12; H63.

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1. Introduction

Risk aversion is the individual's reluctance to invest in assets that may lead to changes in their future income or consumption. Therefore, individuals ask for compensation for exposing themselves to uncertain events when compared with a more stable scenario. For example, individuals invest their savings in equities only if the expected return on these speculative assets is higher than the return on a risk-free asset. Thus, there should always be a positive risk premium in equity returns to induce risk-averse investors to buy these financial instruments instead of holding their money in safer assets. In this case, one may interpret the premium as an excess of expected returns to compensate the investor for the uncertainty of the equity market. Risk premium is also present in fixed-income securities, including government bonds.

Fixed-income investors face different kinds of risk. Hence, there is more than one risk premium embedded in these securities. Regarding Treasury bonds, it is possible to decompose the nominal yield into three components: (i) a rate to compensate for expected inflation; (ii) a risk-free real rate of return; (iii) a real rate risk premium; and (iv) an inflation risk premium, which represents a reward to hold risk associated with an increase in the prices of goods and services (see, for instance, Durham, 2006). However, one can also look at the nominal interest rate from another perspective: a decomposition into two components, the cumulative expectation of short-term interest rates and the term premium (see, for instance, Adrian, Crump, and Moench, 2013, Cochrane and Piazzesi, 2008). The first is the long-term interest rate that would prevail if investors were risk neutral. The second is compensation to the investor for holding long-term security instead of consecutively investing in short-term securities.

In this paper we focus on the second decomposition presented in the previous paragraph. In particular, we investigate the main drivers of movements of the Brazilian nominal rates term premium (or risk premium). The motivation stems from the need to deepen our understanding of yield curve dynamics in emerging markets, where the interplay between monetary, fiscal, and external factors tends to be more intricate and less predictable than in developed countries.[1] We estimate the term premium using the methodology of Adrian, Crump, and Moench (2013), referred here as the ACM model, and the nominal yield curve

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[1] This effort complements recent work by Carvalho and Teles (2019), who analyze the yield curve in Brazil from a monetary policy transmission perspective.

from Brazilian fixed-rate government bonds using Svensson (1995) interpolation method. Our sample spans from January 2007 to April 2025.

ACM model belongs to the class of affine term structure models studied by Duffie and Kan 1996). Nowadays, affine term structure models are the workhorse of the yield curve pricing. However, as pointed out by Hamilton and Wu (2012), the estimation of the parameters of such models is tremendously challenging due to highly non-linear and badly behaved likelihood surfaces. To circumvent these problems, Adrian, Crump, and Moench (2013) propose a three-step linear regression approach, which made the estimation fast and reliable.

The analysis of the term premium is directly connected to the expectation hypothesis which states that the *n* period yield is the average of expected future one-period yields plus a constant risk premium

$$y_t^{(n)} = \frac{1}{n}E_t\left[y_t^{(1)} + \cdots + y_{t+n-1}^{(1)}\right] + TP^{(n)} \tag{1}$$

The term on the left refers to the long-term spot interest rate; the first term on the right is the expectation of the cumulative short-term rates (unit size period rates); finally, the last term is the term premium for period *n*. Equation (1) is known as augmented expectation hypothesis. There is another version of the expectation hypothesis in which the term premium is not present, known as pure version. Numerous works have rejected the expectation hypothesis. Shiller and McCulloch (1990) presented a collection of studies that refuse the expectations hypothesis. Campbell and Shiller (1991) also found evidence against the expectations hypothesis using data from US yield curve between 1952 and 1987. For the Brazilian case, several studies show that the expectations hypothesis fail. Among others, we can cite Tabak and Andrade (2003), Brito, Duarte and Guillén (2004) and Marçal and Pereira (2007). Therefore, to reconcile theory and data, we allow a time-varying risk premium in Equation (1).

For investors, knowing the risk premium and, as a result, nominal interest rate expectations is crucial because they may compare their own expectations with market expectations. Moreover, an increase in interest rate expectations indicates a prospect of a higher monetary policy rate in the economy, usually linked to a rise in inflation (which may reflect economic activity growth above its potential output). On the other hand, risk premium influences interest rates to which companies, households, and governments are exposed. Therefore,

central banks should monitor and understand long-term interest rates movements that embed risk premium when assessing financial conditions.

Term premium is related to several types of uncertainty, both external and internal. Knowing the factors that influence the risk premium helps explain why part of the long-term interest rates move. It allows investors and policymakers to identify whether changes are driven by fundamentals, like inflation expectations, fiscal conditions or global risk, or by temporary shocks. This study explores the key factors influencing changes in the risk premium.

The results indicate that most of the volatility in Brazilian nominal interest rates stems from the term premium, which is influenced by both domestic and external factors. Specifically, the monetary policy rate, long-term public financing cost, inflation expectations, public debt, U.S. interest rates, exchange rate (U.S. dollar against the Brazilian Real) and VIX exert a positive and statistically significant impact on the term premium. The time series decomposition further reveals that interest rate variables are the primary drivers of the term premium, followed by inflation, fiscal conditions, and external factors, reflecting the Brazilian market's sensitivity to the macroeconomic environment.

Some papers analyze the determinants of the term premium. Aguilar-Argaez et al. (2022) study the Mexican case and find that the main determinants of the term premium are the compensation for foreign exchange risk, the real compensation, and the U.S. term premium. Özbek and Talasli (2020) estimated the term premium for 16 emerging market economies (including Brazil) and evaluate the impacts of country specific and global factors on the term premia of the emerging countries The authors find that market liquidity, inflation, macroeconomic uncertainty and global market risk are the main drivers of the term premium. Iania et al. (2021) examine bond risk premia dynamics in Brazil, China, Mexico and Russia, evidencing that global factors play a key role, whereas domestic factors have limited explanatory power to explain the risk premium in Brazil. Iskrev (2018) analyzes the relationship between term premia in euro area and US government bond yields. He finds that only a small fraction of the co-movements of these two premia is due to the connection between the US and Euro economy. Our work contributes to this literature by focusing specifically on Brazil and incorporating a set of macroeconomic and financial factors that,

to our knowledge, have not been previously examined using the ACM model.[2]

The work follows this structure: in section 2, we present a short discussion of the ACM model; in section 3, we describe the methodology and sample; in section 4, we present the results; and section 5 brings the final considerations of the article.

2. The ACM model

Estimation of risk premia embedded in yield curves has more commonly been based on affine models (see Duffie and Kan, 1996). The idea is to specify the dynamics of yield curves as linear combinations of stochastic factors (latent or observable). The connection between the physical and risk-neutral distribution of rates takes place by using a risk-premium process to exclude arbitrage opportunities.

Although affine models are widely used in modern fixed-income literature, the estimation of parameters that govern the evolution of factors is not straightforward.[3] There are some alternative solutions to circumvent this difficulty. This study adopts the ACM model. ACM propose a novel and computationally efficient method for modeling the term structure of interest rates using a three-step linear regression approach. Their method allows for the estimation of term structure models with a large number of pricing factors, avoiding the complexity of traditional maximum likelihood estimation.[4] Several papers, such as Ramos-Francia, García-Verdú, and Sánchez-Martínez (2020) and Cohen, Hördahl and Xia (2018), have shown that curves estimated by the ACM model are in line with more general affine models, such as the one by Kim and Wright (2005), as well as Hördahl and Tristani (2021), who examine inflation risk premia in developed markets using similar no-arbitrage frameworks.

The ACM model considers the first five principal components of interest rates as observable

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[2] Costa Filho (2023) also investigates the determinants of the Brazilian term premium. However, he estimates the term premium using an Affine Term Structure Model (ATSM) following the approach of Kaminska et al. (2021), rather than the ACM framework. This implementation is an application of an ATSM based on Joslin, Singleton, and Zhu (2011), employing a Bayesian estimation method via Markov Chain Monte Carlo (MCMC).

[3] As reported by Hamilton and Wu (2012), flat regions around the likelihood function prevent proper convergence, especially of the risk premium.

[4] Alternatively, Joslin, Singleton, and Zhu (2011) propose a framework for Gaussian dynamic term structure models that incorporate macroeconomic factors explicitly.

factors.[5] These factors evolve as a Vector Autoregression (VAR) process with shocks following a normal distribution:

$$X_{t+1} = \mu + \Phi X_t + v_{t+1}, \ v_{t+1} \sim N(0, \Sigma),$$

where $X_t \in R^5$ is a vector of the first five principal components of interest rates.

The no-arbitrage assumption implies the existence of a pricing kernel. In the affine class, the pricing kernel is exponentially affine:

$$M_{t+1} = \exp\left(-r_t - \tfrac{1}{2}\lambda_t'\lambda_t - \lambda_t'\Sigma^{-1/2}v_{t+1}\right).$$

Therefore, the zero-coupon bond price with maturity n at time t is given by

$$\ln P_t^{(n)} = A_n + B_n'X_t + u_t^{(n)},$$

where the coefficients A and B follow recursive equations.

ACM follow Duffee's (2002) proposal and assume that the market prices of risk are essentially affine:

$$\lambda_t = \Sigma^{-1/2}(\lambda_0 + \lambda_1 X_t).$$

Thus, the excess bond return can be decomposed into expected return, convexity adjustment, priced return innovation, and pricing error:

$$rx_{t+1}^{n-1} = \beta^{(n-1)'}(\lambda_0 + \lambda_1 X_t) - \frac{1}{2}\left(\beta^{(n-1)'}\Sigma\beta^{(n-1)} + \sigma^2\right) + \beta^{(n-1)'}v_{t+1} + e_{t+1}^{n-1},$$

where the return pricing errors $(e_{t+1}^{n-1},)$ are conditionally independently and identically distributed (i.i.d.) with variance σ^2 and

$$\beta^{(n-1)} = Cov_t[rx_{t+1}^{n-1}, v_{t+1}']\Sigma^{-1}.$$

Next, the excess returns are regressed on lagged factors and their contemporaneous innovations (errors from the first regression). In the third step, the risk premium parameters

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[5] ACM show that a model using five principal components of yields as factors performs better in out-of-sample forecasts than the well-known Cochrane-Piazzesi (2008) model, while producing similar in-sample dynamics.

arise from a cross-section regression of the lagged factor returns on the contemporaneous factors' innovations.

3. Methodology and Sample

A set of OLS regressions is estimated for the monthly average of daily risk premiums on 5-year nominal interest rate, as estimated by the ACM model, over the period from January 2007 to April 2025. The risk premiums are estimated from the Brazilian nominal yield curve, which is constructed using fixed-rate federal government securities (both without coupons, as the National Treasury Bills – LTNs –, and with coupons, as the National Treasury Notes – NTN-Fs) and the Svensson (1995) interpolation method.

The series begins in 2007 since government bonds started to exhibit greater market liquidity from that point onward. Regarding the interest rate horizon, we adopt the 5-year yield as the long-term rate because it shows higher liquidity compared to the traditional 10-year bond, especially at the beginning of the sample period. Nevertheless, this choice does not influence the study's results, as the time series of risk premiums across different maturities exhibit high correlations.[6]

Multiple specifications are tested to identify statistically significant predictors. Standard errors, robust to heteroskedasticity and autocorrelation (HAC), are computed using the Newey-West correction.

The reduced-form model for the risk premium is described below:

$$ACM_t = \alpha + \beta_1 \pi_{t-1} + \beta_2 i_{t-1} + \beta_3 i^*_{t-1} + \beta_4 f_{t-1} + \beta_5 y_{t-1} + \beta_6 s_{t-1} + \beta_7 E_{t-1} +$$
$$\beta_8 C_{t-1} + \beta_9 V_{t-1} + \varepsilon_t \tag{2}$$

where:

- *ACM* is the risk premium;
- π represents variables related to inflation, either actual or expected;
- *i* represents variables associated with the domestic interest rate;

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[6] Among the risk premium time series for maturities from 1 to 10 years, the lowest correlation is between the 1-year and 10-year series, with a value of 0.60. The correlations between the 5-year series and the others are as follows: 0.667 (1 year), 0.861 (2 years), 0.968 (3 years), 0.996 (4 years), 0.999 (6 years), 0.997 (7 years), 0.994 (8 years), 0.991 (9 years), and 0.998 (10 years).

- i^* refers to U.S. interest rates;
- f represents fiscal variables;
- y corresponds to economic activity variables;
- s represents stock market variables;
- E refers to exchange rate variables;
- C represents commodity-related variables; and
- V refers to the volatility index.

As shown in Equation (2), the explanatory variables are included with a one-month lag to mitigate potential endogeneity issues. These variables aim to capture key macroeconomic and financial factors that may influence the risk premium on nominal interest rates in an emerging economy such as Brazil. It is important to note that we do not include Brazilian fixed interest rates as regressors, since these rates were used in the construction of the risk premium itself. The explanatory variables used in the regressions are detailed below:
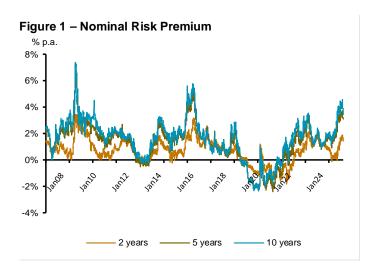
- Inflation: Broad National Consumer Price Index (IPCA), IPCA Services, IPCA Food at Home, IPCA Industrial Goods, and IPCA Administered Prices– all measured as 12-month accumulated variations;
- Inflation expectations: Median survey expectation for IPCA inflation one year ahead, as published in the Focus Report (only the 1-year horizon is used, since longer-term expectations in rolling-horizon format were not collected at the beginning of the sample period);
- Domestic interest rates: Effective Selic rate and the Long-Term Rate (*TLP*), both expressed in annual terms;[7]
- External interest rates: Nominal yields on 2- and 10-year U.S. Treasury bonds and 5-year Treasury Inflation-Protected Securities (*TIPS*);
- Fiscal indicators: Primary balance, general government gross debt as a % of GDP (*GGGD*), and public sector net debt as a % of GDP;
- Economic activity: Output gap, constructed using the HP filter on the seasonally adjusted monthly IBC-Br index;
- Equity indices: Returns on the Ibovespa index and on the MSCI index for developed countries;
- Exchange rates: Return on the U.S. dollar against the Brazilian Real and on the DXY index (U.S. dollar against a basket of developed country currencies);

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[7] TLP replaced the Long-Term Interest Rate (TJLP) as of January 2018. For data prior to that date, the TJLP is used.

- Commodities: Returns on the CRB index and on WTI crude oil prices; and
- Volatility: VIX index, which measures the implied volatility of the S&P 500.

4. Results

Figure 1 presents the daily series of the 2-, 5-, and 10-year risk premia from January 2007 to April 2025, estimated by the ACM model. The model's input data are the nominal rates constructed by the Svensson (1995) interpolation method for maturities from one to ten years and the effective Selic rate. Estimated premia generally corroborate the theory: i) the 10-year is the highest in almost the entire sample, while the 2-year is the lowest; ii) the risk premium is almost always positive; and iii) the risk premium increases around turmoil periods, such as the 2008 Global Financial Crisis, the 2013 street manifestations,[8] the 2016 presidential impeachment, the 2022 elections and in the more recent period (the beginning of President Trump's second term in the U.S.). The sample's median 10-year premium is 1.59%, much higher than that of U.S securities for the same term, of 0.40%.[9]

Figure 1 – Nominal Risk Premium

Estimated risk premia seemed to have followed an unusual trajectory during the Covid-19 pandemic, especially in 2020: risk premia are negatives and short-term premia are larger than long-term ones. However, these unusual behaviors were also observed in other

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[8] The 2013 protests in Brazil were mass demonstrations triggered by a rise in public transport fares, which quickly grew to reflect broader dissatisfaction with corruption, public services, and government spending.

[9] The term premium by the ACM model for U.S. securities is available at the Federal Reserve Bank of New York's website https://www.newyorkfed.org/research/data_indicators/term-premia-tabs

markets, such as in the U.S. and Chilean markets.[10]

Figure 2 shows the daily series of the nominal spot rate and the estimated expectation component, both for the 5-year term. One may observe that the expectation is much less volatile than the spot rate.[11] Therefore, the large variation in the interest rate is mainly due to significant changes in the magnitude of the risk premium. For example, the substantial increase in the 5-year spot rate during the 2008 Global Financial Crisis was almost entirely due to the increase in the risk premium rather than to the increase in interest rate expectations.

Figure 2 – 5-year nominal spot rate and estimated expectation component
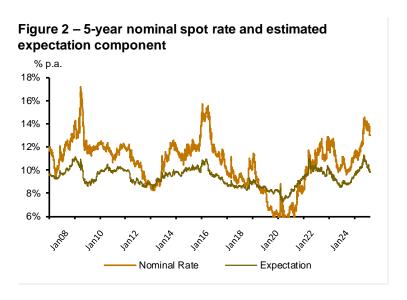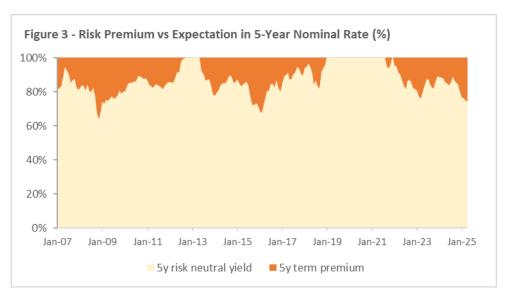

Figure 3 illustrates the decomposition of the nominal interest rate, expressed in percentage terms, into its risk premium and expectation component to show how the share of the risk premium in the nominal interest rate varied over time. For instance, in April 2025, the nominal rate was comprised of 25.8% risk premium. Within the time series, certain intervals exhibit a negative risk premium (the expectation is greater than the nominal rate), most notably during the COVID-19 pandemic, as previously discussed. We can observe that the relative contribution of the risk premium to the nominal interest rate was notably higher during episodes of financial and political stress, such as the subprime mortgage crisis in 2008 and Brazil's political turmoil in 2016. At the outset of 2025, the risk premium component exhibited

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[10] The 10-year term premium by the ACM model for the Chilean securities market is available at the Cemla's website https://www. cemla.org/DatosSelectosMacroeconomicos/Term premium estimates eng.html
[11] The coefficient of variation of the nominal rate is 0.19, while those of the expected nominal rate and the risk premium are 0.08 and 1.11, respectively.

renewed growth, potentially driven by trade policy shocks, including tariffs imposed by the United States on multiple countries and products.

Figure 3 - Risk Premium vs Expectation in 5-Year Nominal Rate (%)

Note: The maximum value on the scale is 100%. Thus, when expectation reaches 100% in the figure, the risk premium is negative.

Table 1 presents the results of seven specifications to identify statistically significant predictors of the term premium.[12] Regression 1 uses one representative variable for each group of factors presented in Section 3. Variables related to inflation, monetary policy, external interest rates, fiscal policy, exchange rates, and volatility are statistically significant at usual levels. The adjusted R^2 is 0.75.

In Regression 2, inflation expectations from the Focus Report are added, while non-significant variables are removed. As a result, the IPCA loses statistical significance, whereas the Focus expectation is significant at the 1% level.[13] The gross debt-to-GDP ratio (*GGGD*) and the USD/BRL exchange rate (*USD/BRL*) also lose significance. The adjusted R^2 increases to 0.78, and the Schwarz Information Criterion (SIC) likewise indicates an improvement in model quality.

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[12] The variables in the regressions are expressed in percentage terms, except for the Primary Balance, which was divided by 100,000.

[13] An alternative specification was also tested, using the components of the IPCA (administered prices, services, industrial goods, and food at home) as regressors instead of the headline IPCA. However, none of the components are statistically significant.

In Regression 3, only the non-significant variables are excluded, except for the *USD/BRL*.[14] The results of this regression are robust to replacing the *nominal* U.S. interest rate variable with the 5-year U.S. *real* rate (*TIPS*), including in terms of the estimated coefficient's magnitude. Regression 4 combines the level of the U.S. real rate with the slope of the U.S. nominal yield curve, measured by the difference between the 10- and 2-year rates. This combination leads to a further improvement in the SIC and raises the adjusted R^2 to 0.81.

In Regression 5, several variables are added to the previous model to assess their statistical significance. Variables that were already significant remain relevant. The *USD/BRL*, which was no longer significant in Regressions 2 to 4, becomes statistically significant again at the 1% level. Among the new variables, only the *TLP* is statistically significant. The adjusted R^2 increases again, and the SIC becomes even more favorable.

Regression 6 maintains a structure similar to the previous one, with substitutions in fiscal, equity market, and commodity variables, as well as the inclusion of the DXY index. There is an improvement in the SIC, and the gross debt-to-GDP ratio (*GGGD*) becomes significant again, but this time with a positive sign.

Finally, Regression 7 preserves the structure of the previous model, excluding variables that did not show statistical significance. The adjusted R^2 remains similar, but the SIC improves substantially due to the model's greater parsimony, making it the best-fitting model for the sample among all those evaluated.[15, 16]

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[14] The specification of Regression 3 was also run including the GGGD/GDP ratio, but this variable remained insignificant and was therefore discarded.

[15] In conducting the regressions, we avoid including variables from the same category to reduce the risk of multicollinearity. Table A in Appendix A reports the correlation matrix for the variables used in Regression 7, which was chosen for detailed analysis. Nearly 90% of the correlations are below 0.5, and about half are low (under 0.15). The highest absolute correlation is 0.69, between the Brazilian fiscal variable (*GGGD*) and the slope of the U.S. yield curve (*USPRE10 – USPRE2*).

[16] A more exhaustive specification could include volatility or lagged terms in the explanatory variables. However, we chose not to do so because this would shift the economic focus and increase dimensionality without clear theoretical justification. The high adjusted R^2 (0.84) also suggests limited additional explanatory gains.

Table 1: Regressions of the 5-year nominal interest rate risk premium (ACM) against various factors

Dependent Variable: ACM							
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
C	-0.02 **	-0.06 ***	-0.05 ***	-0.04 ***	-0.06 ***	-0.08 ***	-0.08 ***
	(-2.3)	(-4.59)	(-9.5)	(-6.53)	(-7.29)	(-8.24)	(-8.02)
IPCA	0.18 ***	0.01					
	(3.03)	(0.22)					
Focus		0.54 ***	0.54 ***	0.46 ***	0.6 ***	0.56 ***	0.54 ***
		(3.79)	(5.59)	(3.37)	(4.78)	(5.01)	(4.65)
Selic	0.2 ***	0.18 ***	0.18 ***	0.18 ***	0.09 *	0.16 ***	0.16 ***
	(5.49)	(5.6)	(5.63)	(5.1)	(2.22)	(3.54)	(3.47)
TLP					0.4 ***	0.28 **	0.27 *
					(3.39)	(2.31)	(2.17)
TIPS_5				0.6 ***	0.63 ***	0.65 ***	0.64 ***
				(6.19)	(7.02)	(7.78)	(7.1)
USPRE10	0.51 ***	0.57 ***	0.55 ***				
	(3.79)	(6.1)	(5.99)				
USPRE10 - USPRE2				0.41 ***	0.51 ***	0.69 ***	0.71 ***
				(5.08)	(6.79)	(6.84)	(6.94)
Primary balance					-0.15		
					(-1.29)		
GGGD	-0.02 **	0				0.03 ***	0.03 ***
	(-2,25)	(0,3)				(2.84)	(3.07)
IBC-BR	-0.08				0		
	(-1,45)				(-1.26)		
IBOV	0					-0.01	
	(-0,26)					(-0.94)	
MSCI_Desenv.					0.01		
					(0.72)		
USD/BRL	0.05 ***	0.04	0.04	0.03	0.04 ***	0.04 **	0.03 **
	(2.98)	(1.81)	(1.79)	(1.8)	(2.68)	(2.53)	(2.49)
DXY						-0.02	
						(-0.72)	
CRB	1.88					0.03	
	(0.67)					(1.24)	
WTI					0		
					(0.98)		
VIX	0.02 *	0.04 ***	0.04 ***	0.02 **	0.02 **	0.02 **	0.02 *
	(2.07)	(4.29)	(4.06)	(2.27)	(2.34)	(2.5)	(2.2)
Adjusted R^2	0.75	0.78	0.78	0.81	0.84	0.84	0.84
SIC	2.37	2.22	2.18	2.05	2	1.95	1.89
Observations	220	220	220	220	220	220	220

t-statistic in parentheses (computed using the Newey–West HAC variance estimator)

*** p < 0.01, ** p < 0.025, * p < 0.05

From this regression, it is observed that the risk premium on Brazilian nominal interest rates is positively associated with the public sector gross debt-to-GDP ratio, inflation expectations, Brazil's policy interest rate (*Selic*), and the *TLP*, which represents the cost of long-term financing provided by the Brazilian Development Bank (BNDES).[17] Additionally, the risk premium is also positively related to external factors such as the slope of the U.S. nominal yield curve, the U.S. real interest rate, the VIX, and the exchange rate of

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[17] The robustness of the results is maintained even when the fiscal variable used, public sector gross debt as a share of GDP, is replaced by public sector net debt as a share of GDP.

the U.S. dollar against the Brazilian Real. These results highlight the influence of the international environment on the Brazilian nominal bond market. These findings are consistent with Costa Filho (2023), who also identifies the relevance of both domestic factors, such as inflation expectations, monetary policy interest rate and public debt, and international conditions, particularly related to U.S. interest rates, as key determinants of Brazil's long-term term premium. However, Costa Filho (2023) reports that VIX is not significant in the best specifications, a difference that may stem from the risk premium measure (he uses an Affine Term Structure Model following the approach of Kaminska et al., 2021), the maturity horizon (10 years vs. 5 years), and the choice of external variables.

Table 2 presents the variation in the risk premium (ΔACM) resulting from a one standard deviation increase in the explanatory variables from Regression 7. Note that the largest fluctuations in the risk premium are associated with changes in U.S. interest rates, demonstrating their influence on the risk premium of Brazilian nominal rates.

Table 2 – Changes in the Risk Premium (ΔACM) Resulting from a One Standard Deviation Change in the Variables of Regression 7

One standard deviation change	ΔACM
Focus	0.005
Selic	0.522
TLP	0.236
GGGD	0.301
TIPS_5	0.732
USPRE10 - USPRE2	0.693
USD/BRL	0.001
VIX	0.137

Figure 4 shows the time-series decomposition of the term premium based on the estimates from Regression 7. The explanatory variables are grouped into four categories: External (*TIPS_5*, *USPRE10 – USPRE2*, *USD/BRL*, and *VIX*), Fiscal (*GGGD*), Inflation (*Focus*), and Interest Rates (*Selic* and *TLP*). The constant and the error term are not shown in the figure.

Note: The estimated risk premium shown in the figure (y-axis) does not consider the (negative) constant or the error term.
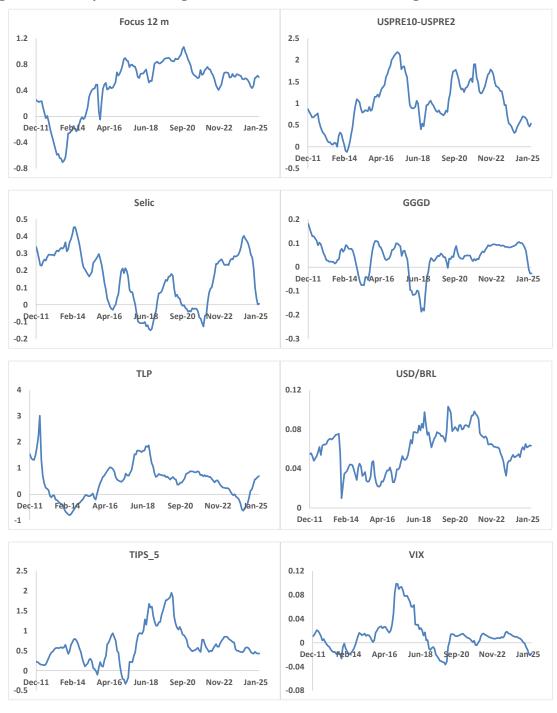
The Interest Rate factor is the most prominent component in the decomposition throughout the sample. Its contribution stands out particularly until 2016 and rises sharply again from 2022 onward. The Inflation factor shows intermediate relevance. It gained greater weight starting in 2014, during a period of increased inflation, but its influence declined after 2017, although it has increased again in the recent period. The Fiscal factor, initially the least representative, begins to play a more significant role from 2016. Finally, the External factor displays a more volatile contribution. It starts the series with relatively high importance, peaking during the 2008 financial crisis, rising again between 2013 and 2016, and once more in recent years.

Next, we analyze how the coefficients of the statistically significant variables from Regression 7 evolve over time. To do this, we estimate the model using a 5-year (60-month) rolling window. The results are presented in Figure 5. Each data point corresponds to the coefficient estimated using the five-year lagged sample.

The time series of estimated coefficients are consistently positive, with the exchange rate being the only variable whose coefficient remains persistently above zero. Inflation expectations (Focus) have become increasingly important in determining the risk premium (at the beginning of the sample, the coefficient was close to zero), while external variables (TIPS_5, USPRE10 – USPRE2, USD/BRL, and VIX) seem to lose relevance toward the end of the sample. USD/BRL gains importance toward the very end of the series, possibly due to U.S. foreign trade policy. The TLP coefficient peaked at the beginning of the series, possibly

due to the subprime crisis and again in the middle of the sample (Brazil's political turmoil). In both periods, BNDES was extensively used to provide subsidies to Brazilian companies. Interestingly, the SELIC coefficient seems to mirror its level over the sample period, reflecting the monetary policy cycle.[18]

Figure 5: Time Dynamics of Regression 7 Coefficients (5-Year Rolling Window)

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[18] The correlation between the two series is 0.42. Appendix B presents both graphs, which reveal a negative trend followed by an upward movement toward the end of the sample period.

5. Final Remarks

This study investigates the determinants of the risk premium embedded in Brazilian nominal interest rates using the methodology of Adrian, Crump, and Moench (2013). The analysis reveals that a broad set of macroeconomic variables, both domestic and external, significantly influence the behavior of the term premium. In particular, the monetary policy rate (Selic), the cost of long-term financing (TLP), inflation expectations, public debt indicators, U.S. interest rates, the USD/BRL exchange rate, and global financial volatility are all identified as relevant drivers. These findings highlight the importance of tracking both local fundamentals and global market conditions when assessing the dynamics of long-term interest rates in Brazil.

The time-series decomposition of the risk premium indicates that domestic interest rate variables account for the largest share of its variation throughout the sample, with inflation expectations and fiscal indicators playing secondary but still relevant roles. External factors such as U.S. interest rates and global volatility indices show increasing influence during episodes of international financial stress. These results have important implications for monetary and fiscal policies, suggesting that shifts in long-term yields may not solely reflect market expectations about the future path of the Selic rate, but also risk compensations driven by macro-financial uncertainty.

Future research could explore several extensions of this analysis. First, it would be valuable to assess the time-varying nature of the risk premium determinants using a rolling window or regime-switching approach, which could better capture structural changes in the economy or shifts in investor behavior. Second, similar methodologies could be applied to estimate and analyze real-term premia, isolating inflation risk more explicitly. Finally, cross-country comparisons with other emerging markets (e.g., inflation-targeting or not)[19] could help identify common and idiosyncratic factors affecting long-term interest rate premia, offering insights into the role of institutional and policy frameworks in shaping market risk perceptions.

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[19] See, for instance, Almeida et al. (2022) for evidence on time-varying term premia in Central and Eastern European countries.

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Appendix A – Correlation Matrix of Variables in Regression 7

Table A: Correlation matrix of variables in regression 7

	Focus	Selic	TLP	TIPS_5	GGGD	USD/BRL	VIX	USPRE10 - USPRE2
Focus	100%							
Selic	47%	100%						
TLP	-6%	63%	100%					
TIPS_5	-32%	50%	59%	100%				
GGGD	-50%	-43%	18%	-2%	100%			
USD/BRL	4%	-5%	-13%	1%	1%	100%		
VIX	-7%	1%	-11%	11%	-7%	25%	100%	
USPRE10 - USPRE2	46%	-1%	-45%	-40%	-69%	1%	18%	100%

Appendix B – Time Dynamics of the SELIC Rate and Its Coefficient in Regression 7 Using a 5-Year Rolling Window