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Determinants of the term premium in Brazil[1]

Determinantes do prêmio de risco pela maturidade na curva de juros brasileira

Resumo: Este artigo utiliza um modelo para decompor os rendimentos nominais no componente da expectativa de taxas de curto prazo no futuro e no prêmio pela maturidade. Em seguida são utilizadas regressões para explicar os determinantes do prêmio pela maturidade no Brasil. Encontra-se que o prêmio de risco pela maturidade e a política monetária americana, assim como as expectativas e as dispersões de mercado para inflação, crescimento econômico, taxa de juros e dívida líquida no Brasil contribuem para explicar os movimentos do prêmio de risco pela maturidade de 10 anos.

Palavras-chave: Prêmio pela maturidade; Expectativas para a taxa de juros de curto prazo; Modelo afim.

Abstract: *This paper uses a model to decompose nominal yields in expected short-term future rates and the term premium. It then uses regressions to explain the determinants of the term premium in Brazil. Among external variables, U.S. term premium and monetary policy help to explain Brazilian 10-year term premium, while among domestic variables, survey expectations for inflation, GDP growth, the Selic policy rate and net debt, along with their disagreement, contribute to explain movements in the Brazilian 10-year term premium.*

Keywords: *Term premium; Expected short-term interest rate; Affine model.*

Classificação JEL: E43; E44; G12; H63.

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1. Introduction

Term premium is defined as the difference between the yield of a long-term bond and the expected average short-term rate over the same period. Therefore, it reflects the risk compensation of holding a long-term bond, rather than rolling over short-term securities. The term premium is not directly observable and is usually estimated from financial and macroeconomic variables.

This paper attempts to understand the determinants of the term premium in Brazil. This question is of interest for both policymakers and investors. For the former, it is crucial to understand which domestic and external variables affect the term premium and hence the cost of financing. Monetary policymakers may be interested in whether changes in long-term yields derives from changes in short-term expectations or term premia. On the other hand, investors are interested in how these variables interact and affect their returns. Therefore, a proper understanding of term premium dynamics is crucial to assess changes in expectations regarding interest rates and their transmission to the economy.

The term premium depends on the amount of risk and the price of risk, both of which vary over time according to change in fundamentals, i.e., uncertainty about inflation, economic activity and monetary policy - suggesting a substantial business cycle component, along with change in the risk appetite along the business cycles, and demand for safe assets, as pointed out by Cohen et al. (2018).

Regarding the relationship between term premium and measures of uncertainty and economic activity, Kim and Orphanides (2007) show a positive correlation between measures of 10-year term premium and the dispersion of forecasts of inflation and short-term interest rates[3]. Other factors that influence the term premium are related to supply and demand imbalances, for instance related to official purchases of government bonds, and demand for specific maturities from investors such as pension funds and insurance companies, exerting downward pressure on long-term yields.

There is a large literature about the term premium for advanced economies, particularly the U.S. Recent papers include Kim and Orphanides (2012), who estimated a three-factor Gaussian affine term structure model augmented with forecasts for the three-month interest rates, finding that information from survey forecasts results in an increased precision of term premium estimates. Adrian et al. (2013) used principal components of bond yields as pricing factors. Hordahl and Tristani (2014) used a model with macroeconomic factors, including data on nominal and real yields, inflation, output gap, and survey data on forecasts of interest-rates and inflation to investigate the inflation risk premium in the U.S. and the Euro Area.

In contrast, evidence on the determinants of the term premium for other countries, particularly emerging markets, is still scant. For India, Dilip (2019) found that the 10-year term premium is impacted positively by inflation volatility and monetary policy uncertainty and negatively by liquidity in the secondary market and net foreign portfolio investments in debt. Callaghan (2019) found that the 10-year term premium in New Zealand is explained by the volatility of inflation, the implied volatility of options on US Treasury futures (the MOVE Index) and the unemployment rate. Likewise, María et al. (2020) found that the term premium in Mexico is explained by: i) the U.S. term premium; ii) the slope of the real yield curve, given by the difference between the 10-year and the 3-years yields, taken as a proxy for the real term premium and: iii) the inflation risk premium, proxied by the FX risk, computed as the difference between the 10-year Mexican Government bonds denominated in pesos and in U.S. dollars.

This paper is motivated by similar research to other countries, as described above, intending to contribute to the macro-finance research in Brazil, which is still limited. Matsumara and Moreira (2006) used no-arbitrage models to study the interactions

3 The coefficient of correlation is 0.56 and 0.72 between the term premium and dispersion of inflation and Treasury bill rate forecasts, respectively.

between the economy and the yield curve from 2000 to 2005. They used daily data, finding that inflation shocks are the main sources of long-run fluctuations in nominal variables. Shousha (2008) found that monetary policy expectations embedded in yield curve spreads help to predict real activity, measured by the industrial production, retail sales, and employment data. Macroeconomic variables explain a large portion of the variance of long-term interest rates, with inflation and the exchange rate responding for a great share of the 12-month yield. Guillen and Tabak (2009) modeled the term premium with the Kalman filter. They rejected the expectations hypothesis of the term structure, finding that term premiums are not constant over 1995-2006. They also found that global risk aversion explains a large part of term premiums.

More recent works using Brazilian data include Ornelas and Silva Jr (2015), who use survey data to account for interest rate expectations. They then obtain measures for the term premium for the DI yield curve and find evidence supporting the Liquidity Preference Hypothesis (LPH), which states that the premium increases with time to maturity. Along the same lines, Buratto (2017) follows the methodology of Crump et al. (2016) and uses survey forecasts to identify interest rates expectations and obtain measures of risk premia for up to 4 years, which he associates to U.S. monetary policy and risk premium, disagreement about domestic inflation and volatility of the exchange rate and interest rates.

The rest of the paper is organized as follows. In addition to this introduction, Section 2 introduces the affine term structure model (ATSM). Section 3 describes the data used to estimate the model. Section 4 shows the results, with the decomposition of nominal yields in an expected future short-term rate components and the term premiums. Section 5 presents the results of the regressions and discusses the results. Section 6 presents the conclusion.

2. Model

This section describes the ATSM model in Kaminska *et al*. (2021), which is used to decompose nominal yields in the expected short-term future rates and term premiums using Brazilian nominal yields.

In these class of models, the evolution of the yield curve is governed by the dynamics of the short rate. This rate is expressed as a linear function of the latent factors, which are assumed to evolve as a Vector Auto-Regression (VAR). The transition of a risk-neutral measure -where there is no risk premium - to a real-world measure is done by a time-varying market price of risk, which is assumed to be an affine (linear) function of the latent factors. There fore, both the short rate and the market price of risk are linear functions of the latent factors, which then drives bond yields dynamics. Macroeconomic and financial factors are usually obtained as the principal components from a set of variables.

A stochastic discount factor (pricing kernel M_{t+1}) prices all bonds:

$$E_t\left[M_{t+1}R_{t+1}^{j}\right]=1 \tag{1}$$

Where E_t the expectation operator with respect to information in period t, M_{t+1} is a kernel that prices all bonds and $R^{(j)}_{t+1}$ is a one-period gross return on a bond of any maturity j. That is, $R_{t+1}^{(j)}=P_{t+1}^{(j-1)}/P_t^{j}$, where $P_t^{(j)}$ is the price in period t, of a bond of maturity j, which becomes a bond of maturity j *-1* one period later. Also $P_t^{(1)}=1$, as one dollar today has a dollar value of one dollar.

The pricing kernel has the following functional form:

$$M_{t+1} = \exp(-r_t)\frac{\psi_{t+1}}{\psi_t} \quad (2)$$

Where ψ_{t+1} is assumed to follow the log-normal process:

$$\psi_{t+1} = \psi_t \exp\left(-\frac{1}{2}\lambda_t^{'}\lambda_t - \lambda_t^{'}\varepsilon_{t+1}\right) \quad (3)$$

Combining both equations and taking logs:

$$-\log M_{t+1} = r_t + \frac{1}{2}\lambda_t^{'}\lambda_t + \lambda_t^{'}\varepsilon_{t+1} \quad (4)$$

Where r_t is the continuously compounded short-term nominal interest rate, λ_t is a $N x 1$ vector of risk prices for N underlying risk factors, and ε_{t+1} is a $N x 1$ vector of innovations.

The N risk factors summarize the state space and are assumed to follow a first-order Gaussian VAR:

$$X_t = \mu + \Phi X_{t+1} + \Sigma \in_t \quad (5)$$

with $\in_t \sim N(0, I_N)$. This VAR process is referred to as the "P-measure", and the implied dynamics as the "P-dynamics". This is referred to as the historical/empirical measure.

Both the short rate and the risk prices are assumed to be related to the N factors through the affine mappings:

$$r_t = \delta_0 + \delta_1^{'} X_t \quad (6)$$

$$\lambda_t = \Sigma^{-1}(\lambda_0 + \lambda_1 X_t) \quad (7)$$

where δ_0, δ_1, Σ^{-1}, λ_0, λ_1 are commensurate to the variables and, in particular, λ_1 is $N x N$. These equations mean that both the short rate r_t and the prices of risk λ_t are functions of the yield curve factors. Under risk neutrality (zero risk prices), the pricing kernel is $M_{t+1} = exp(-r_t)$, meaning that future cash flows are discounted with the short rate. In other words, under risk neutrality (Q – *measure*), the risk-free rate is used for discounting.

This model can be solved recursively for equilibrium bond prices, starting with $P^{(0)} = 1$. The vector of any J yields, $\hat{Y}_t$ can be written as:

$$\hat{Y}_t = A + Bx_t \quad (8)$$

where $\hat{Y}_t$ is a $J x 1$ vector. This equation means that the yield curve is a linear function of the states. This equation describes the model-implied yield curve, i.e., the cross-section of yields at a point in time that is consistent with non-arbitrage. The arbitrage-free loadings A and B are non-linear, recursive functions of the model parameters δ_0, δ_1, λ_0, λ_1, μ, Φ and Σ.

It can be shown that the coefficients A and B are unaffected by switching to risk neutral pricing $M_{t+1} = exp(-r_t)$ and a risk-adjusted law of motion for the risk factors:

$$X_t = \mu^Q + \Phi^Q X_{t-1} + \Sigma \in_t \tag{9}$$

Where:

$$\mu^Q = \mu - \lambda_0 \tag{10}$$

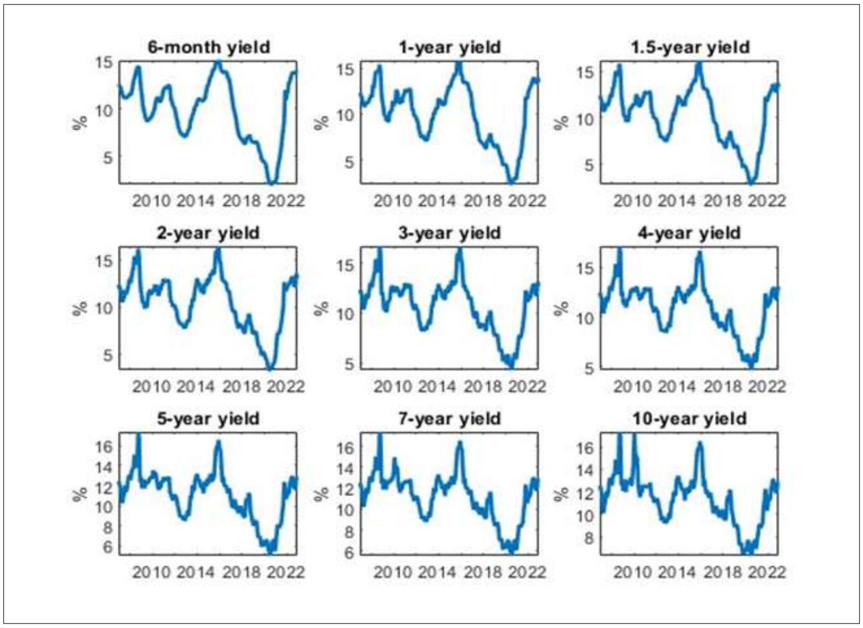
$$\Phi^Q = \Phi - \lambda_1 \tag{11}$$

This VAR is referred to as the Q-measure. describing the Q- dynamics, i.e., under risk neutral pricing. Under this measure, the model is parameterized in terms of δ_0, δ_1, μ^Q, Φ^Q and Σ. The model is estimated using Bayesian methods, using the Markov Chain Monte Carlo (MCMC) algorithm with 1,000,000 iterations. Further details about the model and estimation methods can be found in Kaminska et al. (2021).

3. Data

The dataset encompasses 192 monthly observations of zero-coupon nominal yields from January 2007 to December 2022. Nine maturities were used in the estimations: 6-month, 1-year, 1.5 - year, 2-year, 3-year, 4 - year, 5- year, 7-year and 10-year. Data for the 6-month yield come from the Ipeadata database[4]. Data for the 1-, 2-, 3-, 5- and 10-year yields come from Investing.com[5]. This website also contains data for the 3-month and 6-month yields, but since there are many missing datapoints, it was preferred to use the 6-month yield data from the Ipeadata database. Data for 1.5-, 4- and 7-year yields were linear interpolated from the others. Missing datapoints were also interpolated. Figure 1 plots the series used in the estimations, while Table 1 displays the descriptive statistics.

Figure 1 - Nominal yields used in the estimation.



Data source: Ipeadata, Investing.com

[4] http://www.ipeadata.gov.br/Default.aspx

[5] https://br.investing.com/

Table 1 - Descriptive dtatistics of the yields.

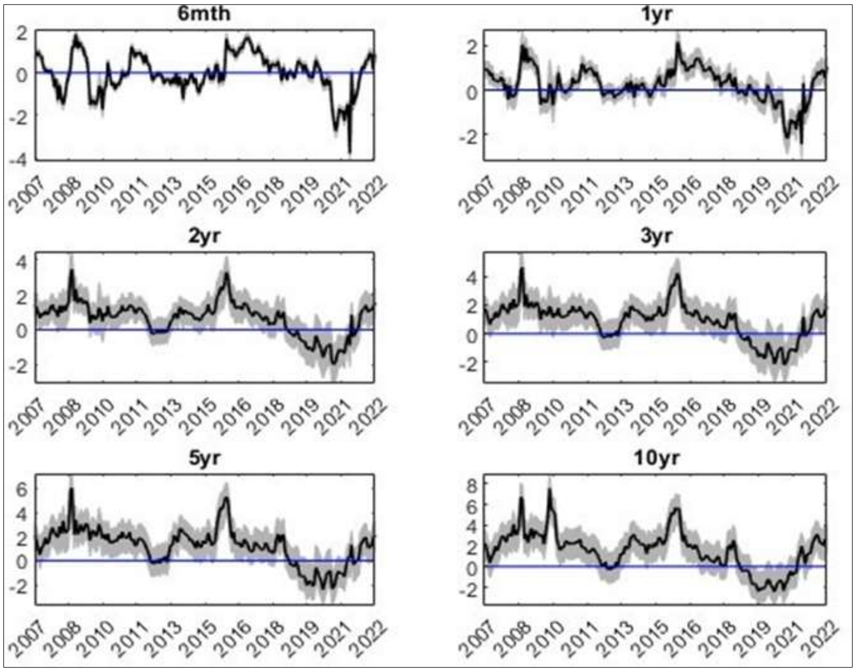
Maturity (years)	Mean	Median	Std. Dev	Min	Max
0.5	9.72	10.64	3.37	1.97	15.07
1	10	10.86	3.29	2.37	15.8
1.5	10.21	11.09	3.12	2.84	16.14
2	10.42	11.28	2.98	3.28	16.47
3	10.71	11.36	2.65	4.26	16.77
4	10.85	11.43	2.54	4.65	17.08
5	10.99	11.56	2.44	5.04	17.38
7	11.14	11.6	2.35	5.54	17.36
10	11.37	11.72	2.24	6.3	17.33

Source: Own elaboration.

4. Results

Figure 2 shows the term premiums for each maturity obtained from the estimation of the ATSM model in Section 2.

Figure 2 - Term premiums.



Source: Own elaboration.

The analysis is focused on the 10-year term premium, given the emphasis on this maturity in the related literature. This contrasts with previous studies about the determinants of the risk premium in Brazil, which focused on shorter maturities.

Noticeable, the correlation coefficient between the 10-year and the belly of the curve is very high, but much lower with shorter maturities. Table 2 displays the correlations.

Table 2 - Correlations across term premiums.

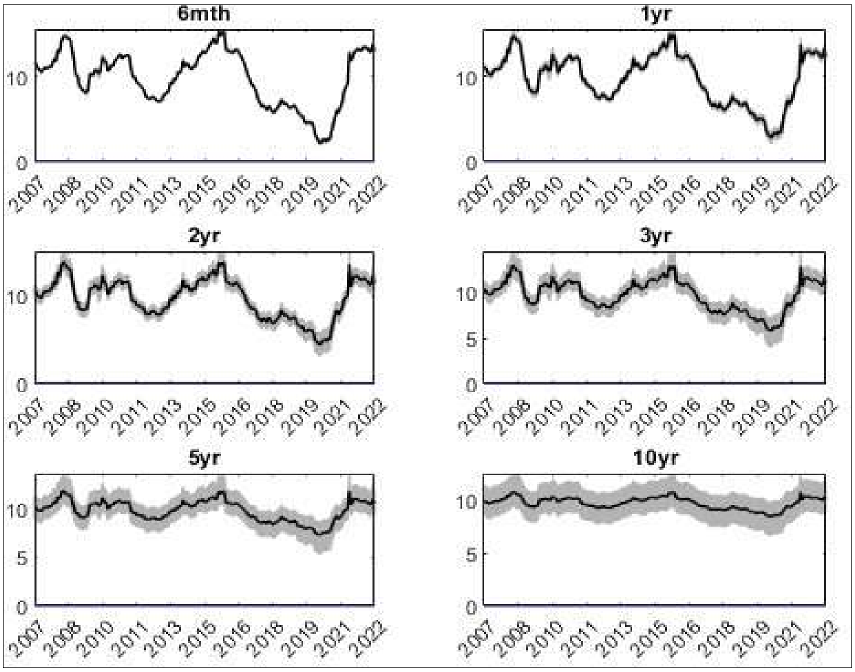
Maturity (years)	0.5	1	2	3	5	10
0.5	1	0.91	0.54	0.37	0.29	0.11
1	0.91	1	0.83	0.72	0.65	0.49
2	0.54	0.83	1	0.98	0.95	0.86
3	0.37	0.72	0.98	1	0.99	0.92
5	0.29	0.65	0.95	0.99	1	0.94
10	0.11	0.49	0.86	0.92	0.94	1

Source: Own elaboration.

Term premiums spiked in 2008, in the aftermath of the Global Financial Crisis (GFC), during the Brazilian recession of 2014-2016, and following general volatility in financial markets stemming from crisis in Argentina and Turkey in 2018. Periods with low term premiums occurred in 2007, before the GFC, in 2011-2012, following monetary stimulus in advanced economies, and were even negative from December 2018 to July 2021, rising significantly from then onwards. Therefore, term premiums were negative throughout the outbreak of Covid-19, but have been negative since 2019.

Figure 3 depicts the average expected short-term future rates, which can be interpreted as the nominal r-star rate of the economy, since the model is estimated with nominal yields. Again, the focus is on the 10-year maturity, consistent with the long-run concept of r-star. The expected rate component was hovering around 10% p.a. at the end of the sample period, while the average throughout the sample period is 9.78% p.a.

Figure 3 - Average expected short-term future rates.



Source: Own elaboration.

5. Determinants of term premiums

Having obtained the estimates of the term premiums for each maturity, this section investigates their drivers. Several domestic and external variables were used as explanatory variables in multiple linear regressions, namely: i) the excess bond premium (Gilchrist and Zakrajšek, 2012); ii) the ACM term premium (Adrian et al., 2013); iii) the Wu-Xia shadow rate (Wu and Xia, 2016); iv) the global economic policy uncertainty index (Baker et al., 2016); v) the MOVE Index, to capture interest rate volatility; vi) the VIX index, to capture stock market volatility and uncertainty in general; vii) the global factor of U.S. monetary policy (Miranda-Agrippino and Rey, 2020); viii) the Federal Funds Rate, Forward Guidance and Large Scale Asset Purchase factors (Swanson, 2021); ix) the IIE-Br uncertainty index of IBRE-FGV; and xii) IPCA, GDP, Selic, primary balance and net debt expectations and their disagreement, collected from the SGS database of the Central Bank of Brazil.

Only the best results are reported below. Even though the intention was to perform a comprehensive analysis on the determinants of term premium in Brazil, preliminary analysis resulted in non-statistically significant results for some variables described above, such as the excess bond premium, the uncertainty indexes, the MOVE and VIX indexes, the global factor of U.S. monetary policy of Miranda-Agrippino and Rey (2020) and the factors of Swanson (2021). All in all, the models showed that the Brazilian term premium is explained mainly by U.S. term premium and monetary policy and survey expectations about domestic variables, along with their disagreement[6].

Table 3 - Determinants of the 10-year term premium in Brazil.

Variables	(1) tp10y	(2) tp10y	(3) tp10y	(4) tp10y	(5) tp10y	(6) tp10y	(7) tp10y
acmtp10	1.12***	0.51***	1.11***	0.65***	0.87***	0.72***	0.58***
	(0.097)	(0.11)	(0.13)	(0.12)	(0.11)	(0.11)	(0.11)
wuxia	0.079*	0.081**	0.21***	0.27***	0.24***	0.041	0.089**
	(0.043)	(0.036)	(0.034)	(0.044)	(0.037)	(0.031)	(0.035)
selic1y		0.41***				0.40***	
		(0.026)				(0.025)	
selic2y			0.50***	0.29***	0.26***		0.57***
			(0.040)	(0.080)	(0.069)		(0.047)
selicsd3y		0.23				-0.17	
		(0.47)				(0.44)	
expgdp3y			-0.79***				
			(0.12)				
expstgdp2y			2.64***				
			(0.64)				
expstgdp3y		3.02***		3.62***	2.40**	2.35**	2.97***
		(1.02)		(1.05)	(1.05)	(1.01)	(1.02)
expipca1y				0.60***	0.60***		
				(0.13)	(0.12)		
expstipca3y			0.67				
			(0.54)				
sdnetdebt3y					0.28***	0.24***	0.27***
					(0.068)	(0.061)	(0.070)
Constant	0.98***	-4.35***	-2.86***	-6.24***	-6.42***	-4.38***	-6.36***
	(0.13)	(0.52)	(0.70)	(0.51)	(0.54)	(0.51)	(0.57)
Observations	191	191	191	191	191	191	191
Adjusted R-squared	0.407	0.766	0.785	0.736	0.759	0.782	0.737

Note: *tp10y* is the Brazil 10-year term premium, *selic1y* and *selic2y* are the expected Selic rate rate 1- and 2-year ahead, respectively, *selicsd3y* is the standard-deviation of the 3-year ahead Selic rate, *expipca1y* is the 1–year ahead expected IPCA inflation rate, *sdnetdebt3y* is the standard-deviation of the 3-year ahead expected Net Debt, *expgdp3y* is the expected GDP growth rate 3-years ahead, *expstgdp2y* and *expstgdp3y* are respectively the standard-deviation of the 2- and 3-year ahead expected GDP growth rate, *expstipca3y* is the standard-deviation of the 3-year ahead IPCA inflation rate, *wuxia* is the Wu-Xia Shadow Rate, *acmtp10* is the ACM (2013) 10-year term premium. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

[6] I transform these series in constant maturity, according to the following equation: $forecast_{j+1}(month_j year_j) = ((12\text{-}month(date))/12) * forecast(year_j) + (month(date)/12) * forecast(year_{j+1})$. This formula builds the constant maturity forecast as a weighted average of the forecasts of two subsequent years. In a given date, there are forecasts for up to 4 years ahead. The equation is uses for each pair of subsequent years to create the constant maturity forecasts for 1,2 and 3 years ahead (j=0,1,2), respectively.

The first column in Table 3 shows a model that explains the 10-year term premium as a function of the ACM 10-year term premium for the U.S. and the Wu-Xia shadow rate. The adjusted R^2 of this model is 0.40, and both variables are statistically significant. This is consistent with the high correlation of term premiums documented in Iskrev (2018) and Cohen et al. (2018), indicating a common dynamic between term premiums across countries.

The effect of the Wu-Xia shadow rate on the Brazilian term premium can be interpreted through the lens of the risk channel of monetary policy, with changes in U.S. monetary policy triggering swings in risk appetite globally. Higher U.S. rates leads to a repricing in risk, with spillovers to emerging markets interest rates (BAUER, 2022; KALEMLI-ÖZCAN, 2019; ROGERS ET AL., 2018; BEKAERT ET AL. 2013 for the stock market).

This finding is consistent with the view that higher risk premia in response to U.S. monetary policy leads to higher long-term rates in emerging markets, steepening the yield curve. Increases in risk premia tighten financial conditions and impairs the transmission of monetary policy in emerging markets, limiting the space for policy actions (SEOKKI et al. 2023).

Columns 2 to 4 show how the results change with the inclusion of expectations, namely the expectations about the Selic policy rate 1 and 2 years ahead (variables *selic1y* and *selic2y*, respectively), disagreement about GDP growth 2 and 3 years ahead (variables *expstgdp2y* and *expstgdp3y*, respectively), and expectations about inflation as measured by the IPCA 1 year ahead (*expipca1y*).

The inclusion of expectations data improve significantly the explanatory power of the models, to above 73%. The importance of disagreement of future GDP growth can be interpreted as a form of uncertainty about the fundamentals of the economy in the future. Relatedly, the models in columns 4 and 5 show that inflation expectations (variable *expipca1y*) play a role in 10-year Brazilian term premium.

Likewise, the effect of expectations of the Selic policy rate (variables *selic1y* and *selic2y*) and their disagreement in the long run (variable *selicsd3y*) for term premiums in Brazil can be seen through the lens of the role of monetary policy and its communication. Since these variables are statistically significant across many specifications (also in Table 4), it highlights that monetary policy should be conducted in a smooth and predictable way in order to not increase the component of term premiums that is due to monetary policy. Relatedly, Bundick et al. (2017) explore the channels between monetary policy uncertainty and the term premium in the U.S.

Finally, the role of fiscal policy is captured by the disagreement about net debt in the long run (variable *sdnetdebt3y*). This variable is statistically significant in the specifications in columns (5) to (7). Uncertainty about fiscal policy in the future commands a risk premium in 10-year rates. This finding is consistent with papers that explore the transmission channels of fiscal policy and the term structure of interest rates (DAI AND PHILLIPON, 2005[7]; BRETSCHER ET AL., 2020[8]), and particularly the role of fiscal policy uncertainty in periods of high government debt to bond risk premia (LIU, 2023).[9]

In order to provide robustness, Table 4 presents the results of the regressions replacing the 10-year term premium of the ACM model by the 10-year term premium of the Kim Wright (2005) model[10]. Overall, this change is associated with a higher explanatory power in all specifications, with U.S. term premium and monetary policy explaining 56% of the variation in the Brazilian 10-year term premium, up from 40% when the ACM term premium is used as a measure of U.S. term premium in Table 3.

7 Using U.S. data from 1970 to 2003, these authors find that a fiscal shock that increase the deficit to GDP ratio by 1% leads to 40-50 basis points increase in the 10-year interest rate. Also, they find that fiscal shocks matter more at longer horizons, explaining around 12% of the variance of interest rates beyond 5 years.

8 These authors explain the link between government spending volatility shocks as follows: higher government spending uncertainty increase expectations of higher government spending in the future. As a response, households increase savings due to precautionary reasons, and then consume less and save more in the present, decreasing demand, current consumption and inflation. Short-term interest rates fall, due to increased demand of bonds in response to higher savings. Government spending volatility shocks have a negative level effect on the term structure but a positive effect on the slope, generating positive term premia. Put differently, fiscal policy uncertainty shocks work as slope shocks in their DSGE model, and this effect is amplified during Zero Lower Bound (ZLB) episodes.

9 For the U.S., this author finds that a one-percentage-point increase in the debt-to-GDP ratio is associated with a 6 basis-point increase in bond excess return, i.e., bond return in excess of the risk-free rate.

10 This series was obtained from the Federal Reserve Bank of St. Louis: https://fredstlouisfed.org/series/THREEFYTP10.

Table 4 - Determinants of the 10-year term premium in Brazil.

Variables	(1) tp10y	(2) tp10y	(3) tp10y	(4) tp10y	(5) tp10y	(6) tp10y
kwtp10	2.75***	1.30***	2.03***	2.26***	1.82***	1.84***
	(0.18)	(0.22)	(0.20)	(0.23)	(0.23)	(0.24)
wuxia	-0.054	0.031	0.081**	0.077*	-0.036	-0.023
	(0.039)	(0.039)	(0.039)	(0.039)	(0.036)	(0.036)
selic1y		0.34***			0.30***	
		(0.031)			(0.030)	
selic2y			0.42***	0.20***		0.45***
			(0.046)	(0.054)		(0.052)
selicsd3y		0.96**			0.85**	
		(0.40)			(0.36)	
expgdp3y			-0.38***			
			(0.083)			
expstgdp2y			2.69***			
			(0.62)			
expstgdp3y		2.10**		1.19	0.85	1.88**
		(0.91)		(0.98)	(0.94)	(0.90)
expipca1y				0.51***		
				(0.098)		
expstipca3y			1.38***			
			(0.52)			
sdnetdebt3y				0.34***	0.28***	0.35***
				(0.057)	(0.054)	(0.060)
Constant	1.20***	-3.88***	-3.33***	-4.79***	-3.77***	-4.93***
	(0.093)	(0.53)	(0.65)	(0.57)	(0.49)	(0.60)
Observations	191	191	191	191	191	191
Adjusted R-squared	0.562	0.784	0.790	0.797	0.805	0.778

Note: *tp10y* is the Brazil 10-year term premium, *selic1y* and *selic2y* are the expected Selic rate rate 1- and 2-year ahead, respectively, *selicsd3y* is the standard-deviation of the 3-year ahead Selic rate, *expipca1y* is the 1–year ahead expected IPCA inflation rate, *sdnetdebt3y* is the standard-deviation of the 3-year ahead expected Net Debt, *expgdp3y* is the expected GDP growth rate 3-years ahead, *expstgdp2y* and *expstgdp3y* are respectively the standard-deviation of the 2- and 3-year ahead expected GDP growth rate, *expstipca3y* is the standard-deviation of the 3-year ahead IPCA inflation rate, *wuxia* is the Wu-Xia Shadow Rate, *kwtp10* is the 10-year Kim-Wright (2005) term premium. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Qualitatively, the results are the same as before for the other controls in the models. Inflation disagreement for 3-years ahead (variable *expstipca3y*) is statistically significant is the specification in column (3), this result is consistent with the effect of inflation uncertainty on term premiums (WRIGHT, 2011; D'AMICO AND ORPHANIDES, 2014), and conforms to the evidence that inflation disagreement impacts nominal interest rates, even after controlling for the impact of volatility of economic growth, expected inflation and inflation volatility (EHLING et al., 2019).

Finally, Figure 4 compares the 10-year term premium of the ACM model, the 10-year term premium of the Kim Wright model and the 10-year Brazilian term premium obtained from the Kaminska et al. (2021) model.

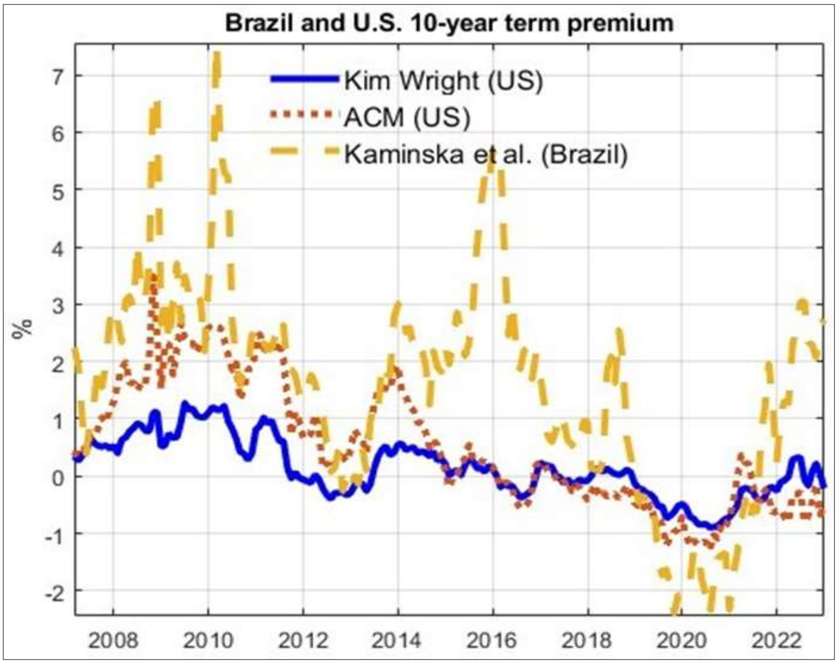
Term premium in Brazilian 10-year rates spiked during the GFC in 2008, during the 2014-2016 recession and in 2018. While the dynamics in 2008 was accompanied by the U.S. term premium, the sharp increase of the Brazilian 10-year term premium in 2014-2016 was mainly driven by domestic variables. In contrast, 10-year term premium was negative in Brazil from December 2018 to July 2021, increasing significantly afterwards.

In comparison with previous studies about the term structure in Brazil, the results presented above are consistent with the notion that interest rate volatility in Brazil is linked to the volatility of its fundamentals, and the great role of macroeconomic factors in yield curve dynamics.

For instance, in the Brazilian literature, Shousha (2008) finds that output gap, inflation, exchange rate volatility and global risk aversion respond for the bulk of interest rate volatility. Guillen and Tabak (2009) find that global risk aversion, along with inflation and exchange rate volatility were the main drivers of the term premium from 1995 to 2006.

Matsumura and Moreira (2006) find a large role for the inflation shock.

Figure 4 - Term premiums in U.S. and Brazil.



Source: Own elaboration.

From a policy perspective, this means that authorities should aim for policies that reduce macroeconomic volatility and promote the stability of the economy.

The interplay between macroeconomic variables and the term premium has been highlighted in papers such as Koop and Williams (2018), which incorporates cyclical aspects of unemployment and inflation in the estimation of the term premium for the U.S., and show that this delivers smooth and stable estimates of expected long-term interest rates.

6. Conclusion

This paper used the term structure model of Kaminska et al. (2021) to decompose nominal yields in expected short-term future rates and term premiums. In the second stage, term premiums were modeled as a function of macroeconomic and financial variables. The main goal was to understand the drivers of term premiums in Brazil, a large emerging market. It bears resemblance with María et al. (2020), Dilip (2019), and Callaghan (2019) who investigate the determinants of the term premium in Mexico, India and New Zealand, respectively.

Relative to previous works that studied the risk premium in Brazilian term structure, this paper innovates in three ways.

First, it uses an ATSM to explicitly obtain measures of the term premium, consistent with the international literature. Previous works mostly obtained measures of the term premium through indirect ways, using survey data to identify interest rate expectations and obtaining term premiums as the residual component in swap rates.

The second difference is the focus on 10-year premiums, aligned with most of the international literature, and more important to understand long-term cost of financing in Brazil. As emphasized by Jotikasthira et al. (2015) and Crump et al. (2016), term premiums are the main source of volatility of long-term bond yields, hence it is important to understand how they react to macroeconomic shocks.

The third distinct feature is to try to model the term premium using a large number of explanatory variables, employing the most common measures of uncertainty and volatility in the literature, along with a comprehensive analysis of survey data.

The main contribution of the paper is to provide new evidence for the determinants of risk premiums in Brazil, using 16 years of data, adding to the literature on the determinants of term premia in emerging markets.

The results are consistent with a global co-movement between term premiums (JOTIKASTHIRA ET AL., 2015; ISKREV, 2018; COHEN et al., 2018), and also with the risk-taking channel of monetary policy. Changes in U.S. monetary policy leads to a repricing of the term premium components of interest rates in emerging markets. In the estimated models in Tables 3 and 4, this channel is represented by the Wu-Xia shadow rate variable. Both the U.S. term premium (either from the ACM or the Kim-Wright models) and the Wu-Xia shadow rate are statistically significant across most specifications.

All in all, the results also highlight the role of domestic fundamentals to explain the Brazilian term premium. The adjusted R2 of models that include expectations of domestic variables increase to up to 78%, from 40% in models that include only external variables in Table 3, and from 56% to 80% according to the results in Table 4.

While the results are consistent with spillovers of U.S. term premiums and monetary policy to Brazil, sizeable part of the movements in the Brazilian 10-year term premium are related to expectations about domestic variables (fiscal and monetary policy, inflation and GDP). Therefore, the estimated models show the importance of sound fundamentals to insulate Brazilian economy from external shocks.

References

ADRIAN, T.; CRUMP, R. K.; MOENCH, E. Pricing the term structure with linear regressions. Journal of Financial Economics, v. 110, n. 1, p. 110–138, out. 2013.

BAKER, S. R.; BLOOM, N.; DAVIS, S. J. Measuring Economic Policy Uncertainty. The Quarterly Journal of Economics, v. 131, n. 4, p. 1593–1636, 11 jul. 2016.

BAUER, M. D. Risk Appetite and the Risk-Taking Channel of Monetary Policy. Disponível em: <https://www.michaeldbauer.com/publication/risk/>. Acesso em: 19 maio. 2023.

BEKAERT, G.; HOEROVA, M.; LO DUCA, M. Risk, uncertainty and monetary policy. Journal of Monetary Economics, v. 60, n. 7, p. 771–788, out. 2013.

BRETSCHER, L.; HSU, A.; TAMONI, A. Fiscal policy driven bond risk premia. Journal of Financial Economics, maio 2020.

BUNDICK, B.; HERRIFORD, T.; SMITH, A. L. Forward Guidance, Monetary Policy Uncertainty, and the Term Premium. Research Working Paper, 12 jul. 2017.

BURATTO, F. J. DE A. O prêmio de risco na estrutura a termo da taxa de juros no Brasil. bibliotecadigital.fgv.br, 22 ago. 2017.

CALLAGHAN, M. Expectations and the term premium in New Zealand long-term interest rates. Disponível em: <https://ideas.repec.org/p/nzb/nzbans/2019-02.html>. Acesso em: 6 set. 2019.

COHEN, B.; HÖRDAHL, P.; XIA, F. D. Term premia: models and some stylised facts. BIS Quarterly Review, 2018.

CRUMP, R. K.; EUSEPI, S.; MOENCH, E. The term structure of expectations and bond yields. Staff Reports, 1 maio 2016.

DAI, Q.; PHILIPPON, T. Fiscal Policy and the Term Structure of Interest Rates. NBER Working Papers, 1 ago. 2005.

D'AMICO, S.; ORPHANIDES, A. Inflation Uncertainty and Disagreement in Bond Risk Premia. Working Paper Series, 11 jan. 2014.

DILIP, A. Term Premium Spillover from the US to Indian Markets. Disponível em: < https://www.rbi.org.in/Scripts/PublicationsView.aspx?id=19405>. Acesso em: 19 maio. 2023.

EHLING, P. et al. Disagreement about inflation and the yield curve. Journal of Financial Economics, v. 127, n. 3, p. 459–484, mar. 2018.

GILCHRIST, S.; ZAKRAJŠEK, E. Credit Spreads and Business Cycle Fluctuations. American Economic Review, v. 102, n. 4, p. 1692–1720, jun. 2012.

GUILLEN, O. T.; TABAK, B. M. Characterizing the Brazilian Term Structure of Interest Rates. Working Papers Series, 1 fev. 2008.

HÖRDAHL, P.; TRISTANI, O. Inflation Risk Premia in the Euro Area and the United States. International Journal of Central Banking, v. 10, n. 3, p. 1–47, 2014.

ISKREV, N. Term premia dynamics in the US and Euro Area: who is leading whom? Economic Bulletin and Financial Stability Report Articles and Banco de Portugal Economic Studies, 2018.

JOTIKASTHIRA, C.; LE, A.; LUNDBLAD, C. Why do term structures in different currencies co-move? Journal of Financial Economics, v. 115, n. 1, p. 58–83, jan. 2015.

KALEMLI-ÖZCAN. U.S. Monetary Policy and International Risk Spillovers. NBER Working Papers, 1 set. 2019.

KAMINSKA, I.; MUMTAZ, H.; ŠUSTEK, R. Monetary policy surprises and their transmission through term premia and expected interest rates. Journal of Monetary Economics, jul. 2021.

KIM, D. H.; ORPHANIDES, A. The bond market term premium: what is it, and how can we measure it? BIS Quarterly Review, 2007.

KIM, D. H.; ORPHANIDES, A. Term Structure Estimation with Survey Data on Interest Rate Forecasts. The Journal of Financial and Quantitative Analysis, v. 47, n. 1, p. 241–272, 2012.

KIM, D. H.; WRIGHT, J. An arbitrage-free three-factor term structure model and the recent behavior of long-term yields and distant-horizon forward rates. Disponível em: <https://econpapers.repec.org/paper/fipfedgfe/2005-33.htm>. Acesso em: 19 maio. 2023.

KOPP, E.; WILLIAMS, P. D. A Macroeconomic Approach to the Term Premium. IMF Working Papers, 15 jun. 2018.

LIU, Y. GOVERNMENT DEBT AND RISK PREMIA. Journal of Monetary Economics, jan. 2023.

MARÍA, A.-A. A. et al. Term Premium Dynamics and its Determinants: The Mexican Case. Disponível em: <https://econpapers.repec.org/paper/bdmwpaper/2020-18.htm>. Acesso em: 19 maio. 2023.

MATSUMURA, M. S.; MOREIRA, A. R. Macro Factors and the Brazilian Yield Curve with no Arbitrage Models. SSRN Electronic Journal, 2006.

MIRANDA-AGRIPPINO, S.; REY, H. US Monetary Policy and the Global Financial Cycle. The Review of Economic Studies, v. 87, n. 6, 8 maio 2020.

ORNELAS, J. R. H.; SILVA JR., A. F. DE A. Testing the liquidity preference hypothesis using survey forecasts. Emerging Markets Review, v. 23, p. 173–185, jun. 2015.

ROGERS, J. H.; SCOTTI, C.; WRIGHT, J. H. Unconventional Monetary Policy and International Risk Premia. Journal of Money, Credit and Banking, v. 50, n. 8, p. 1827–1850, 30 maio 2018.

SEOKKI, H. The Global Transmission of U.S. Monetary Policy. Disponível em: <https://ideas.repec.org/p/wrk/warwec/1257.html>. Acesso em: 17 ago. 2023.

SHOUSHA, S. Estrutura a termo da taxa de juros e dinâmica macroeconômica no Brasil. [s.l.] Banco Nacional de Desenvolvimento Econômico e Social, 2008.

SWANSON, E. T. Measuring the effects of federal reserve forward guidance and asset purchases on financial markets. Journal of Monetary Economics, v. 118, p. 32–53, mar. 2021.

WRIGHT, J. H. Term Premia and Inflation Uncertainty: Empirical Evidence from an International Panel Dataset. American Economic Review, v. 101, n. 4, p. 1514–1534, jun. 2011.

U, J. C.; XIA, F. D. Measuring the Macroeconomic Impact of Monetary Policy at the Zero Lower Bound. Journal of Money, Credit and Banking, v. 48, n. 2-3, p. 253–291, mar. 2016.