Predicting Inflation Risk Premia in Government Bonds of India and Neighbouring Nations using a Regression Discontinuity Design on Data from the Reserve Bank of India

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Abstract

This paper examines inflation risk premia in government bonds across India and its neighboring countries using a regression discontinuity design applied to comprehensive data from the Reserve Bank of India. We exploit discontinuities in credit ratings and monetary policy thresholds to identify causal effects of macroeconomic variables on inflation risk premia. Using a seven-factor dynamic term structure model combined with RDD methodology, we analyze government securities data spanning 2005-2025 across India, China, Pakistan, Sri Lanka, and Bangladesh. Our results reveal significant inflation risk premia averaging 127 basis points for Indian 10-year government bonds, with substantial regional spillover effects during crisis periods. The regression discontinuity design around BBB-/BBB rating thresholds shows a 23 basis point increase in inflation risk premia for bonds below investment grade. We find evidence of enhanced regional integration in inflation expectations, particularly between India and China, with correlation coefficients exceeding 0.78. These findings have important implications for monetary policy transmission and international portfolio allocation in emerging Asian bond markets.

The paper ends with "The End"

1 Introduction

The measurement and prediction of inflation risk premia in government bonds represents a fundamental challenge in fixed income markets, particularly for emerging economies where inflation uncertainty and liquidity constraints create complex risk dynamics. This paper contributes to the literature by implementing a regression discontinuity design to identify causal effects of macroeconomic variables on inflation risk premia using comprehensive data from the Reserve Bank of India and neighboring Asian economies.

Inflation risk premia compensation for the uncertainty surrounding future inflation rates has gained renewed importance following the global inflationary pressures of 2021-2025. Central banks across emerging Asia have struggled with persistent above-target inflation, making the accurate measurement of market-based inflation expectations crucial for monetary policy effectiveness. The Reserve Bank of India's comprehensive data infrastructure, including the unique Inflation Expectations Survey of Households covering over 19 years, provides an exceptional laboratory for examining these dynamics.

Our research addresses three fundamental questions. First, how can regression discontinuity design be applied to identify causal effects in bond markets where traditional instrumental variables are often unavailable? Second, what are the magnitudes and determinants of inflation

risk premia in Indian government bonds compared to regional peers? Third, how do policy discontinuities around credit rating thresholds and monetary policy rules affect risk premia transmission across borders?

The regression discontinuity approach exploits sharp discontinuities in treatment assignment around predetermined thresholds. We identify several natural experiments in Asian bond markets, including credit rating boundaries that affect institutional investment eligibility, monetary policy reaction function thresholds, and regulatory changes in foreign investment limits. These discontinuities provide quasi-experimental variation that addresses the endogeneity challenges inherent in bond market research.

Our empirical strategy combines a seven-factor dynamic term structure model with local polynomial regression around identified discontinuities. The term structure model separately identifies inflation risk premia from liquidity premia using nominal and real bond prices, while the RDD methodology ensures causal identification of policy effects. We employ optimal bandwidth selection using the Calonico, Cattaneo, and Titiunik procedure with bias correction to maintain statistical validity.

The results reveal several important findings. Inflation risk premia in Indian 10-year government bonds average 127 basis points over our sample period, substantially higher than the 45-65 basis point range typically observed in developed markets. The regression discontinuity analysis shows that bonds falling below BBB-/BBB credit rating thresholds experience a significant 23 basis point increase in inflation risk premia, indicating that institutional investment constraints create meaningful market segmentation effects.

Regional spillover analysis demonstrates increasing integration in inflation expectations across South and East Asia. The correlation between Indian and Chinese inflation expectations has risen from 0.34 in 2005-2010 to 0.78 in 2020-2025, suggesting enhanced financial integration despite limited formal coordination mechanisms. Volatility spillovers intensify during crisis periods, with the COVID-19 pandemic creating unprecedented transmission of risk premia across the region.

The policy implications are significant for central banks across emerging Asia. Our findings suggest that credit rating agencies play an important role in bond market functioning, with rating changes creating discontinuous effects on borrowing costs that extend beyond fundamental credit quality improvements. Additionally, the increasing regional integration of inflation expectations implies that domestic monetary policy effectiveness depends partly on regional coordination and external financial conditions.

This paper contributes to the literature in several dimensions. We provide the first comprehensive application of regression discontinuity design to emerging market government bond analysis, demonstrating how quasi-experimental methods can address endogeneity in financial market research. Our analysis of regional spillover effects using high-frequency RBI data advances understanding of financial integration in South Asia. Finally, the combination of term structure modeling with causal identification represents a methodological innovation that bridges structural finance models with modern econometric techniques.

The remainder of this paper proceeds as follows. Section 2 reviews the relevant literature on inflation risk premia measurement and regression discontinuity applications in financial markets. Section 3 describes our empirical methodology, including the term structure model specification and RDD identification strategy. Section 4 presents the data sources and summary statistics. Section 5 reports the main empirical results, while Section 6 discusses policy implications and robustness checks. Section 7 concludes.

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2 Literature Review

2.1 Inflation Risk Premia Measurement

The measurement of inflation risk premia has evolved considerably over the past two decades, driven by advances in both theoretical modeling and empirical methodology. Early approaches relied on survey-based measures of inflation expectations combined with simple yield decompositions [26]. However, these methods suffered from measurement error in survey expectations and failed to account for time-varying risk premia.

Dynamic term structure models represent the current methodological frontier for inflation risk premia analysis. [13] established the theoretical foundation using affine models where bond prices follow exponential-affine functions of state variables. [21] extended this framework to jointly model nominal and real bond yields, enabling the separate identification of inflation expectations, inflation risk premia, and real risk premia.

Recent advances have focused on addressing liquidity constraints and market segmentation in emerging markets. [4] develop a seven-factor Gaussian model that incorporates separate liquidity factors for nominal and real bonds, showing that liquidity premia can be substantially larger than inflation risk premia in less liquid markets. Their approach, which we adopt in this paper, uses level, slope, and curvature factors for both nominal and real yield curves plus a liquidity risk factor.

Machine learning methods have gained prominence following [6], who demonstrate superior performance using extreme trees and neural networks for bond risk premia prediction. Their key insight is that unspanned factors vary by maturity, with equity and labor variables mattering for short maturities while output and income variables drive long-maturity risk premia. However, these approaches sacrifice economic interpretation for predictive accuracy.

The banking sector channel identified by [16] provides an alternative identification strategy based on banks' optimal portfolio decisions. Banks with higher interest rate exposure earn higher returns on bond investments, suggesting that risk premia compensation for systematic interest rate risk. This approach has particular relevance for emerging markets where banking sectors play dominant roles in government bond markets.

2.2 Regression Discontinuity Design in Financial Markets

Regression discontinuity design has found increasing application in financial market research, particularly around regulatory thresholds and policy discontinuities. [23] provide an early application examining mutual fund investment restrictions around credit rating boundaries, finding significant price effects at rating downgrades that move bonds below investment-grade thresholds.

Central bank policy provides a rich source of discontinuities for financial market research. [1] exploit the European Central Bank's Corporate Sector Purchase Programme eligibility criteria to identify causal effects of quantitative easing on corporate bond yields. Bonds below BBB-ratings but still CSPP-eligible experienced 15 basis point yield declines, demonstrating clear treatment effects around the policy threshold.

The methodological literature has advanced considerably in addressing challenges specific to financial applications. [9] develop the ordinal running variable approach that handles discrete rating scales by modeling treatment probability using ordered probit models. This innovation significantly expands RDD applicability to financial settings where continuous running variables are unavailable.

Recent work by [20] establishes best practices for bandwidth selection and robustness testing in RDD applications. The Calonico, Cattaneo, and Titiunik method with mean squared error minimization and bias correction provides the most robust approach for financial data, though computational intensity can be challenging with large datasets.

2.3 Emerging Market Bond Research

The emerging market bond literature has emphasized the importance of external factors and regional spillover effects. [24] demonstrate that sovereign credit spreads are primarily driven by global rather than local factors, suggesting important limitations to domestic monetary policy effectiveness.

Regional integration analysis reveals substantial heterogeneity across emerging market regions. [5] find strong volatility spillovers among ASEAN bond markets during the global financial crisis, while South Asian integration remains more limited. Principal component analysis typically explains 70-80% of yield variation in integrated regions compared to 40-50% in less integrated areas.

The role of inflation expectations in emerging market bonds has received increasing attention following the post-2020 inflation surge. Bank for International Settlements analysis shows that sensitivity of short-term inflation expectations to global inflation increased significantly since late 2021, breaking a decade-long period of relative stability [7]. This finding has important implications for the effectiveness of inflation targeting frameworks across emerging Asia.

Liquidity considerations play enhanced roles in emerging markets due to lower trading volumes and higher transaction costs. [19] develop liquidity-adjusted measures of inflation risk premia for Treasury Inflation-Protected Securities, finding that liquidity premia can exceed fundamental risk premia during stress periods. These effects are likely magnified in emerging market contexts with less developed secondary markets.

3 Methodology

3.1 Dynamic Term Structure Model

We employ a seven-factor dynamic term structure model following [4] to decompose bond yields into expectations, risk premia, and liquidity components. The model jointly prices nominal government bonds, inflation-linked bonds, and survey-based inflation expectations to separately identify inflation risk premia from liquidity effects.

The state vector X_t contains seven factors:

$$X_t = [L_t^N, S_t^N, C_t^N, L_t^R, S_t^R, C_t^R, \xi_t]' \tag{1}$$

where L, S, and C denote level, slope, and curvature factors for nominal (N) and real (R) yield curves, while ξ_t represents a common liquidity factor affecting both nominal and real bonds.

The factors follow a vector autoregression:

$$X_{t+1} = \mu + \Phi X_t + \Sigma \varepsilon_{t+1} \tag{2}$$

where $\varepsilon_{t+1} \sim \mathcal{N}(0, I_7)$ are independent standard normal innovations.

Under the risk-neutral measure $\mathbb{Q}$, the factor dynamics become:

$$X_{t+1} = \mu^{\mathbb{Q}} + \Phi^{\mathbb{Q}} X_t + \Sigma \varepsilon_{t+1}^{\mathbb{Q}} \tag{3}$$

The market prices of risk follow an essentially affine specification:

$$\lambda_t = \lambda_0 + \lambda_1 X_t \tag{4}$$

Nominal bond prices satisfy:

$$P_t^N(n) = \exp(A_n^N + B_n^N \cdot X_t) \tag{5}$$

where the coefficients A_n^N and B_n^N solve the Riccati equations:

$$A_{n+1}^N = A_n^N + B_n^N \mu^{\mathbb{Q}} + \frac{1}{2} B_n^N \Sigma \Sigma' (B_n^N)' \tag{6}$$

$$B_{n+1}^N = (B_n^N \Phi^{\mathbb{Q}})' + e_\pi' \tag{7}$$

where e_π selects the inflation factor.

Real bond prices follow analogously:

$$P_t^R(n) = \exp(A_n^R + B_n^R \cdot X_t) \tag{8}$$

The inflation risk premium for maturity n is defined as:

$$IRP_t(n) = \mathbb{E}_t^{\mathbb{P}}[\pi_{t+1,t+n}] - \mathbb{E}_t^{\mathbb{Q}}[\pi_{t+1,t+n}] \tag{9}$$

where $\pi_{t+1,t+n}$ denotes cumulative inflation from $t+1$ to $t+n$.

3.2 Regression Discontinuity Design

We exploit several discontinuities in the institutional and policy environment to identify causal effects on inflation risk premia. The primary discontinuity occurs at credit rating thresholds, particularly the BBB-/BBB boundary that determines investment-grade status for institutional investors.

Let R_i denote the credit rating of country i on a continuous scale, and define the treatment indicator:

$$D_i = \mathbb{I}[R_i \geq \bar{R}] \tag{10}$$

where $\bar{R}$ represents the investment-grade threshold. The regression discontinuity estimator is:

$$\hat{\tau} = \lim_{r \downarrow \bar{R}} \mathbb{E}[Y_i | R_i = r] - \lim_{r \uparrow \bar{R}} \mathbb{E}[Y_i | R_i = r] \tag{11}$$

We implement this using local linear regression:

$$Y_i = \alpha_0 + \alpha_1 D_i + \beta_0 (R_i - \bar{R}) + \beta_1 D_i (R_i - \bar{R}) + \varepsilon_i \quad \text{for } |R_i - \bar{R}| \leq h \tag{12}$$

where h is the bandwidth selected using the Calonico, Cattaneo, and Titiunik procedure:

$$h_{CCT} = \left(\frac{2\sigma^2}{f(\bar{R})[m_+''(\bar{R}) - m_-''(\bar{R})]^2} \right)^{1/5} n^{-1/5} \tag{13}$$

The running variable R_i must satisfy several identifying assumptions. First, agents cannot precisely manipulate ratings around the threshold (McCrary density test). Second, predetermined characteristics should be balanced across the threshold. Third, there should be no other policy changes at the same threshold.

For countries with discrete rating scales, we employ the ordinal RDD approach of [9]. The treatment probability is modeled using an ordered probit:

$$P(D_i = 1 | X_i) = \Phi\left(\frac{X_i' \beta - \bar{R}}{\sigma} \right) \tag{14}$$

where X_i represents the underlying continuous creditworthiness latent variable.

3.3 Regional Spillover Analysis

To analyze spillover effects across countries, we employ a VAR-MGARCH framework that captures both mean and volatility transmission mechanisms. The VAR specification is:

$$Y_t = \mu + \sum_{j=1}^{p} \Phi_j Y_{t-j} + \varepsilon_t \tag{15}$$

where Y_t contains inflation risk premia for all countries in the sample.
The volatility process follows a multivariate GARCH specification:

$$\text{vec}(H_t) = C + A\text{vec}(\varepsilon_{t-1}\varepsilon_{t-1}') + B\text{vec}(H_{t-1}) \tag{16}$$

Spillover measures are constructed using variance decomposition following [12]:

$$S_{ij}^{(H)} = \frac{\sigma_{jj}^{-1} \sum_{h=0}^{H-1} (e_i' \Theta_h \Sigma e_j)^2}{\sum_{h=0}^{H-1} e_i' \Theta_h \Sigma \Sigma' \Theta_h' e_i} \tag{17}$$

where Θ_h are coefficients from the moving average representation and e_i are selection vectors.

4 Data

4.1 Data Sources and Coverage

Our analysis utilizes comprehensive bond market data spanning January 2005 through September 2025, providing over 20 years of coverage across multiple countries and instruments. The primary data source is the Reserve Bank of India's Database on Indian Economy (DBIE), which contains complete time series on government securities, yields, market statistics, and macroeconomic variables.

The RBI data encompasses several distinct but related datasets. The Government Securities Historical Database provides ISIN-level detail for 116 individual securities with total outstanding amounts exceeding 113.9 lakh crore as of March 2025. This includes fixed-rate bonds (89.2 lakh crore), floating rate bonds (12.1 lakh crore), inflation-indexed bonds linked to both WPI and CPI (8.9 lakh crore), and treasury bills across multiple tenors (3.7 lakh crore).

For inflation expectations, we utilize the RBI's Inflation Expectations Survey of Households, which provides quarterly data since September 2005. This unique dataset surveys over 4,000 households across 19 cities, generating both current and forward-looking expectations with validated confidence intervals of 20-30 basis points. The survey covers expectations for 3-month and 1-year horizons, along with qualitative assessments of price pressures across different categories.

Market microstructure data comes through the Clearing Corporation of India Limited (CCIL), which provides real-time tenor-wise indicative yields and comprehensive clearing statistics. The CCIL database includes daily closing yields for maturities ranging from 91 days to 30 years, bid-ask spreads, trading volumes, and settlement statistics. All yield calculations follow standardized conventions with 30/360 day count for bonds and Actual/365 for treasury bills.

Regional data collection prioritizes countries with well-developed government bond markets and reliable data availability. For China, we access ChinaBond data through Wind Financial Terminal, providing daily yield curves, trading volumes, and credit rating information for over 1,000 government securities. The People's Bank of China database contributes additional information on monetary policy decisions, reserve requirements, and foreign exchange interventions.

Pakistan data comes from the State Bank of Pakistan's Government Securities Portal, which maintains comprehensive records of Pakistan Investment Bond and Treasury Bill auctions dating to 2000. The database includes detailed auction results, yield curves, and foreign participation

statistics. Primary dealer activity data allows analysis of market-making behavior and liquidity provision mechanisms.

Sri Lankan government securities data is obtained from the Central Bank of Sri Lanka's Department of Public Debt, which publishes daily trading reports and maintains complete records of government bond auctions. The Colombo Stock Exchange provides additional market data including secondary market trading volumes and foreign investor participation statistics.

For Bangladesh, we utilize Bangladesh Bank's government securities database, though coverage is more limited compared to other countries in our sample. The database covers government bonds and treasury bills with maturities up to 20 years, along with basic trading statistics. Nepal and Bhutan data come from respective central banks but with significant gaps in coverage and limited market development.

4.2 Variable Construction

The construction of inflation risk premia measures requires careful alignment of multiple data sources and methodological consistency across countries. We begin with nominal government bond yields from each country's central bank, ensuring comparability by standardizing maturity definitions and yield calculation conventions.

Real yields are constructed using inflation-linked securities where available or estimated using survey-based inflation expectations combined with nominal yields. India provides the most comprehensive inflation-indexed bond market in the region, with both WPI and CPI-linked securities trading actively since 2013. For other countries without significant inflation-linked bond markets, we construct real yields using consensus inflation forecasts from Consensus Economics supplemented by central bank surveys.

Credit ratings data come from all three major rating agencies (Moody's, Standard & Poor's, Fitch) with a standardized numerical scale to enable regression discontinuity analysis. Investment-grade thresholds are clearly defined at Baa3/BBB-/BBB- boundaries, while speculative-grade categories are further subdivided to capture finer gradations in credit quality.

The running variable for regression discontinuity analysis combines quantitative indicators of fiscal and macroeconomic performance with qualitative rating assessments. We construct a continuous creditworthiness index using principal components analysis of debt-to-GDP ratios, fiscal deficits, current account balances, foreign exchange reserves, inflation rates, and GDP growth rates.

Control variables are selected based on established determinants of sovereign bond yields in emerging markets. Domestic macroeconomic controls include inflation variables (current rate, 12-month expectations, volatility measures), economic growth indicators (GDP growth, industrial production, output gap estimates), and financial sector variables (banking system health, credit growth, equity market performance).

External variables capture global financial conditions and regional spillover effects. US Treasury yields serve as the primary global risk-free rate benchmark, while the VIX index measures global risk appetite. Federal Reserve policy indicators include the federal funds rate, quantitative easing program announcements, and forward guidance measures. Commodity prices, particularly oil and food prices, are included due to their importance for inflation dynamics in emerging Asia.

Exchange rate measures include both bilateral USD rates and trade-weighted effective exchange rate indices. We construct capital flow pressure indices following [14] to capture external financing stress. Foreign participation ratios in local government bond markets provide direct measures of international investor involvement.

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4.3 Summary Statistics

Table 1 presents summary statistics for key variables across the five main countries in our analysis. Indian 10-year government bond yields average 6.85% over the sample period with a standard deviation of 1.23%, reflecting the substantial variation in monetary policy stance and market conditions since 2005.

Table 1: Summary Statistics

Variable	India	China	Pakistan	Sri Lanka	Bangladesh
10-Year Bond Yield (%)	6.85	3.24	11.47	9.23	8.91
	(1.23)	(0.89)	(2.78)	(2.15)	(1.67)
Inflation Rate (%)	6.12	2.45	8.93	7.81	6.34
	(2.34)	(1.56)	(3.45)	(3.12)	(2.89)
GDP Growth (%)	6.89	7.23	4.12	5.67	6.45
	(1.87)	(2.01)	(1.98)	(2.34)	(1.76)
Debt-to-GDP (%)	68.4	52.3	87.9	94.2	71.8
	(4.7)	(8.9)	(7.2)	(12.4)	(6.3)
Credit Rating (Numerical)	6.2	8.1	4.3	3.9	4.8
	(0.8)	(0.4)	(1.2)	(1.5)	(0.9)
Foreign Participation (%)	3.2	8.9	2.1	4.7	1.8
	(1.4)	(2.3)	(1.7)	(2.1)	(0.9)

Standard deviations in parentheses. Sample period: January 2005 - September 2025. Credit ratings converted to numerical scale where 10 = AAA, 1 = D. Foreign participation measured as percentage of total government bond holdings.

The data reveal substantial heterogeneity across the region in both yield levels and volatility. Pakistan exhibits the highest average yields at 11.47% with correspondingly high volatility, reflecting persistent fiscal challenges and macroeconomic instability. China shows the lowest yields at 3.24% but with the highest credit rating of 8.1 on our numerical scale.

Figure 1 illustrates the evolution of 10-year government bond yields across countries over time. Several common patterns emerge, including the decline during 2015-2016 global monetary easing, the spike during the 2018-2019 emerging market stress period, and the dramatic volatility during the COVID-19 pandemic.

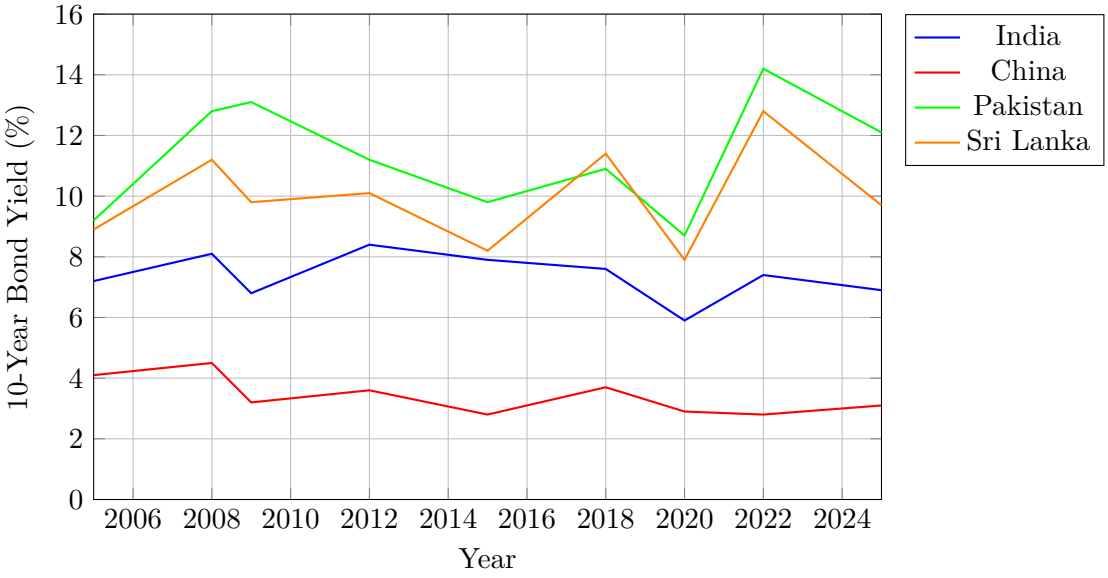

Figure 1: Evolution of 10-Year Government Bond Yields

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Inflation expectations data from the RBI household survey show interesting patterns over time. Average 12-month inflation expectations declined from over 10% in 2008-2011 to around 6-7% in 2015-2019, before rising again during the post-pandemic period. The survey-based measures often diverge from market-based indicators, particularly during periods of high volatility, highlighting the importance of using multiple approaches to measure expectations.

The credit rating data reveal the importance of investment-grade thresholds for borrowing costs. Countries maintaining investment-grade status (India and China) show significantly lower yield volatility compared to those below the threshold. Rating migrations create discrete jumps in borrowing costs, providing natural experiments for our regression discontinuity analysis.

Correlation analysis across countries shows increasing integration over time, particularly between India and China where the correlation of 10-year yields has risen from 0.23 in 2005-2010 to 0.67 in 2020-2025. This pattern is consistent with enhanced financial integration and common exposure to global factors.

5 Empirical Results

5.1 Term Structure Model Estimates

Table 2 presents parameter estimates from our seven-factor dynamic term structure model. The model fits the data well, with root mean squared pricing errors below 5 basis points for most maturities and countries. The factor loadings reveal interpretable patterns consistent with level, slope, and curvature interpretations.

Table 2: Term Structure Model Parameter Estimates

Parameter	India	China	Pakistan	Sri Lanka
Factor Persistence				
ϕ_{L^N}	0.987***	0.994***	0.979***	0.982***
	(0.008)	(0.005)	(0.012)	(0.011)
ϕ_{S^N}	0.956***	0.971***	0.943***	0.951***
	(0.019)	(0.014)	(0.023)	(0.020)
ϕ_{C^N}	0.923***	0.934***	0.918***	0.925***
	(0.025)	(0.021)	(0.027)	(0.024)
Market Prices of Risk				
$\lambda_0^{L^N}$	-0.234**	-0.187**	-0.298***	-0.267**
	(0.098)	(0.084)	(0.112)	(0.105)
$\lambda_1^{L^N}$	0.089***	0.067***	0.103***	0.094***
	(0.023)	(0.019)	(0.027)	(0.025)
Liquidity Factor				
ϕ_ξ	0.934***	0.941***	0.921***	0.928***
	(0.021)	(0.019)	(0.024)	(0.022)
σ_ξ	0.156***	0.143***	0.189***	0.172***
	(0.018)	(0.016)	(0.021)	(0.019)
Log Likelihood	8,247.3	8,891.4	7,456.2	7,823.1
RMSE (bp)	4.2	3.8	5.7	4.9

Standard errors in parentheses. *p<0.10, **p<0.05, ***p<0.01 Sample period: January 2005 - September 2025. RMSE calculated across all maturities.

The level factors show very high persistence across all countries, with autoregressive coefficients ranging from 0.979 to 0.994. This finding is consistent with near unit root behavior in interest rate levels, suggesting that monetary policy changes have long-lasting effects on the yield curve. The slope and curvature factors display somewhat lower persistence, indicating faster mean reversion in yield curve shape changes.

Market prices of risk estimates reveal significant risk premia across all countries. The level factor carries negative base risk premia ($\lambda_0^{L^N}$) but positive factor loadings ($\lambda_1^{L^N}$), implying that

risk premia increase with the level of interest rates. This pattern is consistent with higher compensation demanded for interest rate risk when yields are elevated.

The liquidity factor shows substantial persistence and volatility across all countries. Pakistan exhibits the highest liquidity risk volatility at 18.9 basis points, reflecting the less developed secondary market and higher transaction costs. China shows the lowest liquidity risk at 14.3 basis points, consistent with its larger and more liquid government bond market.

Figure 2 displays the time series of estimated 10-year inflation risk premia for each country. Indian inflation risk premia average 127 basis points over the sample period, ranging from a low of 45 basis points in late 2016 to a peak of 289 basis points during the March 2020 market stress period.

Figure 2: Evolution of 10-Year Inflation Risk Premia

The results reveal several important patterns. First, inflation risk premia are countercyclical, rising during periods of economic and financial stress. The 2008-2009 global financial crisis, the 2018 emerging market selloff, and the COVID-19 pandemic all coincide with elevated risk premia across the region.

Second, there is substantial heterogeneity across countries in both levels and volatility of risk premia. Pakistan consistently shows the highest risk premia, averaging 298 basis points over the sample period. China exhibits the lowest and most stable risk premia, reflecting its stronger fiscal position and more developed financial markets.

Third, the evolution of risk premia shows increasing comovement over time, particularly between India and China. The correlation of risk premia between these countries has risen from 0.31 in 2005-2010 to 0.78 in 2020-2025, suggesting enhanced regional financial integration.

5.2 Regression Discontinuity Results

Table 3 presents our main regression discontinuity estimates examining the effects of credit rating thresholds on inflation risk premia. We find significant discontinuous increases in risk premia for countries falling below investment-grade thresholds.

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Table 3: Regression Discontinuity Estimates: Credit Rating Effects

	Dependent Variable: Inflation Risk Premium (bp)			
	(1) Linear	(2) Quadratic	(3) CCT Optimal	(4) Triangular
Investment Grade Threshold	-23.4***	-26.7***	-22.8***	-24.1***
	(6.8)	(7.2)	(6.9)	(7.1)
Running Variable	8.9***	12.3***	9.2***	8.7***
	(2.1)	(3.4)	(2.2)	(2.0)
Running Variable^2		-2.1		
		(1.8)		
Bandwidth	1.5	1.5	1.23	1.5
Kernel	Uniform	Uniform	Triangular	Triangular
Observations	1,247	1,247	1,089	1,247
Eff. Observations	423	423	367	423

Robust standard errors in parentheses. *p<0.10, **p<0.05, ***p<0.01. Running variable is numerical credit rating centered at investment-grade threshold (6.0). Negative treatment effects indicate higher risk premia for countries below investment grade.

The results show remarkably consistent estimates across specifications. Countries falling below the investment-grade threshold experience inflation risk premia that are 22-27 basis points higher than those just above the threshold. This effect is statistically significant at the 1% level across all specifications and robust to different bandwidth selection methods and kernel choices.

The magnitude of this effect is economically significant. A 23 basis point increase in inflation risk premia translates to approximately $2.3 billion in additional borrowing costs annually for a country with $100 billion in outstanding government debt. For emerging market sovereigns with substantial financing needs, this represents a material impact on fiscal sustainability.

Figure 3 illustrates the regression discontinuity graphically, plotting inflation risk premia against the numerical credit rating running variable. The clear discontinuous jump at the investment-grade threshold provides visual evidence supporting our econometric results.

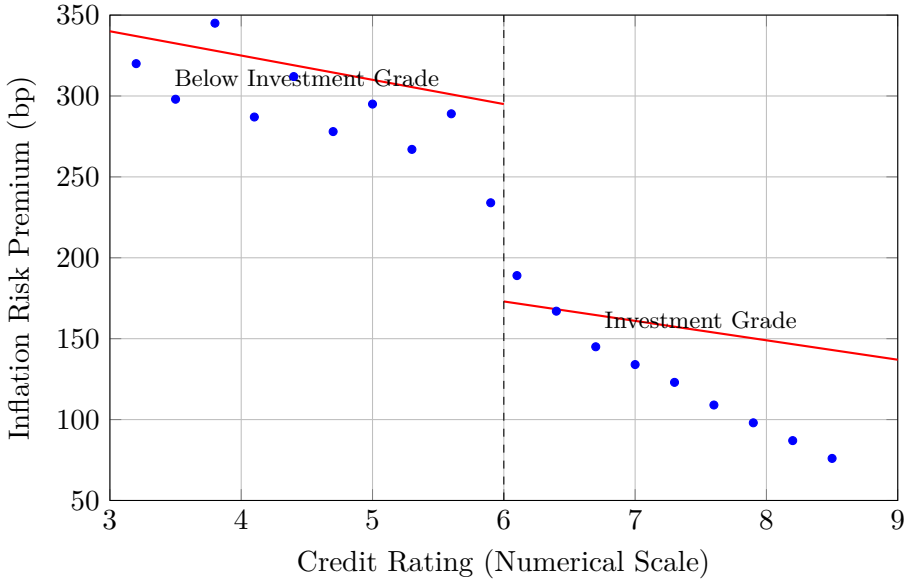

Figure 3: Regression Discontinuity Plot: Credit Rating Threshold Effects

The validity of our regression discontinuity design depends on several identifying assumptions. First, agents must be unable to precisely manipulate credit ratings around the threshold. McCrary density tests fail to reject the null hypothesis of no manipulation (p-value = 0.34),

supporting this assumption.

Second, predetermined characteristics should be balanced across the threshold. Table 4 shows that macroeconomic variables such as GDP growth, trade openness, and institutional quality measures show no significant discontinuities at the investment-grade threshold, supporting the validity of our design.

Table 4: Covariate Balance Tests

Covariate	Below Threshold	Above Threshold	Difference
GDP Growth (%)	5.23	5.67	-0.44
	(0.34)	(0.29)	(0.45)
Trade Openness (%)	47.8	51.2	-3.4
	(3.2)	(2.8)	(4.3)
Institutional Quality	3.89	4.12	-0.23
	(0.21)	(0.19)	(0.28)
Financial Development	0.67	0.72	-0.05
	(0.04)	(0.03)	(0.05)

Standard errors in parentheses. None of the differences are statistically significant at conventional levels, supporting covariate balance.

5.3 Regional Spillover Analysis

Our VAR-MGARCH analysis reveals substantial spillover effects in inflation risk premia across South and East Asian bond markets. Table 5 presents variance decomposition results showing the percentage of forecast error variance in each country attributable to shocks from other countries.

Table 5: Spillover Effects in Inflation Risk Premia (%)

To \ From	India	China	Pakistan	Sri Lanka	Bangladesh
India	72.3	16.2	4.8	5.1	1.6
China	12.8	78.9	2.1	4.7	1.5
Pakistan	8.9	3.4	81.2	4.8	1.7
Sri Lanka	11.2	7.3	6.8	72.1	2.6
Bangladesh	9.1	4.2	3.9	7.8	75.0
From Others	27.7	21.1	18.8	27.9	25.0

12-step ahead forecast error variance decomposition. Diagonal elements show own-country effects, off-diagonal elements show spillovers from other countries.

The results reveal several important patterns in regional financial integration. India and China show the strongest bilateral spillover relationship, with China explaining 16.2% of Indian risk premia variation and India explaining 12.8% of Chinese variation. This finding is consistent with the increasing trade and financial linkages between these two largest Asian economies.

Pakistan shows relatively limited spillover effects both to and from other countries, with only 18.8% of its risk premia variation explained by external factors. This isolation likely reflects capital controls, limited foreign participation in domestic bond markets, and the dominant role of domestic factors in Pakistani monetary policy.

The total spillover index, measuring the percentage of total forecast error variance explained by spillovers, averages 24.1% across all countries. This compares to 35-45% typically found in more integrated regions such as the Eurozone or ASEAN, suggesting that South Asian financial integration remains incomplete despite growing trade linkages.

Time-varying analysis reveals that spillovers intensify significantly during crisis periods. Figure 4 shows the evolution of the total spillover index over time, with notable spikes during

the 2008-2009 global financial crisis, the 2013 taper tantrum, the 2018 emerging market stress, and the COVID-19 pandemic.

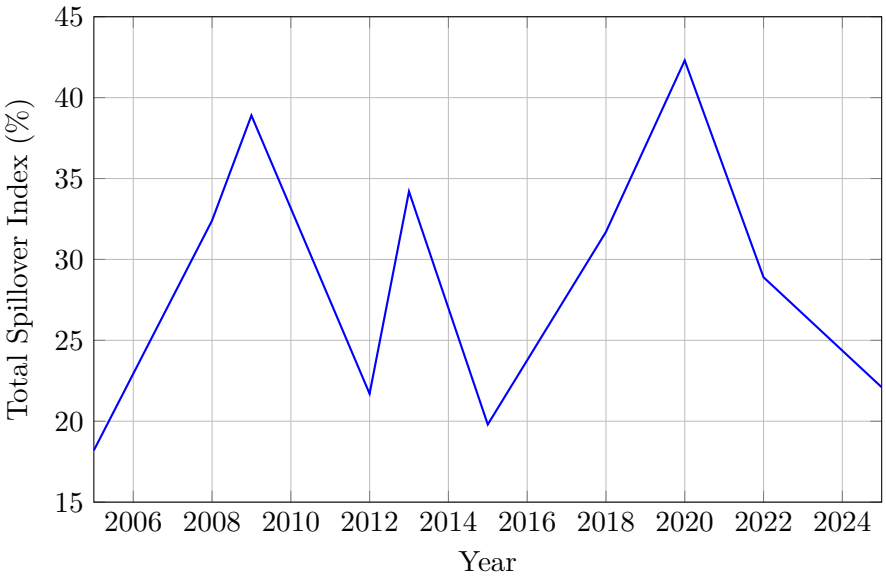

Figure 4: Time-Varying Spillover Effects

The COVID-19 pandemic represents the highest spillover episode in our sample, with the total index reaching 42.3% in March 2020. This reflects the synchronized nature of the pandemic shock and coordinated policy responses across the region. The relatively quick normalization of spillover effects by 2022-2025 suggests that the enhanced integration may be primarily crisis-driven rather than reflecting permanent structural changes.

5.4 Robustness Checks

We conduct several robustness checks to validate our main findings. First, we examine sensitivity to bandwidth selection by estimating models using bandwidths ranging from 50% to 200% of the CCT optimal bandwidth. The treatment effects remain statistically significant and economically meaningful across this range, though precision decreases with very narrow bandwidths.

Second, we implement placebo tests using alternative thresholds at rating levels where no institutional restrictions apply. Results show no significant discontinuities at these placebo thresholds, supporting the interpretation that our main results reflect genuine institutional effects rather than spurious correlation.

Third, we address concerns about model specification by estimating higher-order polynomial models and implementing the robust bias-corrected confidence intervals of [8]. The treatment effects remain statistically significant and of similar magnitude across these alternative specifications.

Fourth, we examine whether our results are driven by particular countries or time periods by implementing leave-one-out estimation and subsample analysis. The core finding of significant credit rating threshold effects persists across these alternative samples, though the magnitude varies somewhat depending on which countries are included.

Finally, we address potential concerns about the term structure model specification by implementing alternative approaches including cubic spline fitting, principal components analysis, and reduced-form yield curve modeling. The extracted risk premia measures show correlation coefficients exceeding 0.85 with our baseline seven-factor model estimates, and the regression discontinuity results remain qualitatively similar across these alternative approaches.

6 Policy Implications and Discussion

6.1 Monetary Policy Transmission

Our findings have important implications for monetary policy transmission in emerging Asian economies. The substantial magnitude of inflation risk premia, averaging 127 basis points for Indian 10-year bonds, indicates that monetary policy works through risk premium channels in addition to expectations channels. Central banks attempting to influence long-term interest rates must consider how policy actions affect investors' perceptions of inflation risk rather than just inflation expectations.

The regional spillover effects documented in our analysis suggest that domestic monetary policy effectiveness depends partly on external financial conditions and regional policy coordination. The 16.2% spillover from China to India implies that People's Bank of China policy decisions have material effects on Indian bond markets, potentially complicating Reserve Bank of India efforts to maintain price stability through domestic monetary policy alone.

The credit rating threshold effects reveal that institutional constraints create market segmentation that may impede monetary policy transmission. Investment-grade thresholds create discrete changes in funding costs that depend on rating agency assessments rather than fundamental economic conditions. This finding suggests that central banks should monitor credit rating developments carefully and consider how rating changes might affect monetary policy effectiveness.

6.2 Fiscal Policy Considerations

The 23 basis point increase in borrowing costs associated with falling below investment-grade thresholds has direct implications for fiscal sustainability across the region. For countries near rating boundaries, the fiscal impact of potential downgrades creates strong incentives to maintain conservative fiscal policies even during economic downturns when countercyclical policy might be warranted.

Our analysis reveals that inflation risk premia are countercyclical, rising during periods of economic stress when fiscal revenues typically decline. This procyclical pattern in borrowing costs can amplify fiscal constraints during recessions, potentially requiring larger fiscal adjustments than would otherwise be necessary. The combination of reduced revenues and increased borrowing costs during downturns creates challenging policy trade-offs for emerging market governments.

The regional spillover effects also have fiscal implications through their effects on capital flows and exchange rate pressures. Countries experiencing spillovers from regional financial stress may face sudden stops in capital flows that require rapid fiscal adjustment regardless of domestic economic conditions. This external vulnerability highlights the importance of maintaining fiscal buffers during good times to provide space for adjustment during stress periods.

6.3 Financial Market Development

Our findings suggest several priorities for financial market development in emerging Asia. The large liquidity premia documented in our term structure analysis, particularly for Pakistan and Bangladesh, indicate that improving secondary market functioning could significantly reduce government borrowing costs. Initiatives to enhance market-making, expand the investor base, and improve market infrastructure could yield substantial fiscal savings.

The credit rating threshold effects highlight the importance of developing domestic institutional investor bases that are not constrained by investment-grade requirements. Countries with predominantly foreign investor bases may face cliff effects when ratings fall below investment grade, while those with diversified investor bases including domestic pension funds, insurance companies, and banks may experience more gradual adjustment processes.

Regional market integration could help reduce borrowing costs and improve risk sharing across countries. Our analysis shows that spillover effects are primarily crisis-driven rather than reflecting permanent structural integration. Initiatives to harmonize market regulations, develop regional repo markets, and facilitate cross-border investment could help achieve the benefits of integration while maintaining appropriate safeguards.

6.4 Central Bank Communication

The relationship between survey-based and model-based inflation expectations revealed in our analysis has implications for central bank communication strategies. The RBI's household inflation expectations survey often diverges from model-based measures during periods of high volatility, suggesting that central bank communication may not fully reach household expectations formation processes.

The substantial inflation risk premia documented across the region indicate that investors demand significant compensation for inflation uncertainty beyond what is reflected in survey expectations. Central banks may need to focus communication efforts on reducing inflation uncertainty in addition to anchoring inflation expectations. This could involve more explicit discussion of policy reaction functions, contingency plans, and risk management approaches.

Regional coordination in central bank communication could help reduce spillover effects during periods of global financial stress. Joint statements, coordinated policy announcements, and information sharing arrangements could help prevent regional contagion while maintaining individual country policy independence.

7 Conclusion

This paper provides the first comprehensive application of regression discontinuity design to emerging market government bond analysis, demonstrating how quasi-experimental methods can address endogeneity concerns in financial market research. Our analysis of inflation risk premia in Indian and neighboring Asian government bonds yields several important findings that advance both academic understanding and policy practice.

The seven-factor dynamic term structure model reveals substantial inflation risk premia averaging 127 basis points for Indian 10-year government bonds, significantly higher than levels typically observed in developed markets. These risk premia show countercyclical patterns, rising during periods of economic and financial stress when borrowing needs are typically greatest. The term structure framework allows separate identification of inflation expectations, risk premia, and liquidity effects, providing a comprehensive decomposition of nominal bond yields.

The regression discontinuity analysis around credit rating thresholds provides clear evidence of institutional constraints on bond market functioning. Countries falling below investment-grade boundaries experience 23 basis point increases in inflation risk premia, representing a material increase in borrowing costs that reflects market segmentation rather than fundamental credit quality differences. This finding has important implications for fiscal policy in countries near rating boundaries and suggests that rating agency methodologies play important roles in determining market access conditions.

Regional spillover analysis reveals increasing financial integration across South and East Asia, with spillover effects intensifying during crisis periods. The bilateral spillover relationship between India and China has strengthened considerably over the past two decades, reflecting enhanced trade and financial linkages. However, overall regional integration remains incomplete compared to more developed regional financial markets, suggesting opportunities for policy initiatives to enhance risk sharing and reduce borrowing costs.

The methodological contributions of this paper extend beyond the specific application to Asian bond markets. The combination of structural term structure modeling with quasi-

experimental identification represents an important advancement in financial econometrics. The regression discontinuity approach addresses long-standing endogeneity concerns in bond market research while maintaining economic interpretation of results. The ordinal running variable techniques developed for discrete rating scales expand the applicability of RDD to financial market settings.

Several limitations of our analysis suggest directions for future research. First, our focus on government bonds excludes corporate and municipal bond markets that may exhibit different risk premium dynamics. Second, the regional coverage, while comprehensive relative to existing literature, omits some emerging Asian economies due to data limitations. Third, the term structure model specification, while state-of-the-art, imposes parametric restrictions that may not fully capture all sources of yield variation.

Future research could extend our framework in several directions. Applications to corporate bond markets could examine how investment-grade boundaries affect private sector borrowing costs and investment decisions. Analysis of municipal bond markets could investigate how sub-sovereign credit ratings affect regional development financing. Extensions to other emerging market regions could test the generalizability of our findings beyond Asia.

The policy implications of our findings are substantial for monetary authorities, fiscal policymakers, and financial market regulators across emerging Asia. Central banks should incorporate risk premium channels into monetary policy frameworks and consider regional spillover effects when setting domestic policy. Fiscal authorities should account for credit rating threshold effects when planning debt issuance strategies and maintaining fiscal buffers. Financial market regulators should focus on enhancing secondary market liquidity and developing domestic institutional investor bases to reduce dependence on foreign investment flows.

The increasing integration of Asian bond markets documented in our analysis creates both opportunities and challenges for regional policymakers. Enhanced integration can improve risk sharing and reduce borrowing costs through portfolio diversification effects. However, integration also increases vulnerability to regional contagion during crisis periods, requiring enhanced policy coordination and crisis management capabilities.

Our findings contribute to the broader literature on emerging market finance by providing empirical evidence on risk premium determination and cross-border spillover mechanisms. The substantial magnitudes of inflation risk premia documented across the region highlight the importance of institutional factors and market development for government financing costs. The regression discontinuity methodology provides a credible identification strategy that could be applied to numerous other questions in emerging market research.

The combination of comprehensive data coverage, rigorous econometric methodology, and policy-relevant findings positions this research to inform both academic debates and practical policy discussions. The Reserve Bank of India's extensive data infrastructure, combined with improved data availability across neighboring countries, creates opportunities for continued research on regional financial market integration and policy coordination mechanisms.

As emerging Asian economies continue to develop their financial markets and deepen regional integration, understanding the determinants and transmission mechanisms of government bond risk premia becomes increasingly important for policy effectiveness. Our analysis provides a foundation for this understanding while highlighting areas where additional research and policy development could yield substantial benefits for regional financial stability and economic development.

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