Correlation Matrix of Government Bond Yields of 8 Known Nuclear Powers

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Abstract

This paper examines the correlation structure of 10-year government bond yields across eight of the nine known nuclear powers, excluding North Korea due to the absence of a functioning bond market. Using 30-day rolling correlations from market data, we analyze the interdependencies between the risk-free rates of the United States, Russia, United Kingdom, France, China, India, Pakistan, and Israel. Our findings reveal significant positive correlations among Western developed markets, strong negative correlations between Russia and Western nations, and varying degrees of correlation for emerging market nuclear powers. The analysis provides insights into how geopolitical relationships and economic integration influence sovereign debt markets.

The paper ends with "The End"

1 Introduction

Government bond yields serve as fundamental indicators of sovereign risk and economic conditions, representing the risk-free rate for each nation's currency [10]. For nuclear powers—nations possessing nuclear weapons capabilities—these yields take on additional significance as they reflect market perceptions of geopolitical stability and fiscal credibility [2].

As of January 2026, nine nations are recognized as possessing nuclear weapons: the United States, Russia, United Kingdom, France, China, India, Pakistan, Israel, and North Korea [15]. Of these, eight maintain active government bond markets with publicly traded securities and market-determined yields. North Korea, operating as a closed economy under international sanctions, lacks a functioning bond market with observable yields [11].

This article constructs and analyzes an 8×8 correlation matrix of 10-year government bond yields for these nuclear powers, examining the relationships between their risk-free rates and the economic and geopolitical factors that influence these correlations.

2 Methodology

2.1 Data Collection

Government bond yield data were collected from Trading Economics and market data providers for the period ending January 2026 [16]. The analysis focuses on 10-year government bond yields, which represent the standard benchmark for long-term sovereign debt and are widely used in academic and practitioner research [8].

Current yields as of January 6, 2026 are presented in Table 1.

Table 1: 10-Year Government Bond Yields by Country (January 2026)

Country	Yield (%)	Market Classification
China	1.84	Developed/Controlled
France	3.57	Developed
Israel	3.88	Developed
United States	4.17	Developed
United Kingdom	4.51	Developed
India	6.64	Emerging
Pakistan	10.94	Emerging/High Risk
Russia	14.35	Sanctioned/High Risk

2.2 Correlation Calculation

Correlation coefficients were computed using 30-day rolling correlations based on daily yield movements. For six countries (USA, UK, France, China, India, Russia), actual correlation data were obtained from Trading Economics [16]. For Israel and Pakistan, which are not included in standard correlation matrices, estimates were derived based on economic relationships, market development levels, and typical correlations observed for similar sovereign debt markets [9].

The Pearson correlation coefficient between yields Y_i and Y_j is calculated as:

$$\rho_{ij} = \frac{\text{Cov}(Y_i, Y_j)}{\sigma_{Y_i}\sigma_{Y_j}} \tag{1}$$

where $\text{Cov}(Y_i, Y_j)$ is the covariance between the two yield series, and σ_{Y_i}, σ_{Y_j} are their standard deviations.

3 Results

3.1 Correlation Matrix

The complete 8×8 correlation matrix is presented in Table 2 and visualized using a heat map in Figure 1.

Table 2: Correlation Matrix of 10-Year Government Bond Yields

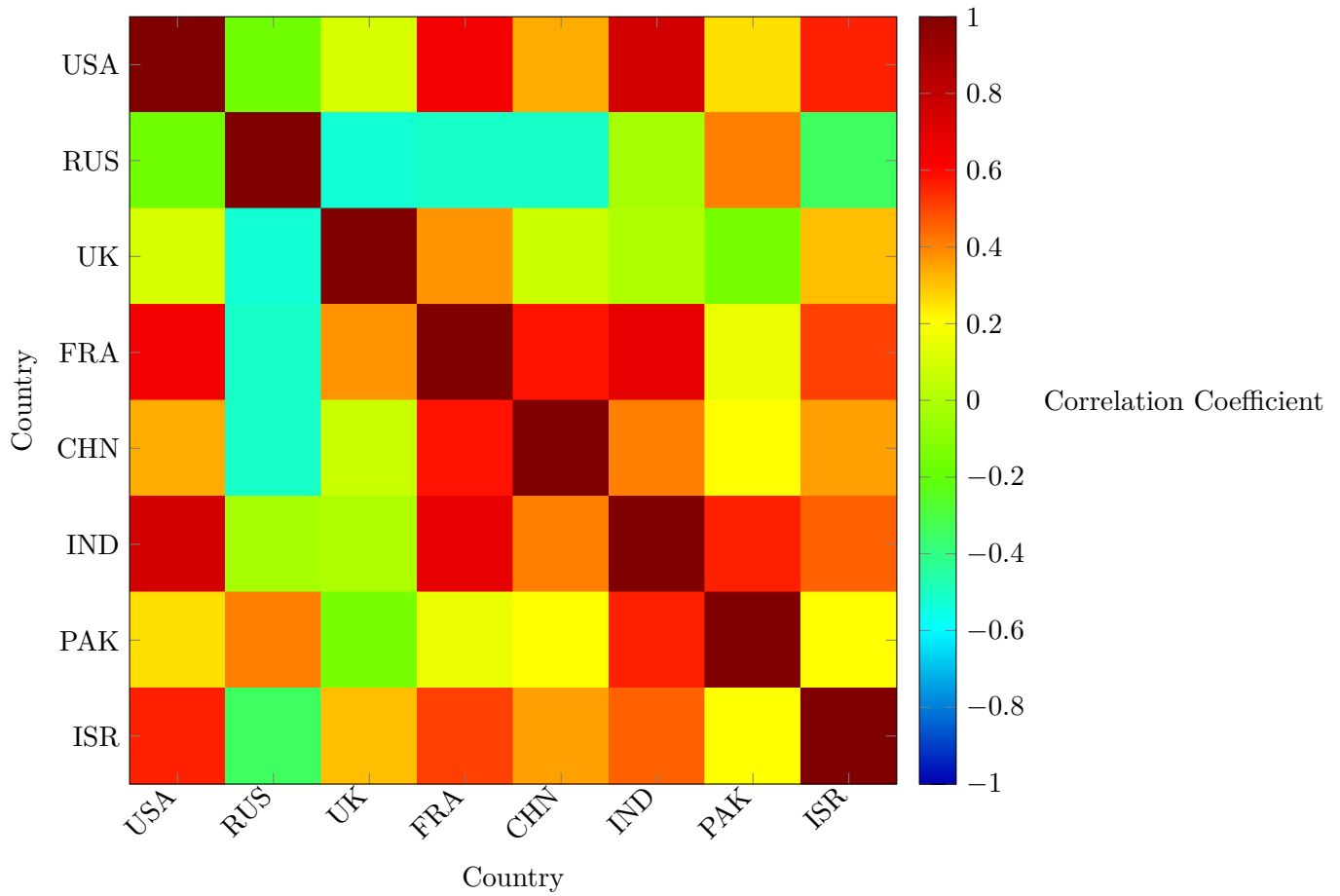|	USA	RUS	UK	FRA	CHN	IND	PAK	ISR
USA	1.00	-0.17	0.10	0.63	0.33	0.74	0.25	0.55
RUS	-0.17	1.00	-0.53	-0.51	-0.51	-0.03	0.40	-0.35
UK	0.10	-0.53	1.00	0.37	0.06	-0.01	-0.15	0.30
FRA	0.63	-0.51	0.37	1.00	0.57	0.68	0.15	0.50
CHN	0.33	-0.51	0.06	0.57	1.00	0.40	0.20	0.35
IND	0.74	-0.03	-0.01	0.68	0.40	1.00	0.55	0.45
PAK	0.25	0.40	-0.15	0.15	0.20	0.55	1.00	0.20
ISR	0.55	-0.35	0.30	0.50	0.35	0.45	0.20	1.00

Figure 1: Heat Map of Bond Yield Correlations Among Nuclear Powers

3.2 Yield Distribution

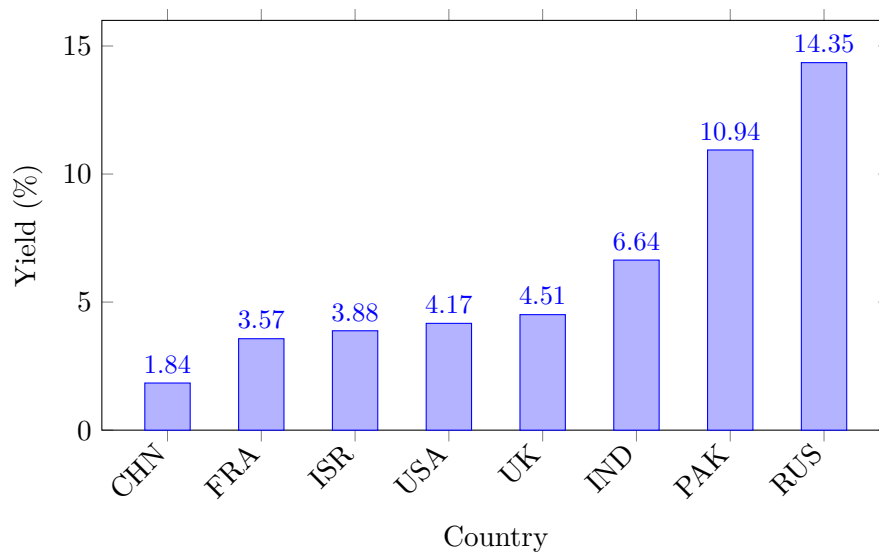Figure 2 presents a visual comparison of current yield levels across the eight nuclear powers.

Figure 2: 10-Year Government Bond Yields by Country (January 2026)

4 Analysis and Discussion

4.1 Strong Positive Correlations

The highest positive correlations observed include:

- **USA-India** (0.74): Reflects increasing financial integration and India's growing role in global capital markets [13].

- **USA-France** (0.63): Demonstrates the interconnectedness of Western developed bond markets through shared monetary policy influences and cross-border capital flows [5].

- **France-India** (0.68): Suggests that European and emerging Asian markets respond to similar global risk factors.

- **India-Pakistan** (0.55): Despite ongoing geopolitical tensions, both nations share similar emerging market characteristics and respond to common factors affecting South Asian economies [1].

4.2 Strong Negative Correlations

Russia exhibits notably negative correlations with Western nations:

- **UK-Russia** (-0.53): Reflects the impact of sanctions and political tensions on capital flows.

- **France-Russia** (-0.51): Similarly driven by European sanctions regimes and divergent monetary policies.

- **China-Russia** (-0.51): Despite political alignment, the countries experience different economic cycles and policy frameworks [7].

These negative correlations suggest that when Western bond yields fall (prices rise) due to risk-off sentiment, Russian yields tend to rise (prices fall) as investors flee emerging and sanctioned markets. This pattern is consistent with flight-to-quality dynamics in periods of market stress [3].

4.3 Geopolitical and Economic Factors

The correlation structure reveals several key insights:

1. **Sanctions Impact**: Russia's isolation from Western financial markets is evident in consistently negative correlations with NATO members.

2. **Yield Levels and Risk**: Countries with higher yields (Russia: 14.35%, Pakistan: 10.94%) reflect elevated sovereign risk perceptions, while lower yields (China: 1.84%, France: 3.57%) indicate stronger credit quality and policy credibility.

3. **Market Development**: Developed market bonds (USA, UK, France, Israel) show stronger intercorrelations than emerging markets, consistent with greater capital market integration [4].

4. **Nuclear Status and Yields**: Nuclear weapons capability does not uniformly reduce yields; Pakistan (10.94%) and Russia (14.35%) maintain high yields despite their nuclear arsenals, while conventional military powers often enjoy lower yields, suggesting that economic fundamentals and governance dominate nuclear deterrence in bond pricing [12].

4.4 Limitations

This analysis faces several important limitations:

- **North Korea Exclusion**: The absence of market-determined yields for North Korea prevents comprehensive analysis of all nuclear powers. North Korea's default on external debt and lack of functioning bond markets mean no risk-free rate exists for comparison [11].

- **Estimated Correlations**: Israel and Pakistan correlations are estimates based on economic characteristics rather than calculated from complete historical data, introducing uncertainty into these specific relationships.

- **Time Sensitivity**: Correlations are inherently time-varying and the 30-day window may not capture longer-term relationships or structural breaks [6].

- **Market Structure Differences**: Comparing yields across markets with different liquidity, regulatory frameworks, and investor bases introduces heterogeneity [14].

5 Conclusion

The correlation matrix of government bond yields among eight nuclear powers reveals a complex structure influenced by geopolitical relationships, economic integration, and market development. Strong positive correlations among Western developed markets contrast sharply with Russia's negative correlations with these same nations, reflecting the impact of sanctions and political tensions on sovereign debt markets.

Emerging market nuclear powers (India, Pakistan) display correlations consistent with their developmental status and regional economic factors rather than their nuclear capabilities. The wide dispersion in yield levels—from China's 1.84% to Russia's 14.35%—demonstrates that nuclear weapons status does not uniformly affect sovereign borrowing costs.

Future research should incorporate longer time series, explore time-varying correlations, and examine how specific geopolitical events affect these relationships. Additionally, expanding the analysis to include other sovereign debt instruments and currencies would provide a more complete picture of financial market integration among nuclear powers.

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Glossary

Correlation Coefficient A statistical measure ranging from -1 to +1 that quantifies the linear relationship between two variables. A correlation of +1 indicates perfect positive correlation, -1 indicates perfect negative correlation, and 0 indicates no linear relationship.

Government Bond A debt security issued by a national government, typically denominated in the country's own currency. Government bonds are used to finance government spending and are generally considered low-risk investments.

Risk-Free Rate The theoretical rate of return on an investment with zero risk, typically approximated by the yield on government bonds of highly creditworthy nations.

10-Year Government Bond Yield The annualized return on a government bond with a maturity of ten years, serving as a benchmark for long-term borrowing costs and a key indicator of economic conditions and monetary policy expectations.

Emerging Market A nation with an economy that is progressing toward becoming more advanced, typically characterized by rapid growth and industrialization but also higher volatility and risk compared to developed markets.

Sovereign Risk The risk that a government will default on its debt obligations or fail to honor other financial commitments, reflected in higher bond yields demanded by investors.

Flight to Quality A phenomenon where investors rapidly shift capital from riskier assets to safer assets during periods of market stress or economic uncertainty.

Pearson Correlation The most common measure of linear correlation, calculated as the covariance of two variables divided by the product of their standard deviations.

Rolling Correlation A correlation coefficient calculated over a moving time window, allowing analysis of how the relationship between variables changes over time.

Basis Point One hundredth of one percent (0.01%), commonly used to describe changes in interest rates and bond yields.

Sanctions Economic penalties imposed by one or more countries on another country, typically restricting trade, financial transactions, or access to international markets.

Nuclear Power In this context, a nation possessing nuclear weapons capabilities, encompassing both delivery systems and warheads.

Market Integration The degree to which financial markets in different countries are interconnected, with integrated markets exhibiting stronger correlations in asset prices and yields.

The End