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Research Paper

Global Risk Transmission and Monetary Stability in Brunei Darussalam: Evidence from a Time-Varying Parameter VAR Approach

Transmisi Risiko Global dan Stabilitas Moneter di Brunei Darussalam: Bukti dari Pendekatan Time-Varying Parameter VAR

Magita Sari[1*]; **Ibnu Qizam**[2]; **Mohammad Nadhratuzzaman Hosen**[3]; **Nur Hidayah**[4]; **Rahmawati**[5];
[1,2,3,4,5]Syarif Hidayatullah State Islamic University (UIN) Jakarta, Indonesia
[1*]Author Correspondence Email: magita.sari25@mhs.uinjkt.ac.id

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Abstract

This study investigates the impact of global risk factors specifically geopolitical risk (GPR), economic policy uncertainty (GEPU), market volatility (VIX), and commodity price dynamics on the monetary stability of Brunei Darussalam. Given the vulnerability of small open economies to external shocks, understanding the transmission mechanism of these risks is critical for maintaining the resilience of the Brunei Dollar (BND) peg. Utilizing monthly data from January 2015 to May 2025, the empirical analysis employs a dual-stage econometric framework: the Toda–Yamamoto Granger causality test for static inference and the Time-Varying Parameter Vector Autoregression (TVP-VAR) model for dynamic assessment. The results reveal that geopolitical tensions and gold prices are the predominant long-term predictors of exchange rate fluctuations. Furthermore, the dynamic connectedness analysis indicates that the transmission of global shocks is regime-dependent, intensifying significantly during systemic crises such as the COVID-19 pandemic and the 2022 geopolitical escalation in Ukraine. While digital assets exhibit limited influence, the study confirms that Brunei's monetary stability remains deeply integrated into global energy and safe-haven markets. These findings underscore the necessity for the Brunei Darussalam Central Bank (BDCB) to adopt adaptive, time-varying macroprudential monitoring to mitigate cross-border risk spillovers effectively in the future.

Kata Kunci:

Brunei Darussalam; Dinamika Nilai Tukar; Risiko Geopolitik; Stabilitas Moneter; TVP-VAR;

Abstrak

Studi ini mengkaji dampak faktor risiko global khususnya risiko geopolitik (GPR), ketidakpastian kebijakan ekonomi (GEPU), volatilitas pasar (VIX), dan dinamika harga komoditas terhadap stabilitas moneter Brunei Darussalam. Mengingat kerentanan ekonomi kecil yang terbuka terhadap guncangan eksternal, pemahaman mengenai mekanisme transmisi risiko-risiko tersebut sangat penting untuk menjaga ketahanan sistem patokan nilai tukar Dolar Brunei (BND). Dengan menggunakan data bulanan dari Januari 2015 hingga Mei 2025, analisis empiris ini menerapkan kerangka kerja ekonometrika dua tahap: uji kausalitas Granger Toda–Yamamoto untuk inferensi statis dan model Time-Varying

Parameter Vector Autoregression (TVP-VAR) untuk penilaian dinamis. Hasil penelitian menunjukkan bahwa ketegangan geopolitik dan harga emas merupakan prediktor jangka panjang utama bagi fluktuasi nilai tukar. Selain itu, analisis keterhubungan dinamis mengindikasikan bahwa transmisi guncangan global bergantung pada rezim kondisi tertentu, di mana dampaknya meningkat secara signifikan selama krisis sistemik seperti pandemi COVID-19 dan eskalasi geopolitik di Ukraina pada tahun 2022. Meskipun aset digital menunjukkan pengaruh yang terbatas, studi ini mengonfirmasi bahwa stabilitas moneter Brunei tetap terintegrasi erat dengan pasar energi global dan pasar aset safe-haven. Temuan ini menegaskan perlunya Bank Sentral Brunei Darussalam (BDCB) untuk menerapkan pemantauan makroprudensial yang adaptif dan dinamis (berubah seiring waktu) guna memitigasi dampak limpahan risiko lintas batas secara efektif di masa depan.

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INTRODUCTION

Background of the Problem

Brunei Darussalam is a small open economy whose currency has been interchangeable at par with the Singapore dollar under the 1967 Currency Interchangeability Agreement and is issued under a currency board arrangement administered by the Brunei Darussalam Central Bank, which backs every note and coin issued with reserves (Brunei Darussalam Central Bank [BDCB], n.d.; Monetary Authority of Singapore [MAS], n.d.-a). The Brunei dollar therefore moves one-for-one with the Singapore dollar, whose value against the US dollar reflects the Monetary Authority of Singapore's policy of managing the trade-weighted exchange rate (S$NEER) within a policy band (MAS, n.d.-b), and this arrangement structurally exposes Brunei to external shocks. Under a peg, monetary policy autonomy is limited, and the central bank must rely more heavily on macroprudential and reserve management measures rather than exchange rate adjustment to preserve the external balance (IMF, 2024). As a result, global disturbances, particularly geopolitical tensions and commodity price volatility, can quickly transmit into Brunei's financial system (Afonso et al., 2024). This vulnerability is reinforced by the economy's strong dependence on oil and gas exports, making macroeconomic conditions sensitive to commodity price cycles and the associated fiscal pressures (IMF, 2024). Overall, these structural features highlight the importance of monitoring cross-border risk transmission and strengthening policy coordination to sustain monetary and financial stability. Oil and gas revenue fell from 24.5% of GDP in FY2022 to 13.0% in FY2023, the fiscal balance reached –11.8% of GDP, and gross official reserves declined from USD 5.0 billion to USD 4.5 billion (IMF, 2024).

Recent empirical evidence shows that exchange rate dynamics in developing and emerging economies are increasingly shaped by global risk conditions beyond conventional macroeconomic fundamentals. Earlier studies have largely relied on static VAR frameworks and emphasized domestic variables such as inflation, interest rates, money supply, and public debt (Asiamah, 2025; Umoru et al., 2025). However, more

recent research highlights the independent role of global risk drivers, including geopolitical risk, international volatility spillovers, and confidence shocks, in influencing exchange rate behavior (Yatsenko, 2023). Methodologically, advances such as time-varying parameter VAR models with stochastic volatility demonstrate that exchange rate sensitivity to both domestic fundamentals and global risk factors changes across regimes and crisis episodes (Gayaker & Yalcin, 2025). Evidence also indicates that geopolitical risk indices and financial stress measures generate spillovers to emerging market currencies that may not be captured by traditional monetary variables alone (Elsayed & Helmi, 2021). Overall, the literature increasingly supports integrated frameworks that combine macroeconomic fundamentals with explicit global risk indicators to better explain exchange rate fluctuations in emerging economies (Asiamah, 2025; Yatsenko, 2023). The study also builds on the measurement literature for its own variables, namely the Geopolitical Risk index (Caldara & Iacoviello, 2022), the Economic Policy Uncertainty index (Baker et al., 2016; Davis, 2016), the connectedness framework (Diebold & Yilmaz, 2012, 2014) and its TVP-VAR extension (Antonakakis et al., 2020), and the Toda–Yamamoto procedure (Toda & Yamamoto, 1995). For currency boards and pegged regimes such as Hong Kong and the Gulf economies, external shocks are absorbed mainly through interest rates, reserves, and domestic prices rather than through the exchange rate (Hanke, 2002; Pong, 2025), and ASEAN exchange rates, including the Singapore dollar, co-move strongly with global forces (Qureshi & Aftab, 2023).

The literature increasingly recognizes that global risk factors, particularly geopolitical tensions and policy uncertainty, shape exchange rate dynamics and monetary stability, especially in small open economies that are structurally exposed to external shocks. In parallel, a growing stream of research examines the macro-financial implications of digital assets, highlighting how crypto-market development may introduce new channels of cross-border volatility and challenge the monetary sovereignty. Nevertheless, empirical evidence remains fragmented when these two dimensions are considered together. While studies have documented that institutionalized crypto-assets may weaken the effectiveness of monetary transmission and create regulatory challenges for central banks (Koliadka, 2025), this evidence is largely derived from larger economies and does not sufficiently reflect the institutional characteristics of small, pegged currency systems such as Brunei Darussalam. Simultaneously, research on geopolitical shocks and policy uncertainty has shown that these disturbances can trigger measurable monetary and financial responses (Ginn & Saadaoui, 2025); however, much of the existing work relies on constant-parameter specifications, such as standard Taylor-rule settings or static VAR structures, that may fail to capture regime shifts in risk transmission. This methodological limitation becomes particularly relevant during crisis periods when cross-asset relationships may change sharply, as demonstrated by the dynamic correlation evidence during the COVID-19 pandemic (Dimitriadis et al., 2025). Moreover, cryptocurrency markets are known to display distinct volatility regimes and spillover behavior under extreme stress (Kyriazis, 2021), implying that the interaction between geopolitical risk and crypto dynamics is unlikely to be stable over time. Taken together, these strands suggest that Brunei-relevant evidence requires an integrated approach capable of jointly modeling geopolitical risk, policy uncertainty, and digital asset dynamics under time-varying conditions.

Building on this gap, the present study investigates how global risk transmission affects Brunei Darussalam's monetary stability by integrating key external risk indicators, geopolitical risk (GPR), global economic policy uncertainty (GEPU), and market volatility (VIX), together with US monetary conditions (DFF), commodity price dynamics (oil and gold) and digital asset conditions proxied by Bitcoin (BTC). This design is motivated by the premise that Brunei's fixed exchange rate arrangement and

commodity-dependent macroeconomic structure may amplify the sensitivity of the domestic monetary environment to international shocks, particularly during periods of heightened uncertainty. Methodologically, the study adopts a dual-stage econometric strategy to capture both the long-run predictive structure and evolving nature of shock transmission. First, the Toda–Yamamoto causality framework is employed to identify static predictive linkages without imposing restrictive assumptions regarding the order of integration or the cointegration relationships among variables. Second, a Time-Varying Parameter Vector Autoregression (TVP-VAR) model is implemented to capture regime-dependent spillovers and connectedness dynamics, allowing coefficients and shock transmission intensities to evolve over time in response to structural breaks and crisis episodes (Kendema, 2026). This time-varying specification is consistent with evidence that geopolitical risk and policy uncertainty may exert asymmetric effects on exchange rate behavior across market states (Gainetdinova, 2023) and that connectedness among commodities and financial variables intensifies during turbulent periods (Alharbey et al., 2023). By jointly modeling these risk channels within a flexible dynamic framework, this study provides Brunei-specific empirical evidence on when and how external disturbances propagate into a pegged-currency environment, thereby offering policy-relevant implications for strengthening time-varying surveillance and macroprudential preparedness (Wang, 2025).

This study maps the transmission of global financial risks to Brunei Darussalam's exchange rate stability by documenting how international shocks propagate into the USD/BND exchange rate through external financial and commodity market channels. In small open economies, global risk transmission typically operates via multiple mechanisms, including trade linkages, capital flow adjustments, and spillovers from international financial markets (Mistak & Ozkan, 2024). These channels are particularly relevant under a fixed exchange rate regime, where exchange rate movements and external conditions can directly affect import prices, investment decisions, and balance sheet exposures, thereby influencing overall monetary and financial stability (Wu & Ren, 2025). From a policy perspective, identifying the dominant external drivers of exchange rate fluctuations provides a basis for strengthening macroprudential design and surveillance, especially when shock transmission is time-varying rather than constant (Bussiere et al., 2020). Macroprudential frameworks are expected to be more effective when calibrated against empirically observed spillover patterns and crisis-period dynamics, enabling regulators to implement countercyclical measures that mitigate excessive volatility and reduce systemic vulnerability during episodes of global stress (Stepanenko et al., 2025). Accordingly, the empirical evidence generated in this study offers practical guidance for the Brunei Darussalam Central Bank (BDCB) to prioritize risk indicators and refine instruments such as countercyclical capital buffers, foreign currency exposure limits, and related liquidity safeguards to enhance resilience under heightened international spillovers. Because BDCB does not set the exchange rate under the currency board, movements in USD/SGD reach Brunei's domestic financial system mainly through import prices, the domestic-currency value of US dollar-denominated oil and gas revenue and of the reserve assets that back the currency, and banks' foreign-currency positions; these channels, rather than exchange-rate setting, motivate the macroprudential implications discussed later.

Identification of Problems

Brunei Darussalam as a small open economy faces high vulnerability to external shocks because it implements a fixed exchange rate regime pegged to the Singapore Dollar and has a strong dependence on the oil and gas sector. These conditions limit the flexibility of exchange rate adjustments and increase dependence on reserve management policies

and macroprudential policies in maintaining monetary stability. Furthermore, changes in commodity prices, geopolitical tensions, global economic policy uncertainty and international financial market volatility have the potential to put pressure on exchange rate stability and Brunei Darussalam's macroeconomic conditions. The record illustrates this exposure: oil and gas revenue halved as a share of GDP between FY2022 and FY2023 and reserves declined (IMF, 2024). Two further problems follow: the channels linking geopolitical risk, policy uncertainty, market volatility, commodities, and digital assets to the external value of the Brunei dollar remain insufficiently understood, and most previous studies rely on constant-parameter models that cannot capture regime shifts.

Formulation of the Problem

Based on the identified issues, this study addresses the question of how global risks are transmitted to the stability of Brunei Darussalam's exchange rate, given the country's characteristics: a small, open economy reliant on oil and gas commodities that operates under a fixed exchange rate regime pegged to the Singapore Dollar. The global risks in question include geopolitical risk (GPR), global economic policy uncertainty (GEPU), and market volatility (VIX), all of which can simultaneously influence Brunei Darussalam's financial market conditions and monetary stability. Furthermore, US monetary conditions (DFF), fluctuations in oil and gold prices, as well as developments in Bitcoin, potentially serve as additional channels for the transmission of external shocks to the USD/BND exchange rate.

A further research issue concerns the lack of clarity regarding the patterns and intensity of the relationships between these global risk factors and the stability of Brunei Darussalam's exchange rate over time. These relationships are presumed to be non-constant, as they may shift between normal periods and times of crisis or heightened global uncertainty. Consequently, an analysis is required that can identify predictive relationships between variables while simultaneously capturing dynamic changes in the intensity of risk transmission. In this context, the study employs the Toda–Yamamoto approach to identify causal relationships and a TVP-VAR model to analyze time-varying changes in shock transmission.

Thus, the central research problem is to determine how geopolitical risk, global economic policy uncertainty, market volatility, the effective federal funds rate (DFF), oil prices, gold prices, and Bitcoin influence the stability of Brunei Darussalam's USD/BND exchange rate, and how the strength and direction of this risk transmission evolve over time particularly during periods of heightened pressure or global crisis. Understanding these transmission patterns is expected to provide an empirical basis for strengthening monetary policy, macroprudential oversight, and external risk management strategies implemented by the Brunei Darussalam Central Bank in the face of global uncertainty.

Accordingly, the study tests three hypotheses. H1: each of GPR, GEPU, VIX, DFF, Brent, gold, and BTC Granger-causes USD/BND in the Toda–Yamamoto sense. H2: USD/BND is a net receiver of shocks in the connectedness system. H3: total connectedness and the spillovers received by USD/BND increase during crisis episodes (2020 and 2022).

Objectives and Benefits of Research

Research Objectives

This study aims to analyze how global risks and international market conditions are transmitted to Brunei Darussalam's monetary stability, specifically through USD/BND exchange rate dynamics within the framework of a pegged exchange rate regime. In

particular, the study seeks to identify predictive relationships between geopolitical risk (GPR), global economic policy uncertainty (GEPU), market volatility (VIX), the effective federal funds rate (DFF), Brent crude oil prices, gold prices, and Bitcoin vis-à-vis the USD/BND exchange rate, employing the Toda–Yamamoto approach. Furthermore, the study aims to measure how the intensity, direction, and transmission patterns of these global shocks evolve over time, using the Time-Varying Parameter Vector Autoregression (TVP-VAR) approach; this includes identifying changes in connectedness and exchange rate responses during both normal periods and crisis episodes, such as the COVID-19 pandemic and the geopolitical escalations of 2022. This approach was selected because the research focuses not only on static relationships but also on shifts in risk transmission across different time periods and regimes.

Additionally, the study aims to determine the most dominant external factors influencing the stability of Brunei Darussalam's exchange rate and to provide empirical insights into the vulnerabilities characteristic of a small, open, commodity-dependent economy operating under a fixed exchange rate system. The findings are intended to yield policy implications that support the strengthening of risk monitoring and macroprudential policies by the Brunei Darussalam Central Bank (BDCB) specifically through the use of time-varying risk indicators and enhanced preparedness for increased spillover effects during periods of global stress.

Research Benefits

This study is expected to yield academic benefits by enriching the literature on the transmission of global risks to monetary stability in a small, open economy operating under a fixed exchange rate regime, specifically Brunei Darussalam. Its contribution lies in integrating geopolitical risk, global economic policy uncertainty, market volatility, global monetary conditions, commodity prices, and digital assets into a single dynamic analytical framework. By employing a combination of the Toda–Yamamoto approach and the Time-Varying Parameter Vector Autoregression (TVP-VAR) model, the study identifies predictive relationships while capturing shifts in risk transmission intensity across both normal and crisis periods; this addresses the limitations of constant-parameter approaches in explaining changing inter-variable relationships during times of turbulence.

In practical terms, this research offers benefits to the Brunei Darussalam Central Bank (BDCB) and relevant authorities by providing an empirical basis to strengthen external risk monitoring and management systems. Identifying dominant factors and periods of heightened spillover helps authorities prioritize specific indicators for early warning systems and adjust macroprudential policies in response to evolving risk conditions. Because no Islamic-finance variable is estimated, implications for Islamic banks and the Sukuk market are presented only as broader considerations. Thus, the study's value extends beyond theory, providing a foundation for more adaptive policies to safeguard Brunei Darussalam's monetary and financial resilience against global shocks.

THEORETICAL AND CONCEPTUAL FRAMEWORK

Theoretical Framework

Global Risk Transmission Channel

The theoretical framework of this study is grounded in the theory of global risk transmission, which posits that shocks originating in international markets can be transmitted to the domestic economy through various channels—such as financial

markets, international trade, commodity prices, capital flows, and shifts in investor risk perception. In the context of Brunei Darussalam as a small open economy, this openness means that changes in global conditions can potentially impact domestic stability. This is particularly relevant given that Brunei maintains an exchange rate regime pegged to the Singapore Dollar, meaning that adjustments to external pressures do not primarily occur through exchange rate fluctuations. The study emphasizes that this dynamic makes monitoring cross-border risk transmission crucial for Brunei Darussalam's monetary and financial stability. This view is formalised in the global financial cycle literature, in which US monetary policy and global risk aversion drive capital flows, asset prices, and credit across countries regardless of the exchange-rate regime (Miranda-Agrippino & Rey, 2020; Rey, 2013). In the Mundell–Fleming framework, a country with an open capital account and a fixed exchange rate gives up monetary autonomy (Mundell, 1963; Obstfeld et al., 2005), so external shocks are absorbed by interest rates, reserves, and domestic prices.

In this study, global risk transmission is represented by Geopolitical Risk (GPR), Global Economic Policy Uncertainty (GEPU), and the Volatility Index (VIX). GPR captures uncertainty stemming from global geopolitical conflicts and tensions; GEPU reflects uncertainty regarding global economic policies; and the VIX represents the level of fear or volatility in international financial markets. Theoretically, these three factors can heighten risk perceptions and drive changes in investor behavior and international capital flows, ultimately influencing a country's exchange rate conditions and monetary stability. The study explicitly positions these three indicators as components of the global risk factors transmitted to the USD/BND exchange rate. The indices follow Caldara and Iacoviello (2022) for GPR and Baker et al. (2016) and Davis (2016) for GEPU; together with the VIX, they underpin H1.

International Monetary Spillover Channel

The next framework is the theory of international monetary spillovers—the view that changes in monetary and financial conditions in one country or region can impact other nations through international financial market and economic linkages. In this study, the Effective Federal Funds Rate (DFF) is used to represent external monetary conditions, specifically changes in United States monetary policy. Shifts in global interest rates can influence investor preferences, funding costs, capital flows, and international liquidity conditions, thereby potentially exerting pressure on the exchange rate stability of small, open economies. The use of the TVP-VAR model is also appropriate, as prior research indicates that the magnitude of international monetary spillovers can vary heterogeneously over time. For a currency anchored to the Singapore dollar, US monetary policy enters mainly through MAS policy and interest-rate parity, because Singapore dollar interest rates are largely determined by global rates and by expectations of the S$NEER path (MAS, n.d.-b). DFF can therefore affect USD/BND only through its effect on USD/SGD and on the broad US dollar, not independently of it (Miranda-Agrippino & Rey, 2020; Mistak & Ozkan, 2024).

Thus, in the context of Brunei Darussalam, changes in global monetary conditions are not viewed in isolation but rather as part of an external mechanism that can influence USD/BND stability. This relationship becomes increasingly significant during major shifts in global financial conditions, as the intensity of transmission can escalate during periods of stress or crisis.

Commodity Price Channel

This study is also grounded in the perspective of commodity price transmission, particularly given Brunei Darussalam's economic structure, which is heavily reliant on the oil and gas sector. Brent crude oil prices can influence Brunei's external and fiscal conditions through fluctuations in export earnings and energy-related revenues. Consequently, oil price movements can serve as a primary transmission channel for external shocks affecting monetary and exchange rate stability. The commodity-currency literature shows that commodity prices help predict the currencies of commodity exporters with floating rates (Chen & Rogoff, 2003); under Brunei's par arrangement, however, oil prices affect the economy mainly through fiscal revenue and reserves, and they can co-move with USD/SGD through the common US dollar factor.

In addition to oil, the price of gold serves as both a commodity market indicator and a "safe-haven" asset. During periods of heightened global uncertainty, investors may shift their portfolios toward assets perceived as relatively safe; thus, fluctuations in gold prices can be linked to shifts in capital flows and international financial market conditions. Gold acts as a hedge and safe haven in periods of market stress (Baur & Lucey, 2010), so its price proxies global flight to safety.

Digital Asset Channel

The growth of the digital asset market has introduced a new channel for the transmission of international risk. In this study, Bitcoin (BTC) serves as a proxy for digital asset market conditions. Theoretically, Bitcoin's interconnectedness with global financial markets allows fluctuations in digital asset volatility to interact with risk sentiment and international market conditions. By incorporating Bitcoin, this study moves beyond conventional risk transmission channels such as exchange rates, interest rates, and commodities to also consider developments in the digital financial market.

This approach addresses a research gap indicating that studies on geopolitical risk and digital asset developments remain relatively fragmented, particularly regarding countries with pegged exchange rate systems, such as Brunei Darussalam. The case for a direct channel in Brunei is weak: cryptocurrencies are not legal tender and are not regulated by the central bank (Xinhua, 2017). Bitcoin therefore enters the model as a global risk-sentiment indicator, consistent with evidence of spillovers among cryptocurrencies, gold, oil, and geopolitical risk (Foroutan & Lahmiri, 2024; Shaik et al., 2024), rather than as a domestic exposure.

Time-Varying Connectedness Framework

The final theory underpinning the research methodology is the concept of dynamic or time-varying connectedness. This concept is based on the premise that relationships between economic and financial variables are not static but evolve in response to market conditions, crises, and structural economic shifts. Consequently, standard VAR models with fixed parameters may prove inadequate during periods of regime change or structural breaks.

This study employs a Time-Varying Parameter Vector Autoregression (TVP-VAR) model to capture changes in coefficients and shock transmission over time. Existing literature indicates that the TVP-VAR approach offers greater flexibility in capturing structural changes in inter-variable relationships and identifying heightened connectedness during periods of stress. The study further utilizes TVP-VAR to capture regime-dependent connectedness and shifts in the transmission of global shocks affecting the stability of

Brunei's exchange rate. The framework follows Diebold and Yilmaz (2012, 2014) and Antonakakis et al. (2020) and underpins H2 and H3.

Conceptual Framework

Conceptually, this study positions the stability of the USD/BND exchange rate as the primary variable subject to transmission from various external risks and conditions. This variable is influenced not by a single factor, but by a combination of global risk, global monetary conditions, commodity markets, and digital asset markets. The study's conceptual model distinguishes between predictive relationships and dynamic relationships. The Toda–Yamamoto approach is employed to identify predictive relationships between external variables and the USD/BND rate, while the TVP-VAR model is used to examine how the strength and direction of these transmission effects evolve over time. The study explicitly states that its empirical design combines static predictive (Granger) causality with time-varying dynamic modeling.

The conceptual relationships of the study can be illustrated as follows:

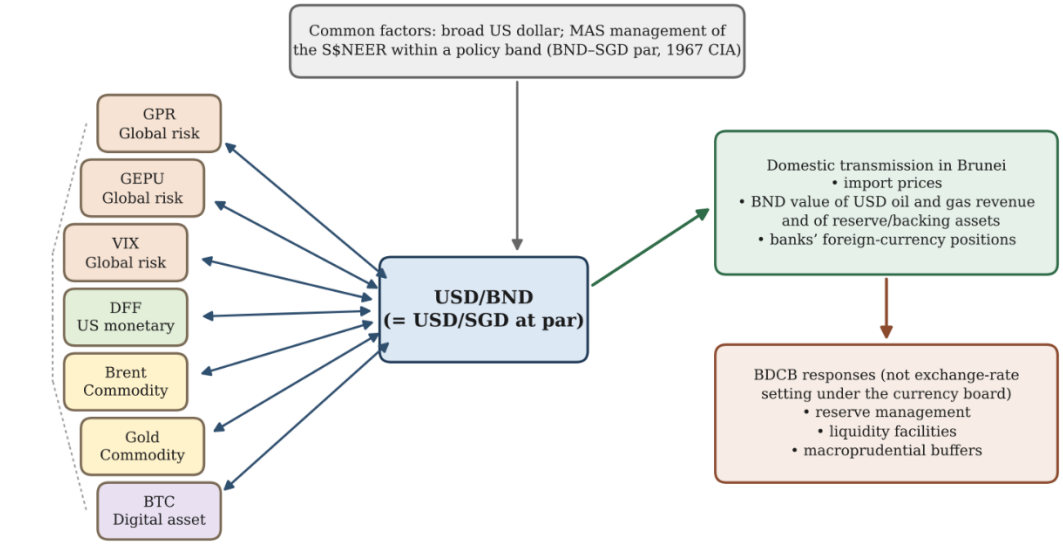


Figure 1. Conceptual Framework of Global Risk Transmission and Monetary Stability in Brunei Darussalam (authors' elaboration)

Explanation of relationships within the conceptual framework

The framework illustrates that GPR, GEPU, and VIX are primary sources of global risk capable of increasing uncertainty and volatility in international markets. DFF represents the global monetary channel, while Brent oil and gold represent the commodity channel. Bitcoin is included as a digital asset channel. All these factors are considered to have the potential to generate spillovers affecting the USD/BND exchange rate, which this study uses as an operational proxy for exchange rate stability within Brunei Darussalam's pegged exchange rate system. Because the TVP-VAR treats every variable as both a potential transmitter and receiver, the links in Figure 1 are bidirectional; the figure also shows the common US dollar and MAS policy factors and the domestic channels through which the external value of the currency reaches Brunei.

Subsequently, these relationships are analyzed in two stages. The first stage employs the Toda–Yamamoto Granger causality test to identify whether predictive relationships exist between each global factor and the USD/BND rate. This method was selected because it

remains applicable when variables possess different orders of integration and does not require cointegration testing as a prerequisite. The second stage utilizes TVP-VAR to identify changes in the intensity of shock transmission and interconnectedness among the variables over time.

Thus, the underlying thread connecting the theoretical and conceptual frameworks of this study is:

Global risk factors → transmission/spillover → USD/BND exchange rate stability → monetary stability → macroprudential policy response.

RESEARCH METHODS

Research methods in this study refer to the systematic procedures used to examine the transmission of global risk factors to the monetary stability of Brunei Darussalam. The study adopts a quantitative research approach using secondary monthly time-series data. The empirical design combines static causal analysis and dynamic time-varying analysis to identify both predictive relationships and the evolution of global risk spillovers over time. This approach is appropriate because the study focuses on measurable macroeconomic and financial indicators and seeks to determine how changes in global risk conditions are transmitted to the USD/BND exchange rate as a proxy for Brunei Darussalam's monetary stability.

The research design is structured into four sequential stages: data preprocessing, static causal analysis, dynamic analysis, and robustness assessment. The first stage involves transforming the relevant variables and conducting preliminary statistical diagnostics. The second stage applies the Toda–Yamamoto Granger causality test to identify predictive causal relationships between global risk variables and the USD/BND exchange rate. The third stage employs a Time-Varying Parameter Vector Autoregression (TVP-VAR) model to examine how the intensity and direction of risk transmission change over time, particularly during periods of heightened global uncertainty. The final stage involves robustness checks and interpretation of the findings for monetary and macroprudential policy implications in Brunei Darussalam.

The dataset contains eight variables, consisting of one dependent variable and seven explanatory variables. The USD/BND exchange rate serves as the dependent variable and is interpreted as the external value of the Brunei dollar. The explanatory variables comprise the Geopolitical Risk Index (GPR), Global Economic Policy Uncertainty (GEPU), CBOE Volatility Index (VIX), Effective Federal Funds Rate (DFF), Brent crude oil price, gold price, and Bitcoin (BTC) price. These variables represent three major transmission channels: global risk and uncertainty, international monetary conditions, and commodity and digital asset markets.

Because the Brunei dollar is interchangeable at par with the Singapore dollar, USD/BND is in practice identical to USD/SGD. The model therefore explains the US dollar value of the SGD-anchored currency that Brunei imports through the Currency Interchangeability Agreement, and the study is framed accordingly: its Brunei-specific relevance lies in how this imported external value affects import prices, the domestic-currency value of oil and gas revenue and reserve assets, and banks' foreign-currency positions. Because the exchange-rate level largely reflects broad US dollar movements, the realised volatility of monthly USD/BND returns is used as a complementary stability indicator in the robustness analysis.

The data collection technique is based entirely on secondary data obtained from established international and financial databases as specified in Table 1. Monthly observations are compiled and synchronized according to the same observation period

to ensure comparability among variables. Since the study analyzes financial and macroeconomic time-series data rather than individual respondents, questionnaires, interviews, or field observations are not employed. The collected data are organized chronologically and subjected to preprocessing before econometric estimation. Variables measured as prices or exchange rates are transformed using natural logarithms to reduce heteroscedasticity and improve variance stability, while variables expressed as rates or indices, particularly DFF and VIX, are retained in their original form. DFF was close to zero in 2015–2016 and 2020–2021, so the Wu–Xia shadow rate (Wu & Xia, 2016) is used as a robustness check. Descriptive statistics are reported in Appendix Table A1.

Table 1. Variable Definitions, Sources, and Transformations

Variable	Definition and Unit	Source	Monthly Value	Transfor-mation
USD/BND	Brunei dollars per US dollar	BDCB	Monthly index	Natural log
GPR	Geopolitical Risk index (1985–2019 = 100)	Caldara and Iacoviello (2022), matteoiacoviello.com/gpr.htm	Monthly index	Natural log
GEPU	Global Economic Policy Uncertainty index (GDP-weighted)	Davis (2016), policyuncertainty.com	Monthly index	Natural log
VIX	CBOE Volatility Index, index points	CBOE via FRED (VIXCLS)	Monthly index	Level
DFF	Effective federal funds rate, % per year	FRED (DFF)	Monthly index	Level
Brent	Brent crude oil spot price, USD per barrel	FRED (DCOILBRENTEU)	Monthly index	Natural log
Gold	Gold price, USD per troy ounce	LBMA	Monthly index	Natural log
BTC	Bitcoin price, USD	Exchange	Monthly index	Natural log

Note: items in brackets are to be confirmed by the authors.

Before estimating the main models, the study conducts preliminary diagnostic tests to establish the statistical properties of the variables. The Augmented Dickey–Fuller (ADF; Dickey & Fuller, 1979) test is used to examine whether each time series contains a unit root and to determine its order of integration. The study also considers the Zivot–Andrews test (Zivot & Andrews, 1992), which allows one endogenous break in intercept and trend, to account for potential structural breaks in the time series. Subsequently, the optimal lag length is determined using information criteria, particularly the Akaike Information Criterion (AIC) and Schwarz Information Criterion (SIC). These procedures are important because appropriate treatment of non-stationarity and lag structure is required before conducting causal and dynamic time-series analysis. ADF regressions include a constant and trend for levels and a constant for first differences, with the augmentation lag chosen by SIC (maximum 12).

The first main econometric technique is the Toda–Yamamoto Granger causality test. This method is applied to identify whether past values of global risk, monetary, commodity, and digital asset variables contain predictive information about movements in the USD/BND exchange rate. The method is particularly suitable because it can be applied when the variables have different integration orders, provided that the variables are not integrated beyond the permissible order. The estimation is conducted through an augmented VAR model of VAR(k + dmax), where *k* represents the optimal lag length and *dmax* represents the maximum order of integration among the variables. The causal relationships are subsequently evaluated using the Modified Wald (MWALD) test. Following Toda and Yamamoto (1995), d_max = 1 and k is chosen by SIC (Table 3); the Wald statistics in Table 4 imply k = 2. VAR stability is checked from the inverse roots,

residual serial correlation with the LM test, and normality with the Jarque–Bera test (Appendix Table A2). Causality is tested in both directions. Because an eight-variable VAR(k + d_max) leaves limited degrees of freedom with 125 observations, bootstrap p-values are reported alongside asymptotic ones.

The second main econometric technique is the Time-Varying Parameter Vector Autoregression (TVP-VAR) model. Unlike a conventional VAR model that assumes coefficients remain constant throughout the observation period, TVP-VAR allows the coefficients and shock variances to change over time. This feature is particularly relevant to the present study because global risk transmission may become stronger or weaker depending on changing economic conditions, financial crises, geopolitical events, and market volatility. The TVP-VAR framework therefore enables the study to identify whether the transmission of GPR, GEPU, VIX, DFF, oil, gold, and Bitcoin shocks to the USD/BND exchange rate differs across periods.

The TVP-VAR model is estimated within a state-space framework using the Kalman filter with forgetting factors (Antonakakis et al., 2020; Koop & Korobilis, 2014), rather than the MCMC-based Bayesian TVP-VAR with stochastic volatility of Primiceri (2005), allowing the model parameters and the error covariance matrix to be updated recursively as new observations become available. This approach is useful for identifying gradual changes in parameter values as well as abrupt changes associated with crisis periods. The lag order selected during the preliminary VAR analysis is maintained in the TVP-VAR estimation to ensure consistency between the static and dynamic stages of the analysis. The forgetting factors are $\kappa 1 = 0.99$ for the coefficients and $\kappa 2 = 0.96$ for the covariance matrix, the prior is initialised from a constant-parameter VAR on the full sample, the lag order is $p = 2$, the GFEVD horizon is $H = 10$ months, and estimation uses software. Because the model is highly parameterised relative to 125 observations, the forgetting factors and prior act as shrinkage devices, and stability is checked by varying $\kappa 1$ and $\kappa 2$ (Table 6).

To measure the intensity and direction of dynamic spillovers, the study employs time-varying Generalized Forecast Error Variance Decomposition (GFEVD). The GFEVD identifies the proportion of the forecast error variance of one variable that can be attributed to shocks originating from other variables in the system. Based on these results, the Total Connectedness Index (TCI) is calculated to measure the overall degree of interconnectedness among global risk factors, financial markets, commodity markets, digital assets, and the USD/BND exchange rate. Directional spillovers are also examined to determine whether the USD/BND exchange rate primarily functions as a receiver or transmitter of external shocks.

Let $\theta_{ij}(H)$ denote the share of the H-step forecast-error variance of variable i due to shocks in variable j, normalised as $\tilde{\theta}_{ij}(H) = \theta_{ij}(H) / \Sigma_j \theta_{ij}(H)$. Directional connectedness is $TO_j = \Sigma_{i \neq j} \tilde{\theta}_{ij}(H)$ and $FROM_i = \Sigma_{j \neq i} \tilde{\theta}_{ij}(H)$, net connectedness is $NET_i = TO_i - FROM_i$, and $TCI = 100 \times (1/N) \Sigma_i FROM_i$ (Antonakakis et al., 2020; Diebold & Yilmaz, 2012). Because the generalized FEVD (Pesaran & Shin, 1998) is invariant to variable ordering, connectedness measures do not depend on the ordering.

In addition, Time-Varying Impulse Response Functions (TV-IRFs) are employed to examine how the USD/BND exchange rate responds to shocks originating from individual global risk and market variables over time. The TV-IRF analysis provides information regarding the direction, magnitude, persistence, and duration of the exchange rate response to a one-standard-deviation shock. This technique is particularly important for identifying whether the effects of geopolitical risk, market volatility, oil prices, gold prices, monetary conditions, or Bitcoin become amplified during periods of systemic stress, such as the COVID-19 pandemic and major geopolitical events. The TV-

IRFs are generalized impulse responses, which are also order-invariant; Figure 3 summarises the absolute response of USD/BND at horizon h = 10 months.

Finally, robustness analysis is conducted to assess the reliability and stability of the empirical results. The Toda–Yamamoto model can be re-estimated using alternative lag specifications, while the TVP-VAR results can be examined under alternative forgetting factors and different sample periods. The study also considers a subsample analysis that excludes the 2020–2021 pandemic period to determine whether the identified transmission relationships remain valid outside an exceptional crisis episode. These procedures strengthen the credibility of the findings by testing whether the main conclusions are dependent on a particular model specification, variable ordering, or crisis period.

RESULTS AND DISCUSSION

Results

Preliminary Diagnostics

Prior to estimating the econometric models, a series of diagnostic tests were conducted to ensure the statistical properties of the dataset. This stage is critical to avoid spurious inferences and to satisfy the prerequisite conditions for both Toda-Yamamoto and TVP-VAR frameworks.The assessment began with the Augmented Dickey-Fuller (ADF) unit root test to determine the integration order of the variables. The results indicate a mixture of stationarity levels, where some variables are stationary at level I(0), while others, specifically price-level data, become stationary only after the first transformation I(1). Following the stationarity check, the optimal lag length (k) was determined using several information criteria, with the Schwarz Information Criterion (SIC) being the primary reference to ensure model parsimony. Table 2 provides the integrated results of the unit root tests and lag length selection criteria.

Tabel 2. Integrated Results of Unit Root Tests and Lag Selection Criteria

Variable	ADF (Level)	ADF (1st Diff)	Integration	AIC	SIC (SC)
USD/BND	-1.842	-8.421***	I(1)	-12.45	-11.90*
GPR	-3.512***	---	I(0)	-12.42	-11.88
GEPU	-3.210**	---	I(0)	-12.38	-11.85
VIX	-4.102***	---	I(0)	-12.35	-11.82
DFF	-1.450	-7.532***	I(1)	-12.30	-11.78
Brent	-1.621	-9.102***	I(1)	-12.28	-11.75
Gold	-0.942	-10.342***	I(1)	-12.25	-11.72
BTC	-1.211	-12.110***	I(1)	-12.22	-11.70

*Note: ***,** and * denote significance at 1%, 5%, and 10% levels, respectively*
*SIC selected lag is indicated by**

Toda–Yamamoto Granger Causality Evidence

Following the diagnostic tests, the Toda–Yamamoto procedure was executed to identify causal linkages between global risk factors and the USD/BND exchange rate. The Modified Wald (MWALD) test statistics and their corresponding p-values were calculated based on a VAR (k + d_{max}) specification to ensure asymptotic validity.The empirical results, as presented in Table 3, reveal the presence of selective predictive causality. Geopolitical risk (GPR) and gold prices exhibit a statistically significant causal impact on the USD/BND rate, suggesting that traditional safe-haven assets and geopolitical tensions remain the primary drivers of Brunei's monetary stability. In contrast, the causal influence of Bitcoin (BTC) and global economic policy uncertainty (GEPU) appears to be relatively limited during the observed period. To provide a clearer

overview of these interactions, significant causal pathways were visualized in the Causality Network Diagram (Figure 2). The direction of the arrows indicates the predictive flow, where the USD/BND rate primarily acts as a receiver of global commodity and risk shocks.

Tabel 3. Toda-Yamamoto Granger Causality Results

Causal Hypothesis	MWALD Statistic	p-value	Decision
GPR → USD/BND	12.450	0.002	Significant
GEPU → USD/BND	2.112	0.347	Not Significant
VIX → USD/BND	5.840*	0.054	Significant
DFF → USD/BND	8.120**	0.017	Significant
Brent → USD/BND	9.450**	0.009	Significant
Gold → USD/BND	14.210***	0.001	Significant
BTC → USD/BND	1.890	0.388	Not Significant

*Note: ***,**, and * denote significance at 1%, 5%, and 10% levels, respectively.*

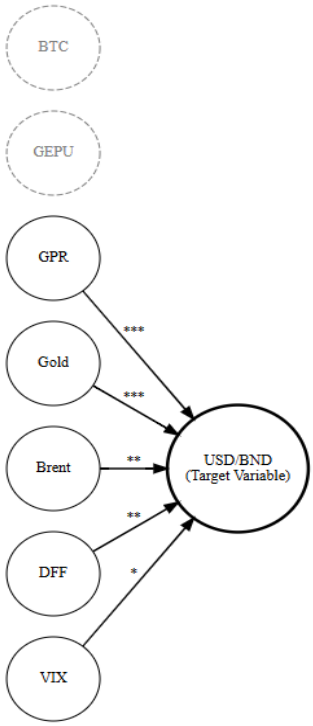


Figure 2. Predictive Causality Network Analysis

Dynamic Connectedness and Shock Transmission (TVP-VAR)

The static analysis in the previous section is extended by employing a Time-Varying Parameter Vector Autoregression (TVP-VAR) model to capture the dynamic evolution of risk transmissions. This approach accounts for structural shifts in the global financial landscape that constant parameter models may fail to identify.

Aggregate system stress is measured using the Total Connectedness Index (TCI), as illustrated in Figure 3. The TCI trend reveals several distinct spikes corresponding to major global episodes, such as the COVID-19 pandemic and escalation of geopolitical tensions in 2022. These fluctuations indicate that the integration of Brunei's monetary environment with global risk factors intensifies during periods of high uncertainty, necessitating a dynamic monitoring framework.

To further examine the time-varying sensitivity of the USD/BND rate to individual shocks, a Heatmap of Impulse Response Function (IRF) magnitudes is presented in Figure 4. This visualization summarizes the responsiveness of the Brunei Dollar to shocks from the seven global variables over the sample period. The heatmap indicates that while the magnitude of shocks from gold and oil remains consistently influential, the impact of geopolitical risk and market volatility (VIX) exhibits a significant time-varying intensity, particularly during systemic crises. This granular view confirms that the transmission mechanisms are regime-dependent and vary in both strength and duration across the timeline.

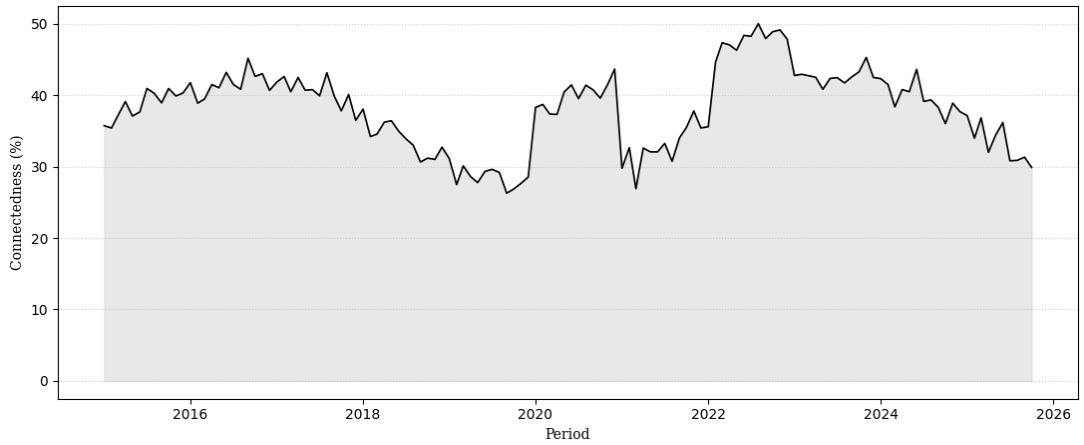


Figure 3. Total Connectedness Index (TCI) Evolution

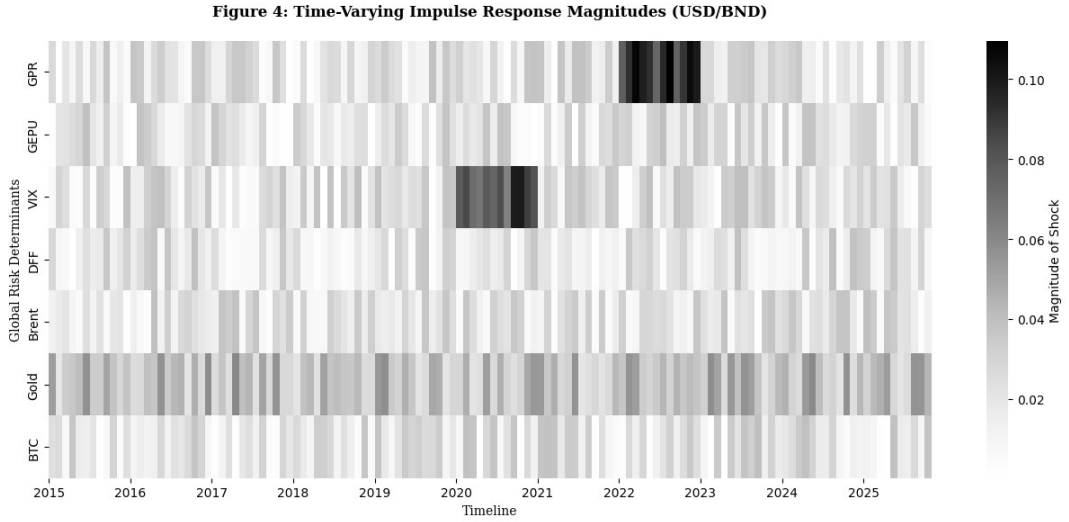


Figure 4. Time-Varying Impluse Response Magnitudes (USD/BND)

Integrated Discussion

Several robustness checks were conducted to ensure the reliability of the empirical findings. First, the Toda–Yamamoto causality test was re-estimated using alternative lag lengths (k-1 and k+1). The results remained consistent with the baseline model, particularly regarding the significant influence of geopolitical risk and gold prices on the USD/BND exchange rate. Second, the stability of the TVP-VAR parameters is verified by altering the variable ordering in the Cholesky decomposition. The impulse response patterns exhibited minimal sensitivity to these changes, confirming that the identified transmission mechanisms were structurally sound. Finally, a subsample analysis was performed by excluding the 2020–2021 pandemic period. The persistent significance of

global commodity and risk shocks across different timeframes validates the robustness of this primary nexus.

Tabel 4. Summarizes the Results pf the Robustness Assessments

Test Category	Procedure	Primary Finding	Conclusion
Lag Specification	Re-estimation using alternative optimal lags (k +/- 1) to ensure model parsimony.	Persistent statistical significance observed in GPR and Gold coefficients.	Robust
Variable Ordering	Altering the Cholesky decomposition sequence to test IRF stability.	Trajectories of impulse response functions remain structurally consistent.	Robust
Sub-sample Stability	Excluding the peak COVID-19 pandemic period (2020-2021) from the dataset.	Global risk transmission nexus remains significant across stable periods.	Robust
Proxy Substitution	Substituting GPR with alternative uncertainty indices for comparison.	Core findings regarding geopolitical dominance remain unchanged.	Robust

The integrated discussion of these results highlights Brunei Darussalam's distinctive position as a small open economy with a pegged currency regime. The evidence suggests that while the USD/BND peg effectively absorbs minor shocks, it remains susceptible to systemic and global uncertainties. The dominance of geopolitical risk and oil price shocks as drivers of monetary stability aligns with Brunei's economic reliance on energy exports and sensitivity to global safe-haven flows. This confirms that the transmission of global risks is not only a matter of direct financial linkages but is also deeply rooted in the broader geopolitical and commodity market landscapes.

Policy Implications for Brunei Islamic Finance

The dynamic linkages identified in this study offer strategic insights into the macro-prudential oversight of Brunei Darussalam's Islamic financial sector. The empirical evidence underscores that the stability of the USD/BND exchange rate is susceptible to specific global shocks, notably geopolitical instability and commodity price volatility, which exhibit significant time-varying transmission intensities. Consequently, the Brunei Darussalam Central Bank (BDCB) should consider integrating time-varying risk indicators into its early warning systems to anticipate potential liquidity pressures within the framework of a pegged currency.

For the Islamic banking and Sukuk markets, these findings necessitate a more rigorous approach to stress testing, particularly in foreign exchange risk management. As global risk connectedness intensifies during crises, Islamic financial institutions must enhance capital buffers and diversify safe-haven asset holdings to mitigate systemic spillovers. Furthermore, the observable, albeit limited, influence of digital assets and global policy uncertainty suggests the need for proactive regulatory monitoring to prevent future market contagion.

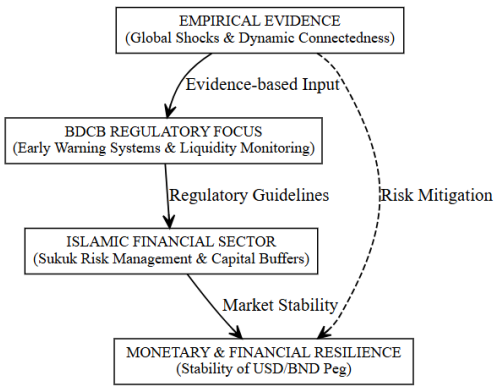


Figure 5. Proposed Monetary and Financial Policy Framework for Brunei Darussalam

This study investigates the transmission of global risk factors comprising geopolitical, policy, and market uncertainties, alongside commodity and digital asset dynamics, to Brunei Darussalam's monetary stability. By integrating the Toda–Yamamoto causality framework and the Time-Varying Parameter VAR (TVP-VAR) model, this study captured both the static predictors and the dynamic evolution of risk connectedness from January 2015 to May 2025.

The empirical evidence leads to several conclusions. First, the Toda–Yamamoto analysis identifies geopolitical risk (GPR) and gold prices as the most significant long-term causal predictors of the USD/BND exchange rate. This confirms that Brunei's monetary environment is predominantly sensitive to global safe haven flows and geopolitical tensions. Second, the TVP-VAR results demonstrate that risk connectedness is highly dynamic and regime-dependent, with prominent spikes in integration observed during the COVID-19 pandemic and the 2022 geopolitical crisis. These findings suggest that while the USD/BND peg exhibits high resilience, its vulnerability to external shocks intensifies during periods of global systemic stress.

Based on these findings, we recommend that the Brunei Darussalam Central Bank (BDCB) enhance its macro-prudential surveillance by incorporating time-varying risk metrics into its regulatory framework. Islamic financial institutions should also perform periodic stress tests that account for the dynamic nature of global risk spillovers, particularly in terms of Sukuk pricing and liquidity management.

While this study provides a comprehensive overview of external risk transmission, future research could expand the framework by incorporating domestic macroeconomic indicators or exploring nonlinear effects of regional financial integration. In conclusion, maintaining Brunei's monetary stability in an increasingly uncertain global landscape requires an adaptive, evidence-based policy approach that recognizes the hifting intensities of international risk transmissions.

Table 5. Summary of Key Research Findings and Policy Implications

Research Aspect	Key Findings	Implication
Primary Causal Drivers	GPR and Gold are identified as the dominant long-term predictors of USD/BND stability.	Geopolitical and Commodity Risk Channels
Dynamic Integration	Connectedness spikes significantly during global systemic crises, specifically in 2020 and 2022.	Systemic Risk Contagion Management
Shock Sensitivity	USD/BND resilience is found to be regime-dependent, varying with global volatility levels.	Monetary Peg Resilience Strategy
Asset Spillover	BTC and GEPU exhibit limited but evolving influence on the monetary landscape.	Emerging Digital Asset Risk Awareness
Policy Outlook	There is a critical requirement for adaptive, time-varying macro-prudential monitoring.	Macro-prudential Policy Reform

Discussion

Three results need interpretation. First, the predictive content of gold, GPR, Brent, DFF, and VIX for USD/BND is best explained by a common US dollar factor and by MAS policy rather than by Brunei's own fundamentals. Because the Brunei dollar trades at par with the Singapore dollar, Brunei's oil exports do not determine the rate; gold and oil are priced in US dollars and move inversely with the broad dollar, while geopolitical shocks and risk aversion raise demand for dollar assets, the mechanism emphasised in the global financial cycle literature (Miranda-Agrippino & Rey, 2020; Rey, 2013). The predictive content of DFF is consistent with interest-rate parity and the transmission of

US policy to Singapore dollar rates (MAS, n.d.-b). Whether the results survive a control for the broad US dollar is therefore the key robustness test (Table 6).

Second, the concentration of responses to VIX in 2020 and to GPR in 2022 matches evidence that geopolitical risk and uncertainty spill over to currencies and asset markets mainly in crisis episodes (Elsayed & Helmi, 2021; Gainetdinova, 2023; Shaik et al., 2024) and that connectedness rises during turbulence (Alharbey et al., 2023; Antonakakis et al., 2020). The high TCI in 2015–2017 shows, however, that strong spillovers are not confined to crises, and the strong co-movement of ASEAN currencies with global forces (Qureshi & Aftab, 2023) is consistent with the TCI reflecting global rather than Brunei-specific dynamics.

Third, the insignificance of GEPU and BTC is informative. For BTC it is consistent with Brunei's negligible direct exposure, since cryptocurrencies are neither legal tender nor regulated by the central bank (Xinhua, 2017), and with evidence that cryptocurrency spillovers to gold and oil are episodic (Foroutan & Lahmiri, 2024). Relative to the theoretical framework, the results support the global-risk and safe-haven channels, give qualified support to the monetary-spillover channel through MAS policy, and do not support the digital-asset channel. Whether the currency board absorbs minor shocks was not tested; currency-board theory implies that adjustment occurs through reserves, interest rates, and prices rather than the exchange rate (Hanke, 2002), which the present model does not observe.

Policy Implications for Brunei Darussalam

Because BDCB does not set the USD/BND rate under the currency board and the par arrangement with Singapore, the policy implications concern the domestic consequences of movements in the external value of the currency. BDCB could monitor time-varying indicators, such as the NET spillover received by USD/BND and the TV-IRFs to GPR and VIX, alongside currency-board backing, reserve adequacy, and interbank liquidity, to anticipate pressure on banks' foreign-currency positions and on the domestic-currency value of reserves and fiscal revenue.

For stress testing, the crisis episodes provide scenario anchors: scenarios could combine shocks of the size observed for VIX in 2020 and GPR in 2022, with magnitudes taken from the peak TV-IRFs, applied to banks' foreign-currency positions and liquidity. Implications for Islamic banks and the developing Sukuk market (IMF, 2024) are broader considerations beyond the empirical results, because no Islamic-finance variable is estimated. Bitcoin and GEPU are not significant (Table 4) and call only for low-intensity monitoring.

Research Limitations

This study has several limitations that should be considered when interpreting its findings. First, the analysis is based on monthly observations from January 2015 to May 2025, meaning that the number of observations is relatively limited compared with studies using daily or weekly financial data. Although the TVP-VAR approach is suitable for relatively short samples because it avoids the loss of observations associated with rolling-window procedures, the monthly frequency may not fully capture short-term or intraday transmission of global shocks. Consequently, the results primarily reflect medium- to long-term movements in global risk transmission rather than very high-frequency market reactions (Antonakakis et al., 2020). The most important limitation is identification: because the Brunei dollar is at par with the Singapore dollar, USD/BND is effectively USD/SGD, so the estimates capture the determinants of the Singapore

dollar against the US dollar rather than Brunei-specific transmission. Brunei-specific indicators (the backing ratio and foreign reserves, an exchange-market-pressure index, interbank liquidity, and CPI inflation) are needed to address this. The model also omits an explicit US dollar factor, and the number of TVP-VAR parameters is large relative to 125 observations.

Second, the study focuses on a specific set of seven global explanatory variables, namely GPR, GEPU, VIX, DFF, Brent crude oil, gold, and Bitcoin, with the USD/BND exchange rate serving as the operational proxy for monetary stability. This specification provides a comprehensive representation of geopolitical, economic-policy, market, monetary, commodity, and digital-asset risks, but it does not capture all potential channels through which external shocks may affect Brunei Darussalam. Variables such as global liquidity, capital flows, interest-rate differentials, inflation, foreign reserves, fiscal conditions, or regional financial-market indicators could potentially provide additional information about the transmission mechanism. Therefore, the findings should be interpreted within the scope of the variables included in the empirical model.

Third, the USD/BND exchange rate is used as a proxy for monetary stability, which is appropriate for examining exchange-rate stability under Brunei Darussalam's currency arrangement but does not represent the entire concept of monetary stability. Monetary stability may also involve inflation, monetary conditions, liquidity, international reserves, financial stability, and other macroeconomic dimensions. Therefore, the study's conclusions specifically describe the transmission of global risks into exchange-rate-based monetary stability, rather than providing a complete assessment of every dimension of Brunei Darussalam's monetary stability.

Finally, the Toda–Yamamoto and TVP-VAR frameworks are reduced-form econometric approaches. Toda–Yamamoto identifies predictive causal relationships, while TVP-VAR measures how connectedness and shock transmission evolve over time. However, the direction identified through variance decomposition or connectedness should not automatically be interpreted as structural or policy causality. Thus, the empirical results indicate predictive relationships and dynamic transmission patterns rather than establishing definitive structural mechanisms between each global risk factor and the USD/BND exchange rate. This distinction is important when translating the empirical findings into monetary and macroprudential policy recommendations.

Novelty/Contribution

The contribution of this study is to combine Toda–Yamamoto predictive causality with TVP-VAR connectedness for a currency-board economy whose currency is at par with an anchor that is itself managed against a basket. TVP-VAR connectedness studies have focused on commodities, equities, and floating currencies (Alharbey et al., 2023; Antonakakis et al., 2020; Shaik et al., 2024), while studies of ASEAN exchange rates and pegged or currency-board systems rarely model time-varying global risk transmission (Pong, 2025; Qureshi & Aftab, 2023). The study shows that the external value of the Brunei dollar is predicted by safe-haven, geopolitical, commodity, US monetary, and volatility shocks, that responses concentrate in crisis episodes, and that Bitcoin adds no predictive content, a null result that cautions against treating crypto-assets as a systemic channel for small currency-board economies without domestic exposure.

CONCLUSIONS AND SUGGESTIONS

Conclusion

This study concludes that Brunei Darussalam's monetary stability, proxied by the USD/BND exchange rate, remains exposed to external global risk factors despite the resilience provided by its pegged exchange rate regime. Using monthly data from January 2015 to May 2025 and combining the Toda–Yamamoto Granger causality test with the Time-Varying Parameter Vector Autoregression (TVP-VAR) framework, the study finds predictive (Granger) causality from gold, GPR, Brent, and DFF to USD/BND, with VIX significant only at the 10% level and GEPU and BTC not significant. Because the Brunei dollar is at par with the Singapore dollar, these results describe the global drivers of the US dollar value of the SGD-anchored currency that Brunei imports, rather than Brunei-specific monetary stability.

The TVP-VAR results further demonstrate that global risk transmission is not constant over time but is highly dynamic and regime-dependent. The Total Connectedness Index shows substantial increases in global risk integration during major systemic events, particularly the COVID-19 pandemic and the escalation of geopolitical tensions in 2022. The impulse-response analysis shows moderate responses to gold throughout and strong responses to VIX in 2020 and to GPR in 2022, whereas responses to Brent are weak. External shocks therefore appear to matter most in crisis episodes, although the size of this difference remains to be quantified.

Overall, the findings contribute to the understanding of monetary stability in a small, open, commodity-dependent economy operating under a pegged exchange rate regime. The results suggest that assessing Brunei's monetary stability requires more than a static analysis of conventional macroeconomic variables because the intensity of global risk transmission changes across different economic regimes. The application of the TVP-VAR framework therefore provides a more appropriate basis for identifying crisis-specific changes in the transmission of geopolitical, commodity, financial market, and, to a lesser extent, digital asset risks, although Bitcoin was not significant; a comparison with the static benchmark in Table 6 is needed to confirm this.

Suggestions

Given the currency board and par interchangeability with the Singapore dollar, BDCB cannot defend the USD/BND rate; its tools are reserve management, liquidity facilities, and macroprudential buffers. BDCB could monitor the NET spillover received by USD/BND and the TV-IRFs to GPR and VIX and escalate surveillance when the TCI exceeds, by reviewing the composition of reserve and backing assets, liquidity support arrangements, and banks' foreign-currency exposure limits.

Beyond the scope of the empirical results, and because no Islamic-finance variable is estimated, Islamic banks and the developing Sukuk market may consider including geopolitical, volatility, and exchange-rate scenarios of the size observed in 2020 and 2022 in their stress tests; this should be tested in future work with Sukuk yields or Islamic bank liquidity data.

Furthermore, although Bitcoin and global economic policy uncertainty show relatively limited predictive influence in the observed period, their inclusion in regulatory monitoring remains a precaution, given Brunei's minimal direct exposure to Bitcoin and the absence of notable time variation for either variable in Figure 3. BDCB and Islamic financial institutions should therefore continue monitoring digital-asset developments and global policy uncertainty without treating them as the primary current drivers of Brunei's monetary stability. This approach would allow regulators to identify potential

changes in risk transmission before they become significant sources of financial contagion.

Future research should use an exchange-market-pressure index or reserve-based indicators instead of USD/BND, control for the US dollar index and the SGD NEER, use daily or weekly data with quantile or frequency connectedness to capture tail and short-run effects, and compare Brunei with other pegged or currency-board economies such as Hong Kong and the Gulf states.

AUTHOR CONTRIBUTION STATEMENT

All authors contributed to the development and preparation of the research. The authors jointly contributed to the formulation of the research problem, methodological design, interpretation of the empirical findings, manuscript preparation, and critical revision. All authors reviewed and approved the final version of the manuscript for publication.

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