Araştırma Makalesi / Research Article

Economic and Financial Integration in BRICS+

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Abstract

The BRICS+ initiative has gained momentum with growing efforts toward economic and financial integration. This study assesses the feasibility of economic and financial integration in BRICS+ countries using the Mundell-Fleming Trilemma framework, focusing on the trade-offs between monetary policy independence, exchange rate stability, and capital mobility. We find inflation convergence among BRICS+ countries, indicating potential for future monetary coordination. However, foreign reserves—including China's substantial holdings—fail to stabilize inflation or reduce exchange rate volatility, challenging conventional knowledge. Instead, capital flows and trade integration show greater stabilizing effects. These findings suggest a strategic shift from reserve accumulation to coordinated capital flow management and institutional development. While structural divergences persist, gradual policy convergence—supported by instruments like the New Development Bank—could enable long-term integration. Recent research confirms several results but highlights ongoing macroeconomic divergence, mixed exchange rate behavior, and the limited impact of passive reserve accumulation.

Keywords: Exchange rate, BRICS, volatility, inflation.

JEL Codes**:** *F32, F13, G10*

BRICS+'da Ekonomik ve Finansal Entegrasyon

Öz

BRICS+ girişimi, ekonomik ve finansal entegrasyona yönelik artan çabalarla ivme kazanmıştır. Bu çalışma, Mundell-Fleming Üçlemi çerçevesinde BRICS+ ülkelerinde ekonomik ve finansal entegrasyonun fizibilitesini değerlendirmekte ve para politikası bağımsızlığı, döviz kuru istikrarı ve sermaye hareketliliği arasındaki dengeyi analiz etmektedir. Bulgularımız, ülkeler arasında enflasyon yakınsamasının güçlendiğini ve parasal koordinasyon potansiyelini göstermektedir. Ancak Çin'in yüksek rezervleri dahil olmak üzere döviz rezervlerinin, enflasyonu ya da kur oynaklığını istikrara kavuşturmadığı görülmektedir. Buna karşılık, sermaye akımları ve ticaret entegrasyonu daha güçlü istikrar etkisi yaratmaktadır. Bu durum, rezerv biriktirmeye dayalı strateji yerine, koordineli sermaye akımı yönetimi ve kurumsal gelişime odaklanılması gerektiğini göstermektedir. Her ne kadar yapısal farklılıklar sürse de Yeni Kalkınma Bankası gibi araçlarla desteklenen kademeli politika uyumu uzun vadede entegrasyonu mümkün kılabilir. Güncel araştırmalar bulgularımızı desteklemekte, ancak makroekonomik uyumsuzluklara ve pasif rezerv birikiminin sınırlı etkisini vurgulamaktadır.

Anahtar Sözcükler: *Döviz kuru, BRICS, volatilite, enflasyon.*

JEL Kodları: *F1, F10, F14, F13*

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Genişletilmiş Özet

Bu çalışma, BRICS+ ülkeleri arasındaki ekonomik ve finansal entegrasyonun dinamiklerini ele alarak, Yeni Kalkınma Bankası'nın (NDB) yatırım hedeflerinin ekonomik etkilerini ve ortak bir para birimi oluşturulmasının yapısal zorluklarını incelemektedir. BRICS grubu, Brezilya, Rusya, Hindistan, Çin ve Güney Afrika'dan oluşmakta olup, son genişlemeyle birlikte Mısır, Etiyopya, İran ve Birleşik Arap Emirlikleri gibi ülkelerin de katılımıyla BRICS+ yapısına dönüşmüştür. Bu genişleme, grubun küresel ekonomi üzerindeki etkisini artırmakta ve alternatif bir finansal mimari oluşturma yönündeki eğilimleri güçlendirmektedir.

Çalışmanın temel amacı, NDB'nin 2022–2026 dönemi için belirlediği 30 milyar Amerikan doları tutarındaki yatırım hedefinin BRICS+ ülkelerinde sürdürülebilir kalkınma ve ekonomik büyüme üzerindeki etkilerini analiz etmektir. Ayrıca, bu ülkeler arasında ortak bir para biriminin oluşturulmasına yönelik teorik ve ampirik değerlendirmeler yapılmakta, özellikle döviz rezervlerinin spekülatif ataklara karşı ne derece etkili bir koruma sağladığı sorgulanmaktadır.

Yöntemsel olarak çalışma, IMF, Dünya Bankası, NDB ve üye ülke merkez bankalarının yayımladığı makroekonomik göstergeleri kullanmakta; 1992–2024 dönemini kapsayan bir veri seti üzerinden analiz yürütmektedir. Kullanılan temel değişkenler arasında tüketici fiyat endeksine dayalı enflasyon oranları, dönem sonu mevduat faiz oranları, ödemeler dengesine bağlı sermaye hareketleri, döviz rezervleri, parasal büyüklükler ve kişi başına düşen gayrisafi yurt içi hasıla (GSYH) yer almaktadır.

Ampirik bulgular, BRICS+ ülkeleri arasında enflasyon oranlarında uzun vadede anlamlı bir yakınsama trendi olduğunu göstermektedir. Bu durum, teorik olarak başarılı bir para birliği için temel koşullardan biri olan fiyat istikrarının sağlanabilirliğine işaret etmektedir (Mundell, 1961; Frankel & Rose, 1998). Ancak döviz rezervlerinin hem enflasyon istikrarı hem de kur oynaklığının azaltılması noktasında beklenen etkiyi yaratmadığı görülmektedir. Özellikle Çin gibi yüksek rezerv tutan ekonominin BRICS+'e mensup olması dahi rezervler ile enflasyon istikrarı arasında nedensel bir ilişki sağlanması açısından yeterli olmamıştır.

Ayrıca, yapılan analizler döviz rezervlerindeki artışların döviz kuru oynaklığını azaltma konusunda sınırlı etkili olduğunu, buna karşılık sermaye girişlerinin bu oynaklığı önemli ölçüde azalttığını ortaya koymaktadır. Bu durum, geleneksel ekonomi kuramlarının öne sürdüğü "rezerv yeterliliği" anlayışının BRICS+ bağlamında sorgulanması gerektiğini göstermektedir. Bu çalışma, BRICS+ için döviz rezervlerinin sınırlı etkisini ortaya koyarak mevcut literatüre eleştirel bir katkı sağlamaktadır

Sonuç olarak, BRICS+ ülkeleri arasında ekonomik ve finansal entegrasyona yönelik güçlü bir eğilim gözlemlenmekle birlikte, rezerv biriktirme stratejileri yerine sermaye akışlarının yönetimi ve ticaret entegrasyonu gibi alternatif istikrar mekanizmalarının ön plana çıkması

gerektiği vurgulanmaktadır. Ancak, ülkeler arasındaki yapısal ve kurumsal farklar, entegrasyon sürecinin yavaş ve dikkatli bir şekilde ilerlemesini gerektirmektedir. Bu bağlamda çalışma, geleneksel para politikası yaklaşımlarının ötesine geçerek, gelişmekte olan ülkelerdeki entegrasyon süreçlerine dair yeni bir bakış açısı sunmaktadır.

1. Introduction

BRICS+ is emerging as a dominant geopolitical and economic bloc, bringing together major developing economies with the potential to reshape global trade, finance, and economic governance. The origins of BRICS+ begin in the early 2000s, when economist Jim O'Neill working at Goldman Sachs investment bank created the term "BRIC." In his important report, O'Neill (2001) pointed out that Brazil, Russia, India, and China were fast-growing economies that would become increasingly important in the world economy. He chose these countries because they had large populations, with high economic growth rates and an increasing share of global economic output. While O'Neill originally created this term for investment purposes, government leaders in these countries later saw the value of political and economic collaboration.

The countries started the cooperation officially in 2006, when the foreign ministers of Brazil, Russia, India, and China met during the United Nations General Assembly meeting. This started what became regular BRIC discussions. The first major BRIC meeting took place in Yekaterinburg, Russia, in 2009. At this meeting, the countries showed they wanted to create a world where power was shared more equally among different regions, rather than being controlled mainly by Western countries. They also wanted to change how international financial organizations like the International Monetary Fund (IMF) and World Bank operated (Armijo, 2007; Cooper, 2016). This was important because it challenged the system that Western countries had controlled since the end of World War II.

South Africa joined the group in 2010, changing BRIC into BRICS and bringing the first African country into the partnership. This expansion strengthened the cooperation's profile as a representative body of major emerging economies from all inhabited continents, building stronger economic bridges with the African continent (Shubin, 2018; Stuenkel, 2020).

A major milestone came in 2015 when BRICS created two important financial institutions: the New Development Bank (NDB) and the Contingent Reserve Arrangement (CRA). The New Development Bank was set up to provide money for building infrastructure like roads, bridges, and power plants in BRICS countries and other developing nations. This gave countries an alternative to borrowing from traditional Western-controlled institutions like the World Bank (Babb & Chorev, 2016). By setting an ambitious investment target of USD 30 billion, the NDB aims to strengthen economic resilience among BRICS+ countries and promote long-term development. The CRA was designed to provide financial support during balance-of-payments crises, showing that BRICS wanted to be financially independent and protect themselves from economic crises caused by outside forces.

Over time, BRICS meetings expanded beyond just economic cooperation to discuss many global issues, including climate change, internet security, development financing,

and international security. The group has consistently positioned itself as a voice for the Global South, frequently challenging the disproportionate influence of Western powers in multilateral institutions and advocating for more equitable representation in global decision-making processes (Stephen & Parizek, 2019).

The idea of adding more countries to BRICS became popular in the early 2020s as tensions between major powers increased and calls for reform in global governance structures intensified. This expansion plan reached its peak at the 2023 meeting in Johannesburg, South Africa, where BRICS invited the following countries to join: Argentina, Egypt, Ethiopia, Iran, Saudi Arabia, and the United Arab Emirates. This led to the creation of BRICS+ in January 2024 (BRICS, 2023).

The expansion of BRICS+ was a strategic move to enhance its global influence. With over 45% of the world's population and a significant share of global economic output, the bloc now plays a major role in international finance and trade (World Bank, 2024). The enlarged group has intensified efforts to reduce dependence on the US dollar, promote local currency use in trade, and propose alternative financial structures.

However, this expansion also introduces coordination challenges. The member countries vary widely in governance models, economic systems, and policy priorities. Hopewell (2015), such heterogeneity, combined with weak institutional mechanisms, may hinder the group's ability to transform shared goals into effective joint action.

Another significant area of discussion within BRICS+ is the feasibility of a common currency. Given the dominance of the US dollar in global trade and finance, BRICS+ countries have expressed interest in reducing their reliance on the dollar by exploring alternative financial mechanisms, including a potential monetary union. However, structural differences in economic policies, inflation rates, and financial systems pose significant challenges to such an initiative. Understanding these challenges and evaluating their implications is essential for assessing the future prospects of economic integration within BRICS+.

This study explores three key research questions related to the economic and financial integration of BRICS+: What are the economic implications of the NDB's massive investment target for BRICS+ countries? This question examines the potential impact of NDB financing on infrastructure development, economic growth, and financial stability within the bloc. What are the structural challenges to forming a BRICS+ common currency area? Given the macroeconomic differences among member states, this question investigates issues such as exchange rate volatility, inflation divergence, and monetary policy coordination. How can foreign reserves mitigate speculative attacks in a potential BRICS+ monetary union? This question explores the role of foreign exchange reserves in ensuring financial stability and countering currency crises within a unified monetary framework.

To address these research questions, the study employs a combination of empirical

analysis, theoretical frameworks, and comparative case studies. First, economic indicators such as inflation rates, foreign exchange reserves, interest rate differentials, and trade balances are analyzed to assess the macroeconomic conditions of BRICS+ countries. This empirical approach provides insights into the feasibility of deeper financial integration and the effectiveness of NDB-financed investments.

Second, the study draws upon key theoretical frameworks, including the Mundell-Fleming Trilemma, which highlights the trade-offs between exchange rate stability, monetary policy autonomy, and capital mobility, and further, speculative attack models, which examine the vulnerability of emerging market currencies to financial crises. These theoretical perspectives help evaluate the risks and opportunities associated with a potential BRICS+ common currency. In sum, this research contributes to the broader discussion on global financial architecture by examining the evolving role of BRICS+ in international economic governance, the prospects for a new monetary order, and the challenges of achieving deeper financial integration among emerging economies.

2. Literature Review

2.1. The Role of International Reserves in Economic Stability

International reserves serve as an important safeguard against external financial shocks, particularly in developing economies. The accumulation of reserves is often motivated by the need for self-insurance to hedge the risk of currency crises and capital flight. In Table 1 the international reserves for the BRICS+ countries are presented.

Table 1

International reserves (in Millions US$).

	2017	2018	2019	2020	2021	2022	2023
Brazil	373,972	374,714	356,884	355,619	362,203	324,702	355,033
Russia	432,747	468,502	554,364	596,074	630,632	581,989	598,591
India	411,272	397,791	461,825	588,433	635,347	564,740	626,264
China	3,421,567	3,351,916	3,388,699	3,536,038	3,606,184	3,466,751	3,610,012
South Africa	50,531	51,640	55,059	54,247	57,821	60,559	62,508
Egypt	47,716	52,515	57,348	50,014.40	56,714	39,358	35,221
Ethiopia	3,045	3,987	2,992	3,046	-	-	-
Iran	12,593	122,473	14,950	13,751	17,741	19,546	21,140
UAE	6,360	73,650	49,137	38,870	33,356	23,816	140,286

Source: IMF (2024b).

Several empirical studies provide insights into how reserves contribute to economic stability.

Obstfeld et al. (2009) found that countries with higher reserves experience lower exchange rate volatility and are less susceptible to financial crises. This suggests that reserves play a protective role against speculative attacks. The study indicated that countries with sufficient reserves can defend their exchange rates without routing to drastic policy adjustments, such as devaluation or interest rate hikes. Aizenman and Lee (2007)

argued that emerging markets accumulate reserves primarily for precautionary reasons, as they face more frequent external shocks. Their empirical analysis of 40 developing countries showed that countries with weak domestic financial systems and greater external vulnerabilities tend to accumulate more reserves. The study highlighted that reserves are particularly valuable in preventing external balance crises. Jeanne and Rancière (2011) showed through a model that while reserves offer protection, they also involve significant opportunity costs. They found that countries that accumulate excessively large reserves suffer from lower economic growth due to the allocation of resources from productive investments to reserve holdings. Ghosh et al. (2017) provided empirical evidence across a large sample of countries, concluding that nations with reserves greater than 20% of GDP were far less likely to experience a currency crisis. They observed that reserve accumulation is an effective crisis prevention tool, especially in countries facing volatile capital flows. Cheung and Qian (2009) found that China's massive foreign reserves have been a stabilizing force, both within China and in the broader global economy. They argued that China's reserves not only shield its own currency from speculative attacks but also contribute to global financial stability by providing a buffer against global financial crises.

These studies show that while the accumulation of reserves can reduce the likelihood of currency crises, it creates a complex trade-off between maintaining reserves for stability and the potential economic inefficiency caused by excessive reserve accumulation.

2.2. Speculative Attacks and Central Bank Defenses

Speculative attacks involve massive sell-offs of a currency, often driven by perceptions of economic weaknesses, such as high inflation, political instability, or unsustainable debt levels. The success of central banks in defending their currencies depends on their foreign reserves, the strength of their economic fundamentals, and the credibility of their monetary policy.

Krugman (1979) introduced the first-generation currency crisis model, which posited that speculative attacks occur when a country's reserves fall below a critical threshold. Krugman emphasized the self-fulfilling nature of crises, where investors sell a currency, creating a crisis that forces the government to either devalue or lose reserves. Eichengreen et al. (1995) in their study of 20 countries, they found that speculative attacks are most likely in countries with low foreign reserves, high external debt, and weak domestic institutions. Their study suggested that countries with high reserves are less vulnerable to speculative attacks, but they also noted that reserves are not a universal remedy in the face of deep structural economic issues. In their analysis of speculative attacks during the Asian Financial Crisis, Bussière and Mulder (1999) found that large reserve holdings provided a buffer for many countries but could not prevent crises in economies with fundamental economic weaknesses. They emphasized that macroeconomic policies (such as fiscal discipline and exchange rate policies) play an equally important role in defending against speculative attacks.

Burnside et al. (2001) studied the impact of speculative attacks during the Asian financial crisis and concluded that while reserves provide some defense against speculative attacks, countries with poor macroeconomic fundamentals (such as high debt and low growth) are still vulnerable. They argued that speculative attacks cannot be fully prevented by reserve accumulation alone but require sound economic policies and institutional reforms. In their analysis of emerging market economies, Ghosh et al. (2016) found that countries with higher reserve levels have a lower probability of facing a speculative attack, especially during periods of global financial volatility. Their findings align with the notion that reserve adequacy helps discourage speculative behavior. Related research on currency crises in emerging markets was analyzed by Obstfeld (1996).

These studies reinforce the idea that while reserves can help mitigate the effects of speculative attacks, they are most effective when supported by strong economic fundamentals and prudent fiscal and monetary policies.

2.3. Feasibility of a BRICS+ Common Currency Area

The possibility of establishing a common currency among the BRICS+ nations has generated considerable interest, as it could offer greater economic integration and reduce reliance on the US dollar. However, the Optimum Currency Area (OCA) theory suggests that adopting a common currency requires certain conditions, including labor mobility, synchronized business cycles, and converging inflation rates.

Mundell (1961) developed the Optimum Currency Area theory, which outlines the economic conditions necessary for a successful currency union. Mundell argued that a common currency is feasible when countries have similar inflation rates, labor mobility, and fiscal policies. He also noted that countries with asymmetric economic shocks may face challenges in adapting to a common currency without fiscal and political integration. Subsequently, they analyzed costs and benefits of monetary unions (Mundell & Fleming, 1964).

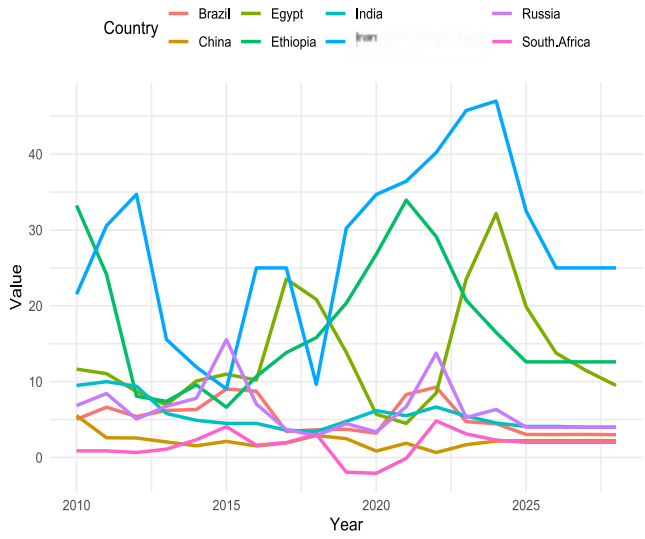
Frankel and Rose (1998) provided empirical support for the OCA theory, suggesting that countries that trade more intensively with each other are more likely to benefit from a common currency. They found that the cost of giving up independent monetary policy could be outweighed by the benefits of increased trade and reduced exchange rate risk. However, they also emphasized that other factors, such as political will and institutional readiness, are elementary for a successful currency union.

De Grauwe (2012) in his study of the Eurozone crisis, he argued that a common currency area without fiscal integration can lead to serious problems when countries face asymmetric shocks. He pointed out that the Eurozone's lack of fiscal coordination led to tensions between member countries, highlighting the risks of a similar approach in BRICS+ economies, where fiscal and political differences are more pronounced. Aizenman et al. (2013) found that although trade integration and macroeconomic convergence are important for the success of a currency union, the divergent inflation rates during the

subprime mortgage crisis in 2008 and divergent economic structures among BRICS+ countries present significant challenges. However, a converging trend in the inflation rates can be observed in recent years. This fact suggests that BRICS+ economies may first need to achieve greater economic convergence before considering a monetary union. In Figure 1, divergent dynamics in the inflation rates and their projections can be seen.

Figure 1

Inflation Rates.



Source: IMF (2024a)

Barro and Gordon (1983) examined the trade-offs between having an independent monetary policy and the benefits of a common currency. They argued that monetary unions can be beneficial in reducing inflation and exchange rate volatility, but countries with highly diverse economies may face challenges in managing a single monetary policy that fits all member states. The empirical evidence suggests that while a BRICS+ monetary union could provide some benefits in terms of trade facilitation and reduced exchange rate risks, economic disparities and divergent monetary policies make it difficult to implement successfully without significant convergence in fiscal, monetary, and economic conditions. Nonetheless, the newly founded common New Development Bank, could provide some positive impact by infrastructure investment on growth (New Development Bank, 2024).

2.4. Comparative Insights from the Eurozone Experience

Studying the Eurozone, which can be regarded as the most advanced and institutionalized monetary union to date, shows both the opportunities and constraints of regional monetary integration. The creation of the euro clearly demonstrated the potential benefits of a single currency, including the elimination of exchange rate risk, enhanced

cross-border trade, and improved monetary credibility (Mongelli, 2002). However, it also revealed significant structural vulnerabilities that emerge when monetary union exceeds fiscal and institutional integration (De Grauwe, 2012; Lane, 2006).

A central lesson from the European experience is the critical role of fiscal coordination in absorbing asymmetric shocks. In the absence of a centralized fiscal mechanisms, Eurozone members that encountered country-specific downturns—such as Greece, Portugal, and Ireland—faced severe constraints in their policy responses, lacking both monetary sovereignty and adequate fiscal buffers (Blanchard & Giavazzi, 2002; Lane, 2012). Their inability to use exchange rate adjustments or independent expansionary monetary policy deepened and prolonged their economic recessions. De Grauwe (2012) emphasizes that monetary unions are more fragile when fiscal responsibilities remain at the national level while monetary authority becomes centralized. These experiences underscore the fundamental importance of constructing any monetary union within a broader institutional architecture capable of ensuring effective countercyclical stabilization.

The Eurozone also provides a practical illustration of the "Impossible Trinity" or Mundell-Fleming Trilemma (Mundell, 1963). According to this established principle, it is impossible to simultaneously maintain fixed exchange rates, free capital mobility, and independent monetary policy. The European Monetary Union resolved this fundamental constraint by abandoning national monetary autonomy and adopting a single currency within a liberalized capital market framework. However, the continued decentralization of fiscal authority exposed member states to speculative pressures and increased sovereign risk during periods of financial stress (Baldwin & Giavazzi, 2015). This shows that resolving the trilemma at the monetary level must be accompanied by parallel efforts in fiscal policy alignment and comprehensive institutional consolidation.

These observations carry particular significance for other regional economic blocs, where macroeconomic diversity often exceeds what existed in pre-euro Europe. While Frankel and Rose (1998) argue that deepening trade integration can promote synchronization of business cycles, a key condition for establishing an optimum currency area (OCA) are the fundamental preconditions outlined by Kenen (1969) and McKinnon (1963), including factor mobility and effective risk-sharing mechanisms, which still needs to be established in the BRICS+ cooperation. Aizenman et al. (2013) further observe that the pre-crisis convergence observed in some currency unions can be of transitory nature if not supported by institutional framework and robust macroprudential oversight.

Moreover, unlike the Eurozone, most regional economic arrangements lack a supranational central bank or a comprehensive treaty-based legal framework to guide fiscal and monetary governance effectively. The European Central Bank (ECB), with its substantial degree of operational independence and clearly defined mandate, served as a crucial anchor for monetary credibility throughout the Eurozone's development (Issing, 2008). In the case of BRICS+ the New Development Bank provides some initial steps

towards political agreement and deep institutional trust among members.

The crisis episodes that affected several Eurozone countries between 2010 and 2012 further illustrated how monetary union without fiscal union creates systematic vulnerabilities. Countries experiencing economic difficulties found themselves unable to use traditional adjustment mechanisms such as currency devaluation or independent monetary stimulus. Instead, they were forced to pursue internal devaluation through wage and price adjustments, a process that typically involves significant economic and social costs, including prolonged periods of elevated unemployment and reduced living standards.

The Eurozone's experience highlights that while financial market integration is beneficial normally, it can worsen crises by spreading problems across interconnected banking systems, making coordinated responses difficult due to fragmented fiscal authority. This suggests that blocs like BRICS+ should approach deep monetary integration cautiously. They should prioritize regional financial cooperation, gradual fiscal harmonization, and building strong supranational institutions before pursuing currency unions or fixed exchange rate regimes. Essentially, BRICS+ needs to invest heavily in institutional foundations before advancing monetary cooperation.

2.5. Research Gaps and Future Research

Despite extensive research on international reserves, speculative attacks, and currency unions, there are still several key gaps in the related literature that need to be addressed. Reserve adequacy in emerging markets, and thus the optimal level of reserves required to prevent speculative attacks remains uncertain, and empirical studies often offer conflicting views. More research is needed to evaluate the effectiveness of reserve accumulation in the context of emerging markets like those in the BRICS+ group.

The role of China in BRICS+ Integration China’s large reserve holdings and growing influence in the global financial system suggest that it could play a central role in the stability of a potential BRICS+ currency union. Future research should focus on how China’s economic policies and reserves can contribute to the stabilization of such a union.

Monetary and fiscal coordination in BRICS+, given the economic diversity and institutional differences among BRICS+ countries, requires more attention. Future research should explore policy coordination mechanisms that would be necessary to support a common currency, particularly with respect to fiscal integration and monetary policy alignment.

3. Data and Methodology

3.1 Data Collection

Our dataset comprises BRICS+ countries, including Brazil, China, Egypt, Ethiopia, India, Indonesia, Iran, Russia, South Africa, and the United Arab Emirates. The analysis

spans the period from 1992 to 2024, with annual frequency data. The key macroeconomic variables considered in the study include inflation rates (measured by the consumer price index), end-of-period deposit interest rates, balance of payments approximated by net capital inflows, foreign reserves, monetary aggregates, foreign exchange rates (US dollar denominated) and gross domestic product per capita (nominal in US dollar). The macroeconomic and financial indicators are retrieved from the IMF and national central banks databases.

3.2. Empirical Analysis

This section outlines the empirical strategies used to assess the feasibility of monetary integration in BRICS+ and the role of international reserves in reducing speculative attacks. The analysis employs panel data models, causality tests, and vector autoregressive modeling, with a focus on inflation differentials, monetary policy coordination, and the impact of foreign reserves. We apply Panel Data Regressions to examine how inflation, reserves, and interest rates influence monetary integration feasibility. Vector Autoregression (VAR) models assess economic shocks and speculative attack risks which include forex volatility, interest rate differentials and international foreign reserves.

3.2.1. Panel Data Regression: Inflation Convergence and Monetary Policy Coordination

Feasible Generalized Least Square (FGLS) is an efficient estimation technique for panel data models when there is heteroskedasticity across panels or autocorrelation within panels. It extends the Generalized Least Square (GLS) approach by estimating the unknown error covariance structure from the data. The theoretical Framework is illustrated below.

Consider a linear panel data model:

$$y_{it} = x'_{it}\beta + \varepsilon_{it} \quad (1)$$

where, i = 1, 2, ..., N indexes the cross-sectional units, t = 1, 2, ..., T indexes time periods, x_{it} is a k x 1 vector of explanatory variables, β is a k x 1vector of parameters, ε_{it} is the error term. In matrix notation for the entire panel: $y_{it} = x'_{it}\beta + \varepsilon_{it}$, where ε has covariance matrix Ω.

If Ω were known, the efficient GLS estimator would be:

$$\hat{\beta}_{\text{GLS}} = (X'\Omega^{-1}X)^{-1}X'\Omega^{-1}y \quad (2)$$

Since Ω is typically unknown, FGLS addresses this by obtaining consistent estimates of the residuals, using these to estimate Ω and applying GLS with the estimated $\widehat{\Omega}$. The FGLS implementation for panel data are given below in following steps. First, obtain consistent estimates of β using OLS or fixed effects estimation:

$$\hat{\beta}_{\text{OLS}} = (X'X)^{-1} X'y \tag{3}$$

Second, calculate the residuals:

$$\hat{\varepsilon}_{it} = y_{it} - x'_{it}\hat{\beta}_{\text{OLS}}$$

Depending on the assumed error structure for heteroskedasticity across panels estimate panel-specific variances:

$$\hat{\sigma}_i^2 = 1/T \sum_{t=1}^{T} \hat{\varepsilon}_{it}^2 \tag{4}$$

Third, construct $\hat{\Omega}$ as a block-diagonal matrix.

Some implementation challenges are given as follows. When T is small, the estimated covariance matrix may be singular or imprecisely estimated. For large N, computing and inverting the full $\hat{\Omega}$ matrix can be demanding. The results can be sensitive to the choice of initial estimator for residuals and misspecification.

FGLS is most appropriate when there is clear evidence of heteroskedasticity or autocorrelation to allow precise estimation of the error covariance structure. Alternative estimators for non-stationary data include the Fully Modified OLS of Phillips and Hansen (1990).

One of the key preconditions for a successful monetary union is inflation convergence across member states. To test whether BRICS+ countries exhibit inflation convergence, we estimate the following panel data model whether BRICS+ inflation rates are converging.

$$\Delta\pi_{i,t} = \alpha + \beta\pi_{i,t-1} + \gamma X_{i,t} + \varepsilon_{i,t} \tag{5}$$

where, $\Delta\pi_{i,t}$ = differential of inflation rate in country i at time t, $\pi_{i,t}$ = inflation rate in country i at time t, $X_{i,t}$ = vector of control variables (e.g., interest rate, money supply growth, GDP growth), α = constant term, β = persistence of inflation (if $|\beta| < 1$, inflation is stable over time), γ = coefficients for control variables, $\varepsilon_{i,t}$ = error term.

If BRICS+ countries are converging in inflation levels, we should observe a statistically significant decline in inflation dispersion over time. To assess the feasibility of monetary integration, we test whether countries with high initial inflation rates experience a faster decline in inflation than those with low inflation. In this case, the inflation differentials should decrease over time: Countries with higher inflation will experience a faster decline in the inflation change in future, and thus, convergence in BRICS+ countries over time should be expected.

3.2.2. Vector Autoregression (VAR): Reserves and Inflation Stabilization (VAR Model A)

Consider a panel dataset with N cross-sectional units observed over T time periods. A panel vector autoregression (PVAR) model of order p can be written as:

$$Y_t = A_0 + A_1 Y_{t-1} + A_1 Y_{t-2} + \ldots + A_p Y_{t-p} + \varepsilon_t \quad (6)$$

$$Y_t = \begin{bmatrix} CPI_{i,t} \\ Reserves_{i,t} \end{bmatrix} = A_0 + A_1 \begin{bmatrix} CPI_{i,t-1} \\ Reserves_{i,t-1} \end{bmatrix} + \varepsilon_{i.t} \quad (7)$$

where, CPI is the inflation rate based on consumer price index, reserves exhibit the international foreign reserves of each country's central bank. This test helps, i.e. determining whether China's large reserves could act as a stabilizing force in a potential BRICS+ monetary union.

3.2.3. Vector Autoregression (VAR): Speculative Attacks and Reserve Defenses (VAR Model B)

To assess the risk of speculative attacks and how international reserves counteract them, we estimate a VAR model including: foreign exchange rate volatility, foreign reserves, capital flows, interest rate differentials. The panel vector autoregresssion is given as follows:

$$Y_t = A_0 + A_1 Y_{t-1} + A_1 Y_{t-2} + \ldots + A_p Y_{t-p} + \varepsilon_t \quad (8)$$

$$Y_t = \begin{bmatrix} FXVol_t \\ Reserves_t \\ Capital_t \\ Int\ Diff_t \end{bmatrix}$$

Impulse response functions (IRFs) from the VAR model will help analyze how a shock in foreign reserves affects exchange rate volatility. If an increase in reserves leads to a reduction in speculative attacks, this supports, for example, the argument that China's reserves can stabilize the BRICS+ monetary system.

3.2.4. Granger Causality Tests: Interaction Between Monetary Policy and Foreign Reserves

To examine the relationship between foreign reserves and monetary stability, we apply Granger causality tests to determine whether: a) foreign reserves predict inflation rate movements, b) inflation levels influence foreign reserve accumulation decisions.

4. Results, Analysis and Discussion

4.1. Inflation Differential Model Results

Based on section 3.2.1. the regression output for the inflation differential model, where FGLS regression uses a heteroskedastic setting and panel-specific AR(1) correlation is given in Table 2.

Table 2

Inflation Differential Panel Regression Model.

Variable	Coefficient	Std. Error	z-statistic	p-value	95% Confidence Interval
CPI Inflation (Lag 1)	-0.4551***	0.0554	-8.22	0.000	[-0.5636, -0.3466]
Nominal GDP Growth	-5.6014***	1.2936	-4.33	0.000	[-8.1367, -3.0661]
Monetary Growth	15.0840***	2.4221	6.23	0.000	[10.3367, 19.8312]
Constant	1.0142***	0.3380	3.00	0.003	[0.3517, 1.6767]
Wald chi2(3)=82.87	Prob > chi2 = 0.0000				

Notes: Significance levels, ***p<0.01, **p<0.05, *p<0.1

According to the model results we can observe the following key findings. Significant negative coefficient -0.4551 ($p<0.001$) indicates a strong mean reversion in inflation differentials. This finding suggests that above-average inflation periods tend to be followed by below-average inflation periods. Concerning economic growth effect (based on nominal GDP growth), we find a strong negative relationship -5.6014 ($p<0.001$) between nominal GDP growth and inflation differentials. A one percentage point increase in nominal GDP growth is associated with a 5.6 percentage point decrease in inflation differential. This counter-cyclical pattern may reflect effective monetary policy response during economic expansions.

Regarding the monetary effect (monetary liabilities growth), a substantial positive coefficient 15.0840 ($p<0.001$) indicates strong inflationary impact of monetary expansion. A one percentage point increase in monetary growth is associated with a 15.1 percentage point increase in inflation differential. The finding demonstrates a significant transmission mechanism from monetary conditions to price levels. A baseline inflation (intercept term) can be observed.

The positive and significant intercept 1.0142 ($p=0.003$) suggests a structural tendency toward positive inflation differentials. This baseline differential persists even after accounting for key macroeconomic factors. All variables are highly statistically significant ($p<0.01$), demonstrating the robust explanatory power of this specification for inflation differentials.

4.2. Panel Vector Autoregressive Model Results: Reserves and Inflation

The estimation results of the Panel VAR model, which is described in section 3.2.2., are summarized in Table 3. We apply a GMM estimation with a robust weight matrix. The variables are expressed as percentage point changes.

Table 3

PVAR Model A estimation results.

	Coefficient	Std. Err.	z-statistic	p-value	95% Confidence Interval
Equation: CPI					
CPI Inf (t-1)	0.0497	0.0394	1.26	0.207	[-0.0276, 0.1271]
reserves (t-1)	0.9472	1.2643	0.75	0.454	[-1.5308, 3.4252]
Equation: reserves					
CPI Inf(t-1)	0.0009	0.0008	1.15	0.250	[-0.0007, 0.0025]
reserves (t-1)	-0.0128	0.0808	-0.16	0.874	[-0.1711, 0.1455]
Final GMM Criterion Q(b) = 1.59e-34					

Based on Table 3 we can observe the following results. Inflation and percentage change in reserves show limited persistence, with lagged values having statistically insignificant effects on current values ($p > 0.05$). The past values of reserves change have a positive but statistically insignificant impact on Inflation 0.947 ($p = 0.454$). The past values of inflation rates have a minimal and statistically insignificant effect on reserves change 0.0009 ($p = 0.250$). The system shows weak dynamic linkages between variables, suggesting limited predictive relationships in this specification. This finding suggests that foreign reserves cannot stabilize inflation in BRICS+ countries. Therefore, even China is not stabilizing these dynamics despite its tremendous number of international reserves. The corresponding Granger causality test results are given in Table 4.

Table 4

Granger causality test.

Equation	Excluded Variable	χ^2	df	p-value
CPI	Reserve Variability (resfvar)	0.561	1	0.454
Reserve Variability (resfvar)	CPI	1.325	1	0.250

An increase in international reserves does not Granger cause inflation, and vice versa. Therefore, it cannot be concluded that reserves stabilize inflation rates.

4.3. Panel Vector Autoregressive Model Results: Speculative Attacks and Reserves

Estimation results for the Panel VAR model, which is described in section 3.2.3., are given in Table 5. The dynamic relationship among FX volatility, foreign reserves variability, capital flow, and interest rate differentials are analyzed in the vector autoregression model.

Table 5
PVAR Model B estimation results.

Dependent Variable	Coefficient	Std. Error	z-statistic	p-value	95% Confidence Interval
Equation: (fxvoldiff)					
fxvoldiff (t-1)	-0.4297***	0.0825	-5.21	0.000	[-0.5914, -0.2681]
Reserve Variability (t-1)	0.0197	0.0137	1.43	0.152	[-0.0072, 0.0466]
Capital flow % Change (t-1)	-0.0029	0.0033	-0.87	0.386	[-0.0094, 0.0036]
Interest Rate Differential (t-1)	0.0416*	0.0247	1.68	0.092	[-0.0068, 0.0900]
Equation: (resfvar)					
fxvoldiff (t-1)	0.2826	0.8625	0.33	0.743	[-1.4078, 1.9730]
Reserve Variability (t-1)	0.6092***	0.1827	3.33	0.001	[0.2511, 0.9673]
Capital flow % Change (t-1)	-0.1057**	0.0420	-2.52	0.012	[-0.1881, -0.0233]
Interest Rate Differential (t-1)	-0.0974	0.1171	-0.83	0.405	[-0.3269, 0.1321]
Equation: (pct_change_cap)					
fxvoldiff (t-1)	3.5115	3.0840	1.14	0.255	[-2.5331, 9.5561]
Reserve Variability (t-1)	0.2074	0.1609	1.29	0.197	[-0.1080, 0.5229]
Capital flow % Change (t-1)	-0.0608*	0.0352	-1.73	0.084	[-0.1297, 0.0082]
Interest Rate Differential (t-1)	-0.3460	0.3833	-0.90	0.367	[-1.0973, 0.4053]
Equation: (intdiff)					
fxvoldiff (t-1)	-1.5216***	0.5902	-2.58	0.010	[-2.6783, -0.3648]
Reserve Variability (t-1)	-0.0185	0.1502	-0.12	0.902	[-0.3128, 0.2758]
Capital flow % Change (t-1)	0.0000	0.0252	0.00	0.999	[-0.0493, 0.0494]
Interest Rate Differential (t-1)	0.4919	0.4326	1.14	0.256	[-0.3560, 1.3399]
Final GMM Criterion Q(b) = 2.26e-31					

Notes: Significance levels, ***p<0.01, **p<0.05, *p<0.1

We apply the first lags of all above-mentioned endogenous variables (fxvoldiff, resfvar, pct_change_cap, intdiff) as instruments in the GMM estimation with robust weight matrix. The main findings from Table 5 are described below. Concerning the FX volatility dynamics, a strong negative autocorrelation in FX volatility -0.4297 ($p<0.001$) can be observed, suggesting mean-reverting behavior. A weak positive effect from interest rate differentials 0.0416 ($p<0.1$) is given.

The international reserve variability interactions show a moderate positive autocorrelation 0.6092 ($p<0.001$), indicating persistence in reserve movements. A significant negative impact on reserve variability from capital flow changes -0.1057 ($p<0.05$) is observable, suggesting potential policy responses to market movements. Regarding capital flow behavior, a weak negative autocorrelation -0.0608 ($p<0.1$) indicates a modest mean reversion in capital flows.

Interest rate dynamics show a strong negative response to FX volatility -1.5216 ($p<0.01$). An increase in international reserves does not lower forex volatility. Therefore, it cannot be concluded that reserves stabilize forex volatility.

In Table 6 the relevant Granger causality relationships based on the VAR model

from 4.3.1 are presented. We apply a Panel VAR-Granger causality Wald test with the related hypothesis from below.

Ho: Excluded variable does not Granger-cause equation variable
Ha: Excluded variable Granger-causes equation variable

The results in Table 6 exhibit the following main results. Capital flow fluctuations strongly Granger-cause changes in reserve variability $\chi^2 = 6.328$, ($p = 0.012$). This suggests monetary authorities may adjust reserves in response to asset market movements.

Table 6
PVAR Granger Causality.

Equation	Excluded Variable	χ^2	df	p-value Significance
Foreign Exchange Volatility (fxvoldiff)				
	Reserve Variability	2.054	1	0.152
	Asset Price % Change	0.753	1	0.386
	Interest Rate Differential	2.838	1	0.092*
	ALL	4.483	3	0.214
Reserve Variability (resfvar)				
	Foreign Exchange Volatility	0.107	1	0.743
	Asset Price % Change	6.328	1	0.012**
	Interest Rate Differential	0.692	1	0.405
	ALL	6.492	3	0.090*
Asset Price % Change (pct_change_cap)				
	Foreign Exchange Volatility	1.296	1	0.255
	Reserve Variability (resfvar)	1.661	1	0.197
	Interest Rate Differential (intdiff)	0.815	1	0.367
	ALL	6.006	3	0.111
Interest Rate Differential (intdiff)				
	Foreign Exchange Volatility (fxvoldiff)	6.646	1	0.010***
	Reserve Variability (resfvar)	0.015	1	0.902
	Asset Price % Change (pct_change_cap)	0.000	1	0.999
	ALL	9.500	3	0.023**

Notes: Significance levels, ***p<0.01, **p<0.05, *p<0.1

Exchange rate volatility strongly Granger-causes changes in interest rate differentials. Consistent with monetary policy responses to currency market fluctuations. A weaker but still significant (at 10% level) causal relationship is given from interest rates to FX volatility. Further, this fact indicates a bidirectional causality between interest rates and exchange rate volatility. Concerning the joint causality, we can observe that all model variables jointly Granger-cause interest rate differentials $\chi^2 = 9.500$ ($p = 0.023$). All

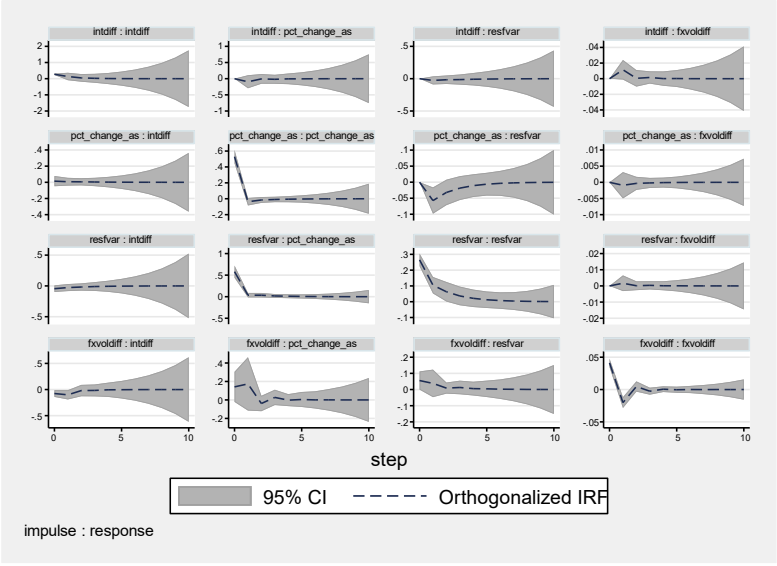
variables jointly Granger-cause reserve variability, though at lower significance $\chi^2 = 6.492$ ($p = 0.090$). No significant causal impacts on capital flow changes from any individual variable prevails. The reserve variability shows no significant causal impact on other variables individually.

4.3.3. Impulse Response Functions

The impulse response functions based on the PVAR model in section 4.3.1 are presented in Figure 2. A change in capital asset inflow provides a positive increase on itself for about 2 years. A foreign reserve change increases the capital inflow for 1 year. The impulse of FX volatility increases the capital inflow by about 20% for about 2 years. The capital flow impulse increases the foreign reserves in a long run response for about 10 years. We observe that capital inflow induces stabilization function in FX volatility and foreign reserves for about a maximum of 1 year.

Figure 2

Impulse response functions PVAR model.



5. Conclusion

This study offers a refined perspective on BRICS+ economic integration, diverging from conventional wisdom in key areas. Firstly, while the New Development Bank's investment is very important, our findings suggest that prioritizing capital flow and trade integration, rather than reserve accumulation, will yield greater stability for the member countries. Secondly, the feasibility of a BRICS+ common currency is supported by observed inflation stabilization, which is conform with the monetary union theory (Mundell, 1961; Frankel & Rose, 1998). However, the study challenges the traditional view

of foreign reserves as a primary defense against speculative attacks, indicating their limited effectiveness within the BRICS+ context. This makes it necessary to explore alternative stabilization mechanisms, such as coordinated capital flow management and enhanced trade integration.

This study's central contribution is the identification of capital inflows—rather than reserve accumulation—as the primary stabilizer of BRICS+ exchange rates. Consequently, an alternative approach to monetary integration is recommended, which emphasizes institutional frameworks and policy coordination. Above all, the Mundell-Fleming Trilemma presents a unique dynamic within BRICS+, where capital mobility may stabilize foreign exchange rate volatility (Pasricha et al., 2018).

The study confirms strong mean reversion in inflation differentials across BRICS+ countries, demonstrating that economies with higher inflation tend to experience faster declines over time. This convergence supports the potential for greater monetary coordination, as inflation fluctuations appear to be stabilizing in the longer term. Earlier literature, particularly the works of Mundell (1961) and Frankel and Rose (1998), emphasized that inflation convergence is an important precondition for a successful currency union. While previous studies (Aizenman et al., 2013; Ghosh et al., 2016) have identified inflation divergence as a major challenge for monetary integration, the findings here suggest otherwise, conforming to the theoretical importance of inflation convergence. Nevertheless, structural and institutional differences among BRICS+ nations may still present obstacles to deeper monetary coordination.

Recent research partially supports our findings on inflation convergence but emphasizes significant macroeconomic asymmetries that persist across the BRICS+ bloc. For instance, while studies report symmetric responses to certain global shocks, such as commodity price movements, fiscal coordination remains limited, and policy divergence continues (Nach & Ncwadi, 2024). Evidence from exchange rate co-movements also highlights important divergences, such as the negative correlation between the Chinese renminbi and other BRICS currencies like the rand and ruble, complicating monetary harmonization (Sbeiti et al., 2025). These asymmetries suggest that even if inflation convergence improves, the path toward a full currency union remains long and institutionally demanding.

Foreign reserves, traditionally viewed as a stabilizing force in emerging economies, fail to provide inflation stability in the BRICS+ case. Even China's massive reserves do not exhibit a stabilizing effect, as confirmed by Granger causality tests, which find no causal relationship between reserves and inflation stability. This challenges the prevailing view that reserves serve as a safeguard against financial instability. Earlier research, including works by Obstfeld et al. (2009) and Aizenman and Lee (2007), has emphasized that reserves reduce exchange rate volatility and protect against speculative attacks. However, the BRICS+ findings contradict this assumption, suggesting that reserves may not be as effective in managing financial volatility as previously thought. This highlights

the need for alternative stabilization mechanisms, such as capital flow management and enhanced trade integration.

Recent studies support this view. Alwadeai et al. (2024) show that even very high reserves-to-GDP ratios do not effectively reduce exchange rate volatility. This is especially true during periods of sanctions or external shocks. Furthermore, their findings suggest that large reserves may be accumulated under economic pressure rather than indicating macroeconomic strength. This supports our argument that imply collecting reserve accumulation does not create long-term financial stability. However, the literature also suggests that active interventions— rather than just collecting reserves—can reduce short-term volatility in foreign exchange markets (Chaudhari & Trivedi, 2022). Thus, the effectiveness of reserves appears conditional on active policy use, not on the reserve volume alone.

Similarly, the study finds that increases in international reserves do not significantly reduce foreign exchange volatility, whereas capital inflows have a significant stabilizing effect. This suggests that trade and investment integration may be more effective tools for stabilizing exchange rates than traditional reserve accumulation. The implications of these findings are closely related to the key aspects of the Mundell-Fleming Trilemma, where capital mobility, rather than undermining financial stability, appears to play a constructive role in exchange rate management (Obstfeld et al., 2009). Earlier literature, including Krugman (1979) on speculative attacks and Frankel and Rose (1998) on trade integration, has generally supported the idea that trade and financial openness contribute to currency stability. The BRICS+ results align with these broader themes but diverge on the role of reserves, indicating the need to rethink stabilization strategies.

Recent analyses increasingly support this trade-focus view of integration. BRICS-wide research shows that capital mobility, spreading investments across different areas, and using local currencies for trade are more effective tools for economic stability than large amounts of foreign currency reserves (Alwadeai et al., 2024; Baum et al., 2018). Evidence suggests that long-term capital inflows, like foreign direct investments within BRICS+, are more likely to reduce currency fluctuations than short-term speculative flows. This detailed perspective builds on our own findings and supports better coordination of capital flows and stronger institutions as keys to future economic stability.

These insights have important policy implications. First, the study suggests that the NDB's USD 30 billion investment should be directed toward fostering capital flows and trade integration rather than increasing reserves. Second, policymakers should explore alternative stabilization mechanisms, such as coordinated capital flow management and institutional reforms aimed at attracting stable investment (De Grauwe, 2012). While inflation convergence provides a foundation for monetary coordination, the limited effectiveness of reserves in stabilizing inflation and exchange rates suggests caution in moving toward a common currency. The historical experience of the Eurozone underscores the importance of fiscal and monetary coordination, as emphasized by De Grauwe (2012)

and Aizenman et al. (2013).

Beyond policy recommendations, the study contributes to broader theoretical discussions on monetary integration. The findings challenge the assumption that foreign reserves serve as a reliable stabilizing factor in emerging market economies, particularly in the context of BRICS+. Furthermore, historical cases of speculative attacks may require reassessment if reserves are not the primary defense mechanism against financial crises (Krugman, 1979; Jeanne & Rancière, 2011).

The future perspectives of BRICS+ are determined by its future ambitions and its structural challenges. As Acharya (2014) argues, the rise of BRICS suggests a shift towards a multipolar global order, where established norms and institutions are challenged. The expansion into BRICS+ amplifies this trend yet also raises concerns over its governance capacity. The importance of a common legal framework for economic cooperation, which could enhance the bloc's institutional development is emphasized by i.e. Silva and Campos (2021). Similarly, Leal-Arcas (2010) warns that it becomes harder to agree on common decisions as member countries get highly diverse.

Nevertheless, BRICS could change how the global economy works. Chaturvedi and Saha (2019) show that BRICS wants countries to have more control over their own money and finances, instead of depending so much on the US dollar and Western-led institutions. Furthermore, Xing (2019) highlights BRICS' growing role in providing global public goods, such as sustainable infrastructure, especially the NDB-funded projects can be considered here. On the cultural and ideological front, Albuquerque and Lycariao (2018) show that BRICS gives developing countries a new way of narratives in global media and diplomacy, different from Western perspectives.

In sum, while BRICS+ faces real limitations in terms of institutionalization and internal divergence, it is becoming an important voice for developing countries as the world order changes. The recent literature on BRICS reinforces our view that BRICS+ will not succeed through reserve accumulation alone. Instead, the bloc's success will depend on its ability to create formal systems for financial coordination, actively manage capital flows, and build mutual trust to eventually enable monetary convergence.

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