BRICS Reserve Currency and Chinese Renminbi Internationalization*

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Abstract

We investigate three interrelated research questions: The prospects of a (i) Common Brazil, Russia, India, China and South Africa (BRICS) reserve currency, (ii) Chinese renminbi (RMB) internationalization and (iii) Progression of the RMB towards global safe asset status. This is in an environment in which the BRICS are part of a common strategic and economic group. Yet, the U.S. dollar is central in the international monetary system. We find that financial market fragmentation of the BRICS reinforced by the different (macroeconomic) fundamentals of each country and lack of convergence in these fundamentals, are major constraints towards any progression for formulating a path concerning a BRICS reserve currency. In contrast, RMB internationalization is a realization because the RMB is part of the basket of the IMF's Special Drawing Rights and superior Chinese fundamentals and active steps taken by China to improve RMB internationalization, show that over time the RMB may be better suited as an alternative reserve currency for the BRIS countries (excluding China). However, additional policy adjustments need to be implemented by China to increase the appeal of the RMB as a global safe asset.

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1 Introduction

In recent times an increasing number of countries have expressed a greater desire for more international currencies in the international monetary system (Frankel, 2023; Devereux et al., 2024; Coppola et al., 2025). These desires have been driven by a wide array of economic factors, especially the increase in international trade and financial linkages between emerging markets (EMs) and China and with the rest of the world (RoW) (Liao and McDowell, 2016; Liu et al., 2019; He et al., 2024).[1] Additionally, the rapid increase in the economic size of EMs and China relative to most advanced economies (AEs) and the potential diversification benefits of holding (and using) alternative currencies and financial instruments denominated in different currencies, have reinforced these greater desires.

In 2009, Governor Zhou Xiaochuan of the People's Bank of China (PBoC) proposed for a reform of the international monetary system with a primary objective of improving the stability of the existing system. Specifically, he emphasized and proposed for an expansion of the number of currencies included in the International Monetary Fund's (IMF) Special Drawing Rights (SDR) valuation and that this must account for currencies of major economies and possibly use the gross domestic product (GDP) of a country as a weight. Additionally, he proposed for the usage of the SDR in international trade, commodities pricing and the creation of SDR denominated financial instruments to increase its appeal in the international monetary system.[2]

Chiţu et al. (2014) and Bénassy-Quéré and Capelle (2014) identify that concerns about the existing international monetary system and global financial architecture have been raised by Group of Twenty (G20) leaders in 2011 at the Cannes Summit along with a commitment towards an international monetary system that consists of new international currencies. Fratzscher and Mehl (2014) highlight that one of the main priorities of the G20's policy agenda is reform of the international monetary system. Liao and McDowell (2016) identify changes in 37 central banks preferences based on the inclusion of the RMB in their portfolios and they argue that this is symbolic of economic and political choices along with a desire for a reform of the international monetary system.

Bery (2018) posits that G20 EMs desires for reform of the international monetary system is based on an objective to stabilize this system, make it less vulnerable to policy shocks originating in AEs and to improve global liquidity by reducing its dependence on one or a few international currencies. Furthermore, some of the key recommendations of the 2024 Brazilian G20 presidency is to achieve a stable, equitable and reformed global financial architecture that allows for the achievement of sustainable development goals (T20 Brasil Task Force 03 Statement, 2024).

These economic developments motivate our study and show the relevance of our study because there is an increasing number of G20 nations that are expressing greater desires for a multi-currency

[1] Chen and Peng (2010) provide an earlier perspective for which over 2006-2007 China was the fourth largest economy in the world and a major trade partner of most Asian economies.

[2] See, https://www.bis.org/review/r090402c.pdf

international monetary system and a change in the global financial architecture that complements the current architecture rather than leading to its demise.[3] For our purposes, we investigate three interrelated questions. (i) Is a (common) Brazil, Russia, India, China and South Africa (BRICS) reserve currency feasible? This is in an environment in which the BRICS are currently part of a common strategic and economic group. (ii) Is Chinese renminbi (RMB) internationalization feasible? (iii) Is it possible for the RMB to progress towards global safe asset status?

Consequently, our study provides four contributions to the literature. The first, second and third contributions are by systematically responding to the three questions concerning the prospects of a BRICS reserve currency, RMB internationalization and the progression possibility of the RMB towards global safe asset status. The fourth contribution is by expanding on the framework of Krishnamurthy and Vissing-Jorgensen (2012) and Ferreira and Shousha (2023) by constructing a simple safe asset model aligned with global investors' risk preferences in which global investors hold domestic and foreign bonds (safe assets) and the safe asset enters directly into their utility function.

Our main objective of constructing and expanding a safe asset model is to quantitatively characterize how a desire for a multi-currency system (that may generate diversification benefits) - along with other macroeconomic and financial indicators - influences the demand and price of safe assets. Thus, we derive the optimal price of a safe asset and determine that it is positively related to the exchange rate depreciation of the global investor's local currency unit relative to the foreign currency unit, inversely related to aggregate inflation, positively related to the ratios of the marginal utilities of consumption, positively related to the demand shift motives of global investors for the safe asset and thus desires for a multi-currency system and its potential diversification benefits and therefore, positively related to the marginal benefit from holding an additional unit of the safe asset.

Our framework allows us to describe how risk preferences may inform global investors' perception and demand for RMB as a global safe asset. Therefore, for our purposes, we construct and propose a simple safe asset model based on RMB denominated government bonds. Our specific contribution to the safe asset literature is by pinning down and characterizing four factors that can drive the demand shift motives of global investors for Chinese safe assets and thus the price of these assets.

These factors are as follows: (i) rising long-term economic uncertainty in the home countries of global investors, (ii) rising short-term global financial uncertainty and thus higher global risk aversion, (iii) rising EMs volatility, typically associated with EMs currency depreciation, that may influence global investors to shift their portfolios out of EMs and into Chinese safe assets and (iv) greater desires for more international currencies because of the potential diversification benefits of holding alternative currencies and specifically debt instruments denominated in different currencies and this is relevant because China's financial markets are opening to long-term and short-term investors.

Within this context, Clayton et al. (forthcoming) note that the Chinese domestic bond market

[3]See also, https://www.cfr.org/backgrounder/what-does-g20-do

is the third largest globally behind the U.S. and the European Union and China initially opened its bond market to long-term investors such as central banks and sovereign wealth funds and it has now opened to short-term investors such as mutual, exchange traded and hedge funds. Thus, as pointed out by Clayton et al. (forthcoming), there is a higher possibility of China being a major global bond investment destination along with RMB denominated bonds rising towards assuming a larger share in international bond markets, see also He and Wei (2023) for a comprehensive review concerning China's economy and financial system. These factors provide additional motivation for our study and show the relevance of examining the prospects of the RMB towards global safe asset status along with characterizing a simple RMB safe asset model.

These events are occurring in an environment in which the U.S. dollar is central in the international monetary system and the U.S. dollar appreciates during periods of heightened global risk (Bruno and Shin, 2015; Gourinchas et al., 2019: Gourinchas, 2023; Georgiadis et al., 2024). Indeed, Jiang et al. (2024) outline that the U.S. dollar is the dominant currency in bond issuance in international markets (by U.S. and non-U.S. issuers), there is a flight to the U.S. dollar and U.S. dollar securities during global downturns and U.S. monetary policy generates sizeable spillovers to the rest of the world, see also Krohn et al. (2025). Moreover, Miranda-Agrippino and Rey (2020) show that there is an intrinsic relationship between U.S. monetary policy and the global financial cycle because U.S. monetary policy shocks influence international financial variables that characterize the global financial cycle.

Du and Huber (2024) emphasize these U.S. dollar features by constructing the first comprehensive estimates of foreign investor holdings of U.S. dollar securities and currency hedging practices. They find that foreign investors exhibit a significant preference for U.S. dollar securities and over the past 20 years they have increased their holdings of U.S. dollar securities. These findings entrench the dominance of the U.S. dollar in the international monetary system, and indeed, over 2022 the U.S. dollar has a 88.4% share in global FX transactions, a 46.5% share in the currency denomination of international Society for Worldwide Interbank Financial Telecommunication (SWIFT) payments for July 2023 and a 83.56% share as a global currency in the trade finance market for August 2024.[4]

The remainder of the paper is organized as follows. Section 2 documents our main findings and policy recommendations. Section 3 presents a simple RMB safe asset model. Section 4 describes related literature, BRICS reserve currency and RMB internationalization prospects. Section 5 concludes.

2 Main Findings and Policy Recommendations

Our main findings can be summarized as follows. First, financial market fragmentation of the BRICS reinforced by the different (macroeconomic) fundamentals of each country, lack of convergence in these fundamentals, lack of depth and liquidity in the financial markets of the BRICS, especially relative

[4]See SWIFT RMB Tracker and Statista.

to the financial markets of the U.S., are major constraints towards any progression for formulating a path concerning a BRICS reserve currency. This dates as far back as 2012 when the establishment of the New Development Bank (NDB) was considered.[5] The lack of convergence and harmonized macroeconomic fundamentals that can support the value of a BRICS reserve currency, are factors that matter for global investors and for reserve currency status, see also Menkhoff et al. (2017).

Second, RMB internationalization is a realization because it is part of the basket of the International Monetary Fund's (IMF's) Special Drawing Rights (SDR) (Ito , 2017; Dollar, 2018). Furthermore and more recently, China has more trading partners in the world than the U.S., see Jarreau and Poncet (2012) for an outline concerning China's rapid economic expansion, export growth and integration into global trade from the early 1990s. Additionally, RMB internationalization, superior Chinese macroeconomic fundamentals relative to Brazil, Russia, India and South Africa (BRIS), and active steps taken by China to improve RMB internationalization (which will be discussed below), show that over time the RMB may be better suited as an alternative reserve currency for BRIS.

Inasmuch as China has taken active steps to internationalize the RMB, China needs to implement additional policy measures to increase the appeal of the RMB and RMB denominated debt instruments as global safe assets. Particularly and as noted by Das (2019), China must improve the depth and liquidity of its onshore RMB foreign exchange (FX) markets, see also Cheung et al. (2018) and Qiao et al. (2024) concerning the institutional background of the onshore RMB FX market and the RMB exchange rate regime dating back from 2005. These factors reinforce the lack of depth and liquidity associated with the onshore RMB FX market.

More importantly, China must improve the depth and liquidity of its (government and corporate) bond markets because this is a crucial characteristic for the internationalization of a currency and for global safe asset status, see also He et al. (2016, 2019), Caballero et al. (2017), Prasad (2018, 2019) and Habib et al. (2020). Additionally, RMB denominated debt instruments would have to preserve their value during periods of global economic turmoil and financial instability because this will allow them to qualify and maintain the status of RMB denominated debt instruments as global safe assets.[6] These features along with an open capital account, generate flexible financial markets that are attractive to domestic and international investors because of the ability to move capital freely, see Chen and Peng (2010), Frankel (2012) and Pettis (2022) with specific reference concerning RMB internationalization prospects.

Therefore, China would need to issue more RMB denominated bonds on-shore and off-shore, China would need to improve the environment in which foreign institutions (and foreign governments) issue

[5] A multilateral development bank established by the BRICS, https://www.ndb.int/about-ndb/history/

[6] Caballero et al. (2017) explain further that safe assets comprise of the properties that (i) investors can transact these assets without adverse selection concerns, (ii) these assets have and preserve intrinsic value during periods of volatility and uncertainty and (iii) encompass a feature that they are safe because other market participants expect these assets to be safe, along with the perception that these assets are safe because of their reputation and history.

RMB denominated bonds on-shore (Panda bonds) and off-shore (Dim Sum bonds), possibly with Chinese state-led banks or institutions as lead underwriters working jointly with other foreign underwriters, and China should allow flexibility associated with the proceeds of these bonds.[7] China's financial system should be willing and able to absorb excess savings from the rest of the world, especially during periods of global economic turmoil and financial instability in which global investors seek global safe assets. This implies that China should be willing to export safe assets while running a trade surplus.[8]

China has taken active steps to remove restrictions on capital inflows and outflows and thus setting up infrastructure that allows and encourages global investors to participate in Chinese financial markets. For e.g. and as noted by Clayton et al. (forthcoming) the launching of the qualified foreign institutional investor (QFII) program in 2002 allowing global investors access to domestic stock and exchange traded bond markets with a one-year lock-up period and in 2009 this was lowered to a three-month lock-up period. Furthermore, the introduction of the RMB QFII scheme in 2011 allowing authorized global investors to participate in mainland China's stock exchanges and to use RMB to participate in China's financial markets rather than using foreign currency, along with the eventual merging of the QFII and RQFII in 2020 (Clayton et al., forthcoming) and regulatory reforms allowing Chinese investors to participate in global markets in the form of the qualified domestic individual and institutional investor schemes (Liao and McDowell, 2016; Ito, 2017).

Cerutti and Obstfeld (2018) and UBS (2021) outline additional reforms taken by China in the form of the China Interbank Bond Market (CIBM) established in 1997 providing direct access to an over the counter market outside the Shanghai and Shenzhen stock exchanges that allows for trade in government bonds, PBoC bills and other debt instruments, the bond connect program (launched in 2017) which is a mutual market access scheme allowing global and mainland Chinese investors to trade in each other's bond markets, along with transaction and settlement processes similar to AEs bond markets and the qualified domestic investment partnership program allowing global asset managers to raise RMB from wealthy and institutional investors in China for overseas investment.

Indeed, the internationalization of Chinese bonds is endorsed by positive global reactions because of the inclusion of Chinese RMB-denominated government and policy bank securities in the Bloomberg-Barclays Global Aggregate Index in 2019, the 2020 inclusion in the JPMorgan Government Bond Index Emerging Markets (GBI-EM) and the 2021 inclusion of Chinese government bonds in the FTSE Russell World Government Bond Index (WGBI), see Clayton et al. (forthcoming). Inclusion in these indexes accounts for rigorous features such as tradability of these bonds, investor access associated with these

[7] See Ito (2017) for a historical outline about Panda and Dim Sum bonds. Notably, the Canadian Province of British Columbia was the first foreign government authorized to issue in China's domestic bond market and it issued a Panda bond on January 2016.

[8] Caballero et al. (2016) provide a related description in a framework of safe asset scarcity and aggregate demand and with reference to Switzerland and Germany.

bonds, investment grade classification and that the local currency debt market of the issuing country has a convertible, freely tradable and hedgeable currency.

Additionally, Eichengreen (2022) and Zucker-Marques (2025) describe that China set up the Cross-Border Interbank Payment System (CIPS) that offers clearing and settlement services for market participants in cross-border RMB payments, it is backed by and supervised by the PBoC and was launched in 2015 with the intention to internationalize the RMB. Relative to SWIFT (which is a messaging network), CIPS offers clearing and settlement services and with more international participants on this platform, this may make RMB transactions faster and more cost-effective, see Zucker-Marques (2025) for a comprehensive review about the PBoC and CIPS, China's cross-border payment infrastructure and key insights about the role of central banks in influencing currency internationalization.

Positive recent developments associated with RMB bond markets are with the events of 31 January 2024, in which the NDB issued the largest ever 5-year Panda bond of RMB 6 Billion priced at 2.66% in the China Interbank Bond Market with the Bank of China Limited as the lead underwriter, along with a credit rating of AA+ by Standard & Poor's (S&P) and AA by Fitch. The NDB documents that this bond was oversubscribed, and this issuance attracted a diverse set of investors with more than 17 onshore and foreign investors participating comprising mainly of central banks, official institutions, bank treasuries and funds. On 24 July 2024 the NDB issued its second Panda bond in 2024 and this is a 3-year Panda bond of RMB 8 billion priced at 2.03 % in the China Interbank Bond Market.[9]

Additionally, on 14 January 2025 the NDB issued a 5-year Panda Bond of RMB 6 billion priced at 1.7% in China's Interbank Bond market with the Bank of China Limited as the lead underwriter. The NDB explains that this bond issuance attracted interest from over 20 investors, including central banks, official institutions, bank treasuries, and insurance companies, with a diverse geographic distribution and this issuance maintains the NDB as the largest Panda bond issuer. Moreover, what is evident is that with more issuance of Panda Bonds by the NDB, this is attracting more investors along with reduction in the interest rate at issuance of the bonds and an unchanged credit rating.

Additional active steps for RMB internationalization are with the policy measures announced on 13 January 2025 by the PBoC and the Hong Kong Monetary Authority (HKMA) with an objective of reinforcing Hong Kong as the global offshore RMB business hub and to deepen the ties between the financial markets of Mainland China and Hong Kong. Some of these measures are as follows: (i) introduction of the HKMA RMB trade financing liquidity facility, (ii) further enhancement and expansion of Bond Connect (Southbound), (iii) offshore RMB repurchase using Northbound Bond Connect bonds as collateral, (iv) inclusion of Northbound Bond Connect bonds as eligible margin collateral at OTC Clearing Hong Kong Limited and (v) cross-boundary payment facilitation.[10]

[9]See, https://www.ndb.int/news/ndb-issues-largest-ever-5-year-panda-bond-reinforcing-commitment-to-financing-infrastructure-and-sustainable-development-projects/ and https://www.ndb.int/news/ndb-issues-rmb-8-billion-panda-bond-reinforcing-commitment-to-financing-infrastructure-and-sustainable-development-projects/

[10]See, https://www.hkma.gov.hk/eng/news-and-media/press-releases/2025/01/20250113-4/

Contrary to our policy recommendations, Eichengreen et al. (2024) argue that an increase in the openness of China's capital account is not essential for RMB internationalization. Instead, they argue that through RMB invoicing, international trade settlement, cross-border flows facilitated by offshore centers (that have less restrictions) and policy support in the form of RMB-denominated loans and currency swaps, these can improve the appeal and function of the RMB for central bank reserve holdings. However, they note that this would need the PBoC to hold a large amount of U.S. dollars to facilitate the provision of these financial services with a high degree of stability and predictability.

They also argue that this trajectory would not lead to the demise of the U.S. dollar or the Euro and instead it would lead to a multipolar global system and a new financial world order in which the RMB, U.S. dollar and the Euro complement each other. Eichengreen et al. (2024) proceed to explain that China is not willing to progress to full capital account openness because this may increase its exposure to external shocks and thus compromise one of China's objectives of balanced economic development. This is all within an environment in which China is experiencing a gradual adjusment and an increase in financial openness. Indeed, as pointed out by these authors, the PBoC does account for market-driven principles. However, this is within an environment in which the PBoC seeks to reinforce its macroprudential regulation concerning cross-border capital flows because these may generate systemic financial and economic risks that can be triggered by insufficient oversight and slack regulatory outcomes in an evolving global financial system.

3 Simple Safe Asset Model

Caballero et al. (2017) provide a pragmatic and narrow definition of a safe asset which they describe as a debt instrument that is expected to preserve its value during adverse systemic events. For our purposes, this suggests that RMB denominated debt instruments must preserve their value during periods of global economic turmoil and financial instability because this will allow them to qualify and maintain their status as global safe assets and they should be issued in deep and liquid markets.

Following this set-up, we describe how risk preferences may inform global investors' perception and demand for RMB as a global safe asset. Thus, we construct and propose a safe asset model based on RMB denominated government bonds. Our model is largely based on Krishnamurthy and Vissing-Jorgensen (2012) and the specific risk preferences are in line with Ferreira and Shousha (2023).

However, we extend on these studies by assuming a representative household is a (risk averse) global investor with a portfolio that consists of domestic D_t and foreign one-period bonds B_t^* with P_t^D and $P_t^{B^*}$ as the domestic and foreign bond prices respectively, see also Justiniano and Preston (2010) and Du et al. (2021). Relative to Justiniano and Preston (2010) and Du et al. (2021), in our model the foreign bond is the safe asset in the global investor's portfolio that enters directly in their utility function and S_t is the nominal exchange rate expressed as domestic currency units per foreign

currency unit, where the foreign currency is the Chinese RMB. Our main objective of expanding a simple safe asset model is to quantitatively characterize how a desire for a multi-currency system (that may generate diversification benefits) - along with other macroeconomic and financial indicators - influence the demand and price of safe assets.

Thus, the global investor derives utility from consumption and holding global safe assets as follows:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \log \left[C_t + \upsilon \left(\Theta_t,\ GDP_t,\ \xi_t \right) \right], \tag{1}$$

subject to their budget constraint,

$$P_t C_t + P_t^D D_t + S_t P_t^{B^*} B_t^* \leq D_{t-1} + S_t B_{t-1}^* + T_t, \tag{2}$$

where β is the inter-temporal discount factor, C_t is consumption, $\upsilon \left(\Theta_t,\ GDP_t,\ \xi_t \right)$ is a function that characterizes the gain or benefit from holding safe assets, where the real safe asset is $\Theta_t = \frac{S_t P_t^{B^*} B_t^*}{P_t}$, P_t is the aggregate price level, $P_t^{B^*}$ is the price of purchasing one unit of the safe asset B_t^*, GDP_t is the exogenous aggregate real income of the economy (thus the real income of the representative household), T_t are exogenous transfers to the household, $\theta_t = \frac{\Theta_t}{GDP_t}$ is the real safe asset relative to the real income of the representative household and ξ_t characterizes demand motives that shift household preferences for safe assets.[11]

We also assume that the utility of holding the real safe asset is homogeneous of degree one in the real income of the representative agent, GDP_t, as follows:

$$\upsilon \left(\Theta_t,\ GDP_t,\ \xi_t \right) = GDP_t \cdot \upsilon \left(\theta_t; \xi_t \right). \tag{3}$$

In our set-up, the global investor derives an increasing benefit of holding an additional real safe asset (relative to real income), however, at a decreasing marginal rate expressed respectively as follows:[12]

$$\frac{\partial \upsilon \left(\frac{\Theta_t}{GDP_t}; \xi_t \right)}{\partial \left(\frac{\Theta_t}{GDP_t} \right)} > 0 \text{ and } \frac{\partial}{\partial \left(\frac{\Theta_t}{GDP_t} \right)} \left(\frac{\partial \upsilon \left(\frac{\Theta_t}{GDP_t}; \xi_t \right)}{\partial \left(\frac{\Theta_t}{GDP_t} \right)} \right) = \frac{\partial^2 \upsilon \left(\frac{\Theta_t}{GDP_t}; \xi_t \right)}{\partial \left(\frac{\Theta_t}{GDP_t} \right)^2} < 0. \tag{4}$$

This property also holds for the marginal benefit of holding an additional unit of the safe asset B_t^*, see the appendix for a detailed derivation.[13] Optimizing with respect to consumption and the one-period

[11] As in Krishnamurthy and Vissing-Jorgensen (2012), the utility generated from holding safe assets is due to their liquidity benefits and safety attribute in the form of absolute certainty of nominal repayment. Additionally, concerning the properties associated with different utility functions, the allocation towards assets with risk-averse appealing properties over different global financial conditions and the relationship between expected utility and loss aversion, see Charles-Cadogan (2016, 2018) and Mateane (2023).

[12] This feature of a decreasing marginal rate characterizes that an increase in the holding of liquid assets will lower the marginal liquidity service provided by any liquid asset, see Krishnamurthy and Vissing-Jorgensen (2012).

[13] In Krishnamurthy and Vissing-Jorgensen (2012), Θ_t is the market value of an agent's real holdings of Treasuries denoted as Θ_t^T and other private-sector assets that provide services similar to Treasuries denoted as Θ_t^P and both assets enter the utility function of the agent directly. We characterize a global investor's holdings of bonds to consist of domestic and foreign bonds, however, we simplify our approach such that only the safe asset enters the utility function directly and the budget constraint of the global investor incorporates domestic and safe asset holdings.

foreign bond delivers the optimal price of the safe asset which is positively related to the exchange rate depreciation of the global investor's local currency unit relative to the Chinese RMB, $\frac{S_{t+1}}{S_t}$, inversely related to aggregate inflation, $\Pi_{t+1} = \frac{P_{t+1}}{P_t}$, positively related to the ratios of the marginal utilities of consumption, $\left(\frac{C_t+\upsilon(\Theta_t,\, GDP_t,\, \xi_t)}{C_{t+1}+\upsilon(\Theta_{t+1},\, GDP_{t+1},\, \xi_{t+1})}\right)$, positively related to the demand shift motives of global investors for the safe asset, ξ_t and therefore positively related to the marginal benefit from holding an additional unit of the safe asset, $\frac{\partial \upsilon\left(\frac{\Theta_t}{GDP_t};\xi_t\right)}{\partial\left(\frac{\Theta_t}{GDP_t}\right)}$ as follows (see appendix for detailed derivation):

$$P_t^{B^*} = \left[\frac{1}{1-\frac{\partial \upsilon\left(\frac{\Theta_t}{GDP_t};\xi_t\right)}{\partial\left(\frac{\Theta_t}{GDP_t}\right)}}\right] \beta \mathbb{E}_t \left[\frac{1}{\Pi_{t+1}} \frac{S_{t+1}}{S_t} \left(\frac{C_t + \upsilon\left(\Theta_t,\ GDP_t,\ \xi_t\right)}{C_{t+1} + \upsilon\left(\Theta_{t+1},\ GDP_{t+1},\ \xi_{t+1}\right)}\right)\right]. \tag{5}$$

We contribute to the safe asset literature by pinning down and characterizing four factors that can drive the demand shift motives ξ_t of global investors for Chinese safe assets and the price of these assets. The first factor is rising long-term economic uncertainty in the home countries of global investors. Second, rising (short-term) global financial uncertainty typically associated with higher global risk aversion. This can be characterized by rising levels and positive changes in the Chicago Board Options Exchange (CBOE) Volatility Index (VIX), see Bruno and Shin (2015), Fatum et al. (2017), Han and Wei (2018) and Röhrer et al. (2025). Indeed, Habib et al. (2020) describe that higher VIX values are associated with global economic and financial conditions in which holding safe assets is more attractive. Third, rising EMs volatility, typically associated with EMs currency depreciation, that may influence global investors to shift their portfolios out of EMs and into Chinese safe assets, see for e.g. Mateane (2023) who characterizes EMs volatility with the CBOE Emerging Markets ETF Volatility Index (VXEEM).[14]

The fourth factor that can drive the demand shift motives of global investors for Chinese safe assets is a greater desire for more international currencies because of the potential diversification benefits of holding and using alternative currencies and debt instruments denominated in different currencies. This fourth factor is at the forefront of policy makers and global investors agenda in recent times because of the evolving global economy, the increase in international trade and financial linkages between EMs, China and the RoW and the rapid increase in the economic size of EMs and China relative to most AEs. Therefore, with China's financial markets opening to long-term and short-term investors, this can influence how capital is allocated globally.

[14]In Mateane (2023), the standard deviation of percentage changes in VXEEM follows a two-state Markov process in which the high (volatility) state is consistent with EMs instability and the low state is consistent with EMs stability. Following this set-up, an EM central bank tracks and examines EMs volatility for which the different states of EMs volatility, generate and capture switches in an EM central bank preferences between (approximated) CRRA and IRRA expected utility. This informs an EM central bank to invest in foreign currency debt instruments (short and long-term) with risk averse appealing properties. Additionally, Mateane (2023) validates his proposed framework using different methods of computing expected FX reserves returns, traditional strategic FX reserve assets and different maturity structures and thus constructs optimal FX reserve weights for Brazil, Indonesia and South Africa.

We construct a safe asset model based on Chinese government bonds and our approach is informed by Gorton and Ordoñez (2020) who describe the key differences between government debt and private sector debt instruments which may constitute as assets in the portfolio of an investor. They explain that an investor may not consider these assets as perfect substitutes because of the heterogeneity in the information quality concerning private sector debt instruments and the associated individual private sector debt issuers. We also consider government bonds as safe assets for which investors would not have concerns that the counterparty (issuing government) has additional private information about the value of the asset relative to the information available to investors (Gorton, 2017) and Ferreira and Shousha (2023) point out that the ability of a sovereign to levy taxes, makes government debt less susceptible to default risk relative to private sector debt.[15]

Our framework is aligned with and draws valuable insights from Clayton et al. (forthcoming) who construct and propose a dynamic reputation model for the purpose of empirically characterizing China's bond market internationalization process. Their model shows how the internationalization process has involved a deliberate policy process of foreign investor selection by staggering and consequently restricting different types of foreign investors into China's domestic bond market along with deciding on how much to borrow from the different foreign investors that qualify to participate in its financial markets. Clayton et al. (forthcoming) describe that this foreign investor selection process is a policy choice that features foreign investment schemes with varying quotas, lock-up periods and registration requirements.

Concerning investors, the core features in Clayton et al. (forthcoming) are (i) two types of foreign investors with varying degrees of capital flight risk. (ii) The first type of investors are stable and long-horizon investors, they exhibit willingness to roll over existing debt and thus characterize lower capital withdrawal risk. Their conduct is perceived as consistent with the investor preferences of central banks, sovereign wealth funds and some private investors with long-horizons and stable funding. (iii) The second type of investors are consistent with most private investors with a high degree of capital flight risk and during periods of economic turmoil and financial instability they are more likely to withdraw their capital and are unwilling to roll over existing debt. Their conduct is associated with short-term and flighty investors such as mutual, exchange traded and hedge funds.

Therefore, this environment allows Clayton et al. (forthcoming) to describe China's bond market internationalization process as one of building a reputation as a global safe asset issuer, because

[15]Empirically and concerning FX markets, Fatum et al. (2017) examine the global safe asset status of the RMB by analyzing how changes in VIX impact the value of RMB traded off-shore relative to the U.S. dollar, Japanese yen, Pound sterling, Euro and Swiss franc. They find that higher market uncertainty is associated with a decrease in the value of the RMB relative to the U.S. dollar and Japanese yen, whereas higher market uncertainty is associated with an increase in the value of the RMB relative to the Pound sterling and Euro. Their findings imply that the RMB still lags the U.S. dollar and Japanese yen global safe asset status and in general, the RMB is not on par with traditional safe haven currencies. Indeed, Cheng et al. (2021) investigate the effectiveness of the RMB in hedging financial stress for global equity investors and they determine that the RMB does not exhibit safe haven currency status.

opening a country's financial markets helps to generate a better reputation with global investors, along with reducing the costs of capital flight that is typically associated with short-term flightier investors. In this environment and from the perspective of global investors, reputation concerns the likelihood that the government will not impose ex-post capital controls triggering investors' fear of being unable to withdraw their capital (repatriation risk) and move it into other global financial markets. Therefore, the reputational problem for the country concerns investors' expectations that capital controls may be imposed during periods of economic turmoil and financial instability. Consequently, the higher the global investors' expectations that the sovereign will impose capital controls, the lower is the country's reputation. This ex-ante worsens the country's credit terms and global financial markets access.

4 Related Literature, Prospects of a BRICS Reserve Currency and RMB Internationalization

4.1 Related Literature

Our study is related to a wide array of literature and the first strand of literature concerns international currencies, the characteristics or factors underlying the determination of an international currency and the documented uses or functions of an international currency. Thus, our paper contributes to this large and expanding research.[16]

An international currency is one that is held and used by non-residents of the country of issuance and it is predominantly used in international markets. Among others, Chinn and Frankel (2008), Kannan (2009), Chen and Peng (2010), Maggiori et al. (2019), Ito (2017) and Mukhin (2022) describe the characteristics underlying the determination of an international currency.

These factors are the size of the economy of the reserve currency issuing country, its share of world trade, its capital account openness, network externalities because global market participants are more likely to use a currency widely used by others and the inertia associated with these network externalities, the depth and liquidity of its financial markets, the stability of its currency's value, its central bank's independence and credibility, prudent fiscal policy and fiscal capacity of the sovereign, the overall credibility of its institutions and a powerful military.[17] Additionally, Bahaj and Reis (2022) show that central bank policies that reduce the volatility of borrowing costs for foreign firms in the international currency, improve and maintain international currency status because preferences of the currency of working capital and sales invoicing complement each other.

As noted by Frankel (2012, 2023), there are three well documented (private sector) functions of an international currency. The first is as a medium of exchange and particularly for international trade

[16] Henceforth we use the terms international currency or reserve currency interchangeably. Notwithstanding that the term reserve currency is typically associated with a currency held in large quantities by central banks.

[17] See also, https://www.imf.org/en/News/Articles/2019/10/21/SP091919-international-role-of-the-euro

and thus conducting international transactions. The second is as a store of value, especially for cross-border investment usually in the form of loans and bond purchases in international markets.[18] As a counterpart, borrowers in international markets frequently use international currencies to denominate bonds, loans and debt contracts in general (Eren and Malamud, 2022). Relatedly, He and Krishnamurthy (2020) describe that the dominance of U.S. dollar denominated debt in international markets is generated by the U.S. dollar safe asset status. The third documented function of an international currency is as a unit of account especially for trade invoicing (Maggiori et al., 2019).

Moreover, an international currency also fulfils its role as a medium of exchange, store of value and unit of account between countries where the reserve currency issuing country is not involved i.e. in third party outcomes (Golberg and Tille, 2008; Gourinchas et al., 2019; Boz et al., 2022; Casas et al., 2023; Krohn et al., 2024). Within this context, Gopinath et al. (2020) propose a dominant currency paradigm which consists of three key characteristics: dominant currency pricing, pricing complementarities and imported inputs in production.

Additionally, in Gopinath et al. (2020), firms set export prices in a dominant currency irrespective of the origin or destination of trade and these firms change these prices infrequently. Similarly, Amiti et al. (2022) examine firms invoice currency choice outcomes and determine that currency invoicing is an active firm-level decision informed by a firm's size, exposure to imported inputs and the currency choices of its competitors. Additionally, they find that the effects of foreign currency price stickiness are significant beyond a one-year horizon and only gradually dissipate in the long run.[19]

The second strand of literature that our study relates to concerns international currencies as safe assets and in particular debt instruments denominated in international currencies. In this strand of literature, a simple characterization of a safe asset is a debt instrument that is expected to preserve its value during adverse systemic events and these debt instruments should be issued in deep and liquid markets (Caballero et al., 2017; He et al., 2016, 2019; Barro et al., 2022). Furthermore, other safe asset studies describe how risk preferences inform investors' perception and demand for safe assets, see Krishnamurthy and Vissing-Jorgensen (2012) and Ferreira and Shousha (2023).

[18] Emter et al. (2024) examine the determinants of currency choice in cross-border bank lending and they find that these determinants are bilateral distance, financial and trade linkages to issuer countries of major currencies and invoice currency patterns. Furthermore, these authors find that trade invoicing and bank lending complement each other with respect to dominant currencies such as the U.S. dollar and the Euro.

[19] Cohen (2012), Lee (2014) and Frankel (2012, 2023) provide a breakdown of the private market and official roles of an international currency and these add up to six roles inclusive of an international currency as an anchor or reference currency that is targeted by managed or pegged exchange rate regimes. Golberg and Tille (2008) and Devereux and Shi (2013) describe that non-residents use an international currency as a vehicle currency and thus as an intermediate value (or medium of exchange between currencies) in transactions between two currencies. For e.g. transactions between South Africa and Thailand may typically be split between South African rand/U.S. dollar and U.S. dollar/Thai baht transactions. Boz et al. (2022) provide comprehensive and updated evidence for 155 countries on export and import invoice currency patterns that reveals the persistence in invoicing patterns and particularly with the U.S. dollar remaining dominant as an invoice currency in global trade and this includes transactions that do not involve the U.S.

In these studies government debt and private sector debt instruments may not be not considered as perfect substitutes because of the heterogeneity in the information quality concerning private sector debt instruments. Moreover, in this environment investors would not have concerns that an issuing government has additional private information about the value of its debt instrument relative to the information available to investors (Gorton, 2017; Gorton and Ordoñez, 2022). Within this context, Krishnamurthy and Vissing-Jorgensen (2012) describe that the value that investors assign to the liquidity and safety attributes offered by global safe assets, such as U.S. Treasuries, is referred to as the convenience yield and Du et al. (2018) proceed to compute the difference between the convenience yield of U.S. Treasuries relative to government bonds of other advanced economies as the deviation from covered interest parity between government bond yields and they denote this difference as the U.S. Treasury Premium.

Similarly, Jiang et al. (2021) construct a theory that associates the FX markets' U.S. dollar valuation to the convenience yield that global investors derive from holding U.S. safe assets. Consequently, they show that this convenience yield is linked to the spread between U.S. Treasuries and currency-hedged foreign government bond yields, an increase in this spread is associated with an upon impact appreciation and eventual depreciation of the U.S. dollar and thus their results reinforce the U.S. dollar as the global dominant currency and the U.S. as the global safe asset issuer. Other studies such as Habib et al. (2020) examine the fundamental determinants of safe assets and based on 40 advanced and emerging countries, whereas Barro et al. (2022) construct a model that concerns heterogeneity in risk aversion for the purposes of quantifying safe assets, estimating safe asset ratios and quantifying the average safe asset ratio across 34 OECD countries.

Our paper is also related to a third strand of literature that concerns the official holdings of international currencies and the currency composition of FX reserves. There are numerous studies that examine the currency composition of FX reserves, trends in the currency composition of FX reserves and factors that are considered to influence the currency composition of FX reserves such as a country's currency composition of trade invoicing, the composition of trade flows, exchange rate intervention considerations and arrangements, a country's currency composition of foreign debt and a wide array of other economic variables, see Heller and Knight (1978), Dooley et al. (1989), Eichengreen and Mathieson (2000), Hatase and Ohnuki (2009), Eichengreen et al. (2016, 2019), Ito and McCauley (2020), Aizenman et al. (2020), Arslanalp et al. (2022), Iancu et al. (2022) and Chinn et al. (2024) for an updated investigation concerning the empirical determinants of FX reserve holdings.

Other studies construct portfolios on the currency composition of FX reserves, incorporate (implicit or explicit) central bank risk preferences and in some instances incorporate central bank unique constraints, see for e.g. Makin (1971), Ben-Bassat (1980), Dellas and Yoo (1991), Papaioannou et al. (2006), Farhi and Maggiori (2018), Lu and Wang (2019) and Mateane (2023). As of 2024:Q1, the IMF's currency composition of official FX reserves (COFER) database reports the world's currency

composition of official (and allocated) FX reserves as follows: U.S. dollar (58.85%), Euro (19.69%), Japanese yen (5.69%), Pound sterling (4.89%), Canadian dollar (2.57%), Australian dollar (2.16%), RMB (2.15%), Swiss franc (0.19%) and the share of other currencies (3.81%).[20]

4.2 Prospects of a BRICS Reserve Currency

Concerning the prospects of a BRICS reserve currency, the answer to this question is that there are major constraints towards any progression for formulating a path concerning a BRICS reserve currency. For our purposes, we comprehensively unpack these major constraints. First, although the BRICS are part of a common strategic and economic group, the financial markets of these countries are not as deep and liquid as the financial markets of other major reserve currency countries. Deep and liquid financial markets, especially bond markets, are key characteristics for the internationalization of a currency and for major reserve currency status.

Second, the credibility of major reserve currency issuers generates and maintains the dominance of their currency (Eichengreen et al., 2016; Iancu et al., 2022).[21] Indeed, Chiţu et al. (2014) describe that the financial development of the U.S. was an important factor that resulted in the U.S. dollar emerging as an international currency and specifically as the dominant currency in global bond markets and superseding the Pound sterling as early as in 1929, see also Benzie (1992) for the history of international bond markets. Relatedly, Maggiori et al. (2019) note that the extent to which a currency is traded and its share in global FX trading volume is a reflection of its liquidity. Additionally, Krohn and Sushko (2022) provide a detailed examination concerning the joint evolution of FX spot and swap market liquidity conditions and with particular emphasis on the two most liquid currency crosses, Japanese yen/U.S. dollar and Euro/U.S. dollar.

Currently, individually and jointly, the BRICS do not have deep and liquid financial markets and that are easily accessible for global market participants. Das (2019) reinforces this outcome by describing the lack of depth and liquidity of the onshore RMB FX market, especially relative to traditional safe haven currency countries with de jure floating currencies. Additionally, the financial markets of the BRICS countries are fragmented. This is evident in the different yields associated with each country's (3-Month) treasury securities and (10-Year) government bonds, see Figure 1.[22]

The secondary bond market typically captures supply and demand bond dynamics that influence

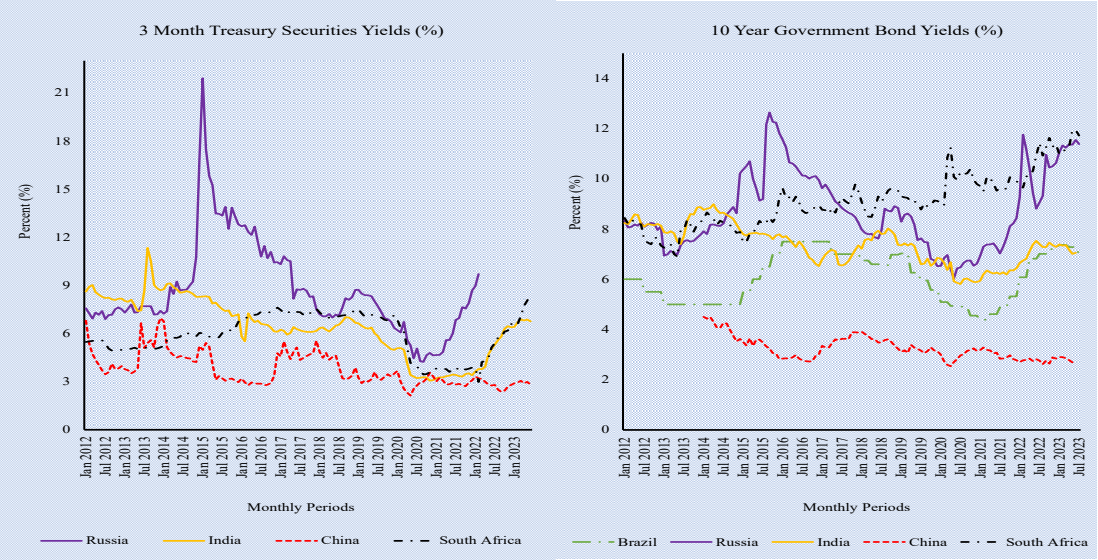
[20] See, https://data.imf.org/?sk=e6a5f467-c14b-4aa8-9f6d-5a09ec4e62a4

[21] Eichengreen et al. (2016) and Iancu et al. (2022) describe the concept of the credibility of reserve issuers and note that a reserve asset should offer a stable store of value over time, be widely used and traded. These factors emphasize the importance of monetary and fiscal policy credibility of a reserve issuer and the depth and liquidity of financial markets. For data purposes, they use the average appreciation of the reserve issuer's currency against the SDR in the previous five years as a credibility measure. Lee (2014) describes that a crucial determinant of international currency status is the stability in its value and uses a country's inflation rate as a confidence measure of its currency.

[22] No data is available for Brazilian 3-Month treasury securities from the Federal Reserve Bank of St. Louis, the IMF's IFS and from the OECD statistics.

bond prices and thus generate changes in bond yields. Furthermore, investors' perception and expectations about (specific) bonds (in the primary and secondary market), the risk profile associated with bonds (for e.g. sovereign debt ratings), the liquidity associated with bonds and general economic and financial activity associated with each economy that issues bonds, influences bond prices and bond yields. Indeed, and concerning the BRICS, Jonasson et al. (2024) document the sovereign credit ratings of each country (except for Russia) and specifically the median of three rating agencies (Fitch, Moody's and S&P) as of end of 2023 and as follows: Brazil (BB), India (BBB-), China (A+) and South Africa (BB-). Therefore, this manifests different credit worthiness and can generate different investors perception about each BRICS sovereign risk profile.

Figure 1: Yields on 3-Month Treasury Securities and 10-Year Government Bonds of BRICS 2012M01-2023M07



Source: OECD statistics, Federal Reserve Bank of St. Louis Economic Data and the IMF's IFS.
Notes: For India and Russia we use interbank rates as a proxy for yields on treasury securities.

As outlined by the BIS (2023), investor perceptions about future monetary policy rate paths, financial conditions, expectations about future economic activity and the reporting by major ratings agencies, are influencing current global bond market dynamics and this is generating volatility of bond yields. Furthermore, Cuaresma and Fernández (2024) and Barbieri et al. (2024) describe the relationship between government bond yields and investors perception about the sovereign risk of a country and they note that bond yields reflect country-specific characteristics.

The treasury securities and government bond yields characterized in Figure 1 cover the January 2012 to July 2023 period because 2012 is the year in which the establishment of the NDB was considered. Yields on Chinese treasury securities and on government bonds are lower than the yields of the other BRICS countries and these yields are less volatile. This shows that Chinese bonds have remained more stable relative to the other BRICS countries and investor expectations and perceptions about the Chinese economy and financial market conditions have remained predominantly positive over the January 2012 to July 2023 period.

India and Brazil exhibit similar (10-Year) government bond yield trajectories especially over January 2017 – July 2023 with an average yield of about 7 %. In contrast, South African and Russian government bond yields exhibit similar trajectories especially over July 2017 – July 2023 with an average yield of about 10.5 %. These features highlight the financial market fragmentation of BRICS countries from as far back as 2012 and the lack of convergence in bond yields. This has been in an environment in which there have been earlier desires for new entrants of multilateral organizations and a desire for a reform of the international monetary system.

Notwithstanding that a common currency area with financial market fragmentation is feasible. The European Monetary Union is a classical case for which investors have different ratings and expectations about bonds of the same currency issuance, for e.g. German bond yields relative to higher Greek bond yields. Within this context, Zaghini (2016) describes that differences in bond yields are not a sufficient measure of financial fragmentation across countries because bond yields and differentials are driven by bond features such as the creditworthiness of the issuer, bond duration and liquidity.

Thus, an additional examination concerning country-specific characteristics is required to reach a determination concerning financial market fragmentation across countries over and above potential determinants of bond risk premia, see also Horváth (2016). Furthermore, Ehrmann and Fratzscher (2017) describe that the feature of Euro area government bonds fragmentation was intensified during the European Sovereign Debt Crisis (ESDC). Barbieri et al. (2024) find that there is no synchronization in Eurozone short-term government bond yields and find a significant decrease in Eurozone medium and long-term government bond yields synchronization over the GFC and ESDC. Additionally, Maggiori et al. (2019) explain that the turmoil during the ESDC was one of the factors that generated a pervasive rise of the U.S. dollar and fall of the Euro as an international currency and Maggiori et al. (2020) document an increase in the U.S. dollar share and reduction in the Euro share of corporate, national and sovereign bond positions following the GFC and the ESDC.

Third, the creation of a BRICS reserve currency would probably need to be backed and be redeemable in terms of a commodity, specifically a precious metal such as gold and/or platinum (group metals). The divine coincidence is that the BRICS group is a world leader in terms of gold mining operations and supply, see the World Gold Council report on gold mining production by country for 2022.[23] Additionally, the BRICS group is a world leader in platinum deposits, and these are crucial industrial metals especially for catalytic convertors that reduce greenhouse gas emissions, see the World Platinum Investment Council and the Minerals Council of South Africa: Pocket Book Facts and Figures - 2022.[24]

Fourth, on 24 August 2023 at the 15th annual BRICS summit in Johannesburg (South Africa), the BRICS announced that they have invited Argentina, Egypt, Ethiopia, Iran, Saudi Arabia and the

[23] https://www.gold.org/goldhub/data/gold-production-by-country

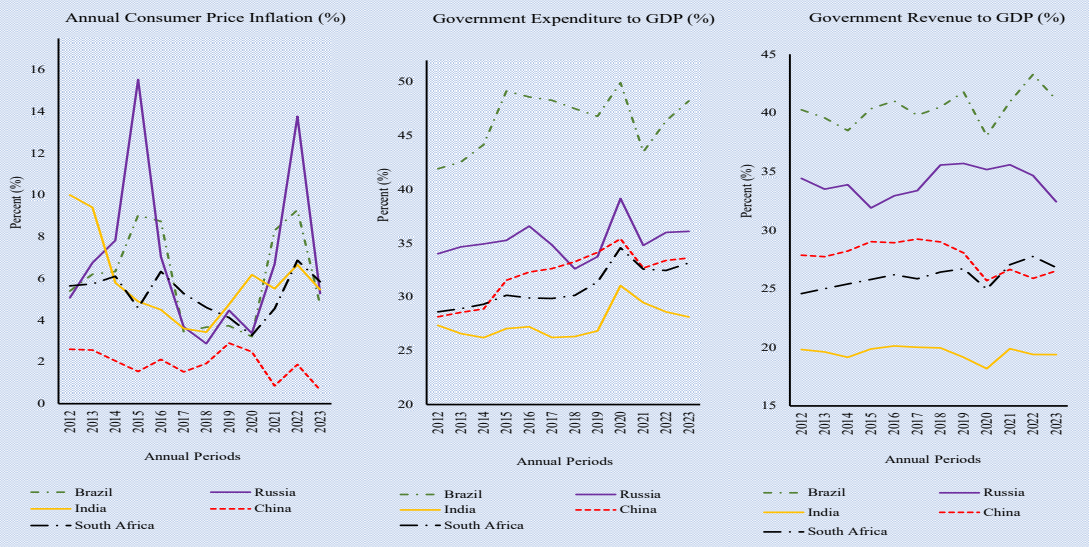
[24] https://platinuminvestment.com/about/platinum-facts and https://www.mineralscouncil.org.za/

United Arab Emirates (UAE) to join their group and these countries can join from 01 January 2024.[25] With these countries joining, and in particular Iran, Saudi Arabia and the UAE, this allows another avenue of the extended BRICS group currency being backed and redeemable in gold, platinum, oil and (natural) gas because Iran and Saudi Arabia are in the top 5 countries in the world with the most oil and gas reserves and highest oil production in 2022 and the UAE is in the top 10.

Additionally, Russia, Iran, Saudi Arabia and the UAE are jointly the world's largest energy suppliers and with the world's largest oil and gas reserves, see also the U.S. Energy Information Administration OPEC Revenues Fact Sheet June 2023 and Holzner (2024) for a discussion concerning the possibility of the extended BRICS group as a potential raw-materials superpower.[26]

These features open up the possibility of a substantial shift in international markets in the invoicing and settlement of oil and gas trade from U.S. dollar into other currencies and possibly in any of the BRICS countries individual currencies and potentially with the RMB taking the lead. However, the characteristic of financial market fragmentation will remain and be a major constraint towards formulating a path concerning a BRICS reserve currency that may account for the expanded BRICS group. Fifth, reinforcing the financial market fragmentation of the BRICS countries are the different macroeconomic fundamentals of each country and lack of convergence in the macroeconomic fundamentals dating as far back as 2012 when the establishment of the NDB was considered.

Figure 2: Inflation, Government Expenditure to GDP and Government Revenue to GDP ratios of BRICS 2012-2023



Source: IMF's World Economic Outlook and the IMF's Fiscal Monitor.
Notes: For the BRICS, 2023 values are IMF estimates, including 2022 values for India.

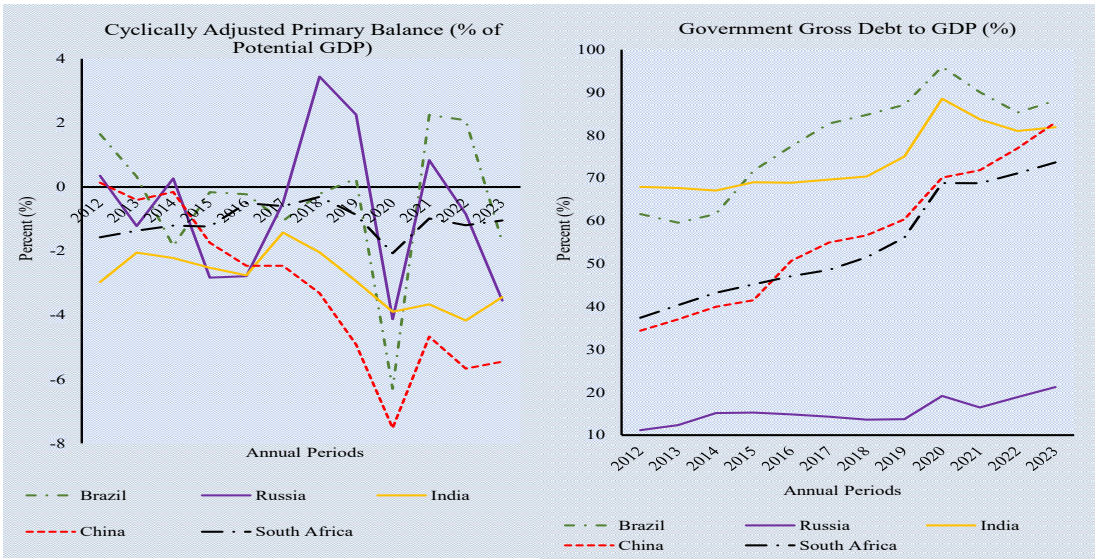
For e.g. the BRICS economies (except for China) are explicit inflation targeting regimes but with

[25] However, following the appointment of Javier Milei as president of Argentina in December 2023, Argentina has decided against joining the extended BRICS group.

[26] https://www.fiw.ac.at/en/2024/02/15/brics-plus-a-new-world-order-and-the-end-of-the-us-dollar-as-the-global-reserve-currency/

different inflation rates and different inflation targets or different inflation target bands. Therefore, market participants have different inflation expectations about these economies and attach different credibility to the monetary policy conduct of each BRICS country.[27] Each economy has different fiscal policy conduct and outcomes, and this is evident in the different government expenditure to GDP ratios and different government revenue to GDP ratios as shown in Figure 2.[28]

Figure 3: Cyclically Adjusted Primary Balance and Government Debt to GDP ratios of BRICS 2012-2023



Source: IMF's Fiscal Monitor and IMF's World Economic Outlook.
Notes: For the BRICS, 2023 values are IMF estimates, including 2022 values for India.

Each BRICS economy has different primary fiscal or budget balances to GDP ratios and different general government gross debt to GDP ratios. For our purposes we use the IMFs Fiscal Monitor's cyclically adjusted primary balance as a percentage of potential GDP. This balance measure excludes net interest payments on public debt (interest expenditure less interest revenue). As described by the IMF's Fiscal Monitor and the Organisation for Economic Co-operation and Development (OECD), the primary fiscal balance – difference between government revenue and government expenditure excluding net interest payments on public debt - is a crucial indicator of the sustainability of a government's finances and this indicator can influence and increase general gross government debt. This follows from the fact that a country with a primary deficit is spending more on public goods and services relative to its revenues collected. Therefore, a country with a primary deficit will borrow to pay for the provision of everyday public goods and services and this compromises the sustainability of a government's finances. Figure 3 characterizes such features because all the BRICS countries are

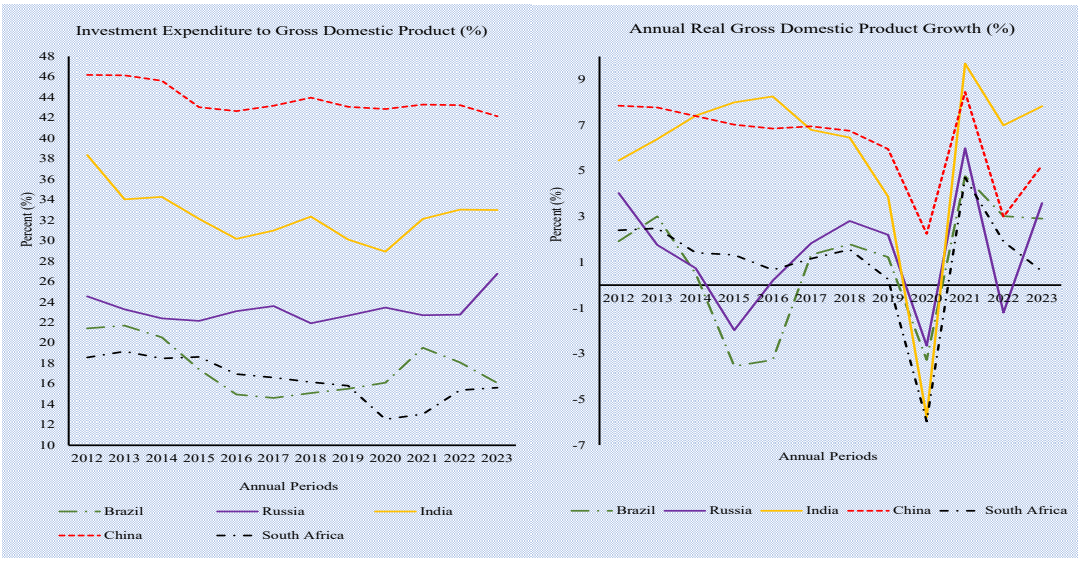
[27]In our paper, inflation refers to annual (year-on-year changes) inflation based on average consumer prices. Interestingly, the IMF's World Economic Outlook (WEO) annual inflation estimates for 2023 show some degree of convergence for Brazil, Russia, India and South Africa's inflation all converging around the 5 % to 6 % range.

[28]For our purposes we use general government total expenditure and general government revenue as a percent of GDP based on the IMF's WEO, where government revenue reflects policy outcomes, see Vegh and Vuletin (2015). We also examine general government gross debt as a percent of GDP based on the IMF's WEO.

running primary fiscal deficits over the majority of the 2012 - 2023 period.

Consequently, this is reflected in their rapidly increasing general government gross debt to GDP ratios. These factors compromise the sustainability of each BRICS government's finances, they generate negative investor perception about the sovereign risk and fiscal capacity of a country and this compromises the potential safe asset appeal associated with government debt instruments issued by each BRICS country.[29] Additionally, each BRICS economy exhibits different total investment to GDP ratios which indicates different (public and private sector) preferences towards the expansion of the productive capacity of an economy and thus different preferences towards investing in the future. Therefore, in Figure 4 each economy has a different trajectory of annual real GDP growth over the 2012- 2023 period.[30]

Figure 4: Total Investment Expenditure to GDP ratios and Annual Real GDP Growth of BRICS 2012-2023



Source: IMF's World Economic Outlook.
Notes: For the BRICS, 2023 values are IMF estimates, including 2022 values for Russia and South Africa.

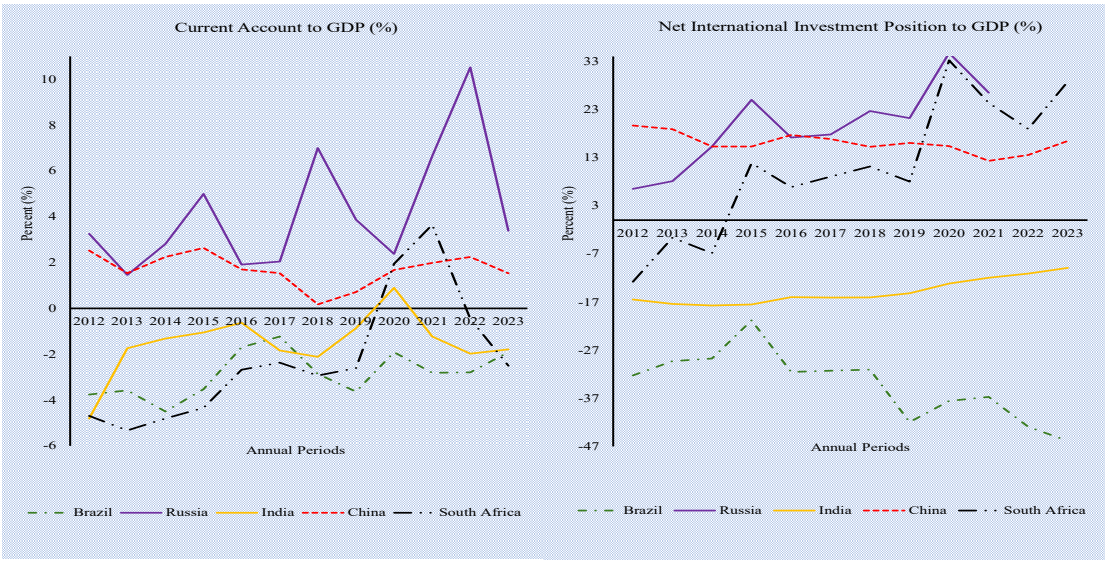
Concerning fundamental determinants of safe haven government bonds, Habib et al. (2020) use indicators of external sustainability in the form of the current account relative to GDP and the stock of net foreign assets to GDP. They argue that investor preferences may be biased towards sovereign bonds of countries that have a balanced or positive position with the RoW (non-residents) during periods of global economic turmoil and financial instability, see also Ito and McCauley (2019) for a perspective concerning currency zones, current accounts, international investment positions and how

[29]For the BRICS, these features are also evident in the rising public sector external debt that generates rising total external debt and where public sector external debt accounts for a large share of total external debt, except for China and India. For brevity, we do not report these trajectories and differences in public sector and total external debt to GDP ratios. However, these trajectories and results are available upon request.

[30]Additionally, this feature is evident for the trajectory of quarterly values of real and seasonally adjusted gross fixed capital formation relative to GDP for Russia, India and South Africa and these results are available upon request. A full quarterly data of gross fixed capital formation is not available for Brazil and China over 2012-2023.

these may influence investor preferences. The approach in Habib et al. (2020) is informed by Habib and Stracca (2012) who study the safe haven status of international currencies and find that external sustainability is a robust and consistent inducer of safe haven currency status.

Figure 5: Current Account and Net International Investment Position to GDP ratios of BRICS 2012-2023



Source: IMF's BOP, IIP Statistics and WOE.
Notes: For Russia, Net International Investment Position (IIP) values are up to 2021

In line with these studies, for our purposes, we document the current account to GDP and the net international investment position (IIP) to GDP for the BRICS countries because this reinforces the differences in the fundamentals of these economies. Therefore, in Figure 5 we document the external sustainability of the BRICS countries over the 2012-2023 period and thus show that China and Russia are consistently running a current account surplus and are also net creditors to the RoW. Whereas India and Brazil are running current account deficits and are large net debtors to the RoW, especially Brazil. On the other hand, South Africa is consistently running a current account deficit yet it is a net creditor to the RoW. As a result, this shows the differing extents of claims on these countries from the RoW and thus different degrees of external sustainability and different fundamentals.[31]

These documented features show the challenges associated with the feasibility of a common BRICS

[31] As described in the IMF Balance of Payments of Statistics, the net IIP shows the difference in the value of financial assets of residents of an economy (that are claims on non-residents) or are gold bullion held as reserve assets relative to the liabilities of residents of an economy to non-residents. Thus, it is the net (financial) claims for creditor nations or net liabilities for debtor nations to the RoW. Moreover, each economy exhibits different trajectories of the extent of openness measured as real and seasonally adjusted exports plus imports relative to GDP and using quarterly values over 2012:Q1 - 2023:Q2. The different trajectories of the extent of openness show that the BRICS countries exhibit different degrees of participation in international trade and this implies different likelihoods of individual currencies being extensively used in international transactions and being extensively traded in principal exchange markets. Additionally, this implies different likelihoods of excess balances associated with trade being invested in foreign currency deposit accounts and in foreign currency securities denominated in the individual currencies of the BRICS countries.

reserve currency because of the lack of convergence and harmonized macroeconomic fundamentals that can support the value of this currency and sustain it long term. The lack of convergence and harmonized macroeconomic fundamentals that can support the value of a BRICS reserve currency, are factors that matter for global investors and for reserve currency status. Therefore, this reinforces major constraints towards any progression for formulating a path concerning a BRICS reserve currency. However, what is evident is that China has superior macroeconomic fundamentals relative to BRIS and this shows that over time, the RMB may be better suited as an alternative reserve currency.

Lastly, and concerning the sixth caveat, the creation and existence of a BRICS reserve currency as a common currency and assuming the surrender of the individual sovereign currencies of each BRICS country, implies a common central bank as the authority responsible for issuance and maintenance of the stability of the BRICS reserve currency. Consequently, this means centralization of monetary policy conduct as in the Euro area and each economy in the BRICS group (or in the expanded group) surrendering the independence of their monetary policy conduct.

This may be difficult to achieve because a necessary condition is willingness and commitment from each country and assuming that parliamentary and government structures of each country approve. Assuming that centralization of monetary policy is achieved, a crucial requirement by international market participants would be the need for convergence and harmonized macroeconomic fundamentals of the BRICS group because this will support the value of the BRICS reserve currency, sustain it long term and encourage its use as an international currency.

4.3 Prospects of RMB Internationalization

RMB internationalization is a realization because the core foundations for supporting and maintaining reserve currency status are in place. This is evident in several factors. First, in 2016 the RMB was added to the basket of the IMF's SDR and this has entrenched the RMB as an international currency among the established small group of international currencies (Feng et al., 2023). As of 2022, the IMF's SDR value is based on a basket of five currencies and the associated weights are as follows: U.S. dollar (43.38%), Euro (29.31%), RMB (12.28%), Japanese yen (7.59%) and Pound sterling (7.44%).[32]

Additionally, the successful internationalization of the RMB has not meant the demise of the U.S. dollar or the demise of any other international currency. Indeed, and from a historical perspective, Eichengreen (2011) emphasizes this point by describing that the U.S. dollar's internationalization between 1914-1924 did not need the elimination of the Pound sterling, see also Lee (2014).

[32]The IMF's SDR is an international reserve asset created by the IMF in 1969 to supplement the official reserves of its member countries. Moreover, the IMF outlines that for a currency to be included in the SDR basket it must (i) meet the export criterion meaning that the associated IMF member is one of the top five world exporters and (ii) meet the freely usable criterion meaning that the currency is extensively used in payments for international transactions and extensively traded in principal exchange markets.

Second, China is the world's second largest economy and has been in this position for over a decade. Third, China is the world's largest exporter and the second largest importer after the U.S. As of 2023, Nye (2023) documents that China is now the largest trade partner to more countries in the world relative to the U.S. Consequently, if the rest of the world is trading with China, this increases the likelihood of exports and imports invoiced in RMB and international trade being conducted in RMB. Fourth, Baldwin (2024) documents China's global expansion by showing that China is the world's sole manufacturing superpower with a wide and deep industrial base and identifies that China's manufacturing exceeds that of the nine next largest manufacturers combined. Furthermore, this author shows the trajectory of China's manufacturing growth and gross globalization ratio.[33]

Along these lines, Prasad (2019) describes that with a reduction in the costs and complications associated with conducting international trade with the RMB, this will increase the RMB's weight as an international payment and settlement currency and increase its weight as an invoice currency particularly in international commodity contracts such as oil and gas and possibly precious metals. These factors increase the likelihood of an improving RMB global status based on positive network externalities typically associated with major reserve currency status, see also Chinn and Frankel (2008) and the European Central Bank (ECB) (2023). Indeed, Eichengreen (2011) describes how an increase in international trade between international companies and China generated an increase in balances, payments and deposit accounts denominated in RMB. Additionally, this resulted in the eventual development of a RMB interbank market in Hong Kong and the Bank of China participating in U.S. dollar-RMB foreign exchange transactions.

Fifth, there are numerous active steps taken by China to improve the internationalization of the RMB, particularly with improving the capability of RMB FX trading and allowing more foreign investors to open RMB bank accounts and to invest in RMB denominated sovereign bonds. For e.g. Fatum et al. (2017) documents that in 2016, China issued in London its first RMB denominated sovereign bond outside of China and these authors describe that investors (individuals, companies, financial institutions) were allowed to open RMB bank accounts in offshore RMB clearing facilities, transfer these funds without any limitations, however, cross-border flows to and from Mainland China remained subject to Mainland China regulations. Additionally, McCauley and Shu (2019) provide a stepwise description concerning the rapid growth of the onshore and offshore market trading of the RMB and this is reinforced by the RMB being the most actively traded non G-7 currency, an increase in the RMB trading global share and the expansion in the offshore RMB market which facilitates RMB spot and derivatives transactions.

Sixth, Eichengreen (2024) provides more perspective concerning recent events that are additional active steps by China to improve the internationalization of the RMB. For e.g. the establishment of more overseas RMB clearing banks, currency swaps with more countries and shifting payments of

[33]Baldwn (2024) defines the gross globalization ratio as the share of manufactured production that is sold abroad and this production is measured as the total sales of all China based manufacturers.

Chinese oil and natural gas imports from U.S. dollar to RMB and this follows a 2022 Chinese-Gulf Cooperation Council summit.

Seventh, as of 2023, China has the second largest share of world military expenditure and it is exponentially modernizing its military, see the Stockholm International Peace Research Institute (SIPRI) report on Trends in World Military Expenditure for 2023.[34] Concerning future military capabilities, Diamond and Ellis (2023) describe that China's military will be increasingly more powerful, modernized, more professional and with more tech-savvy officers along with more precise nuclear and hypersonic weapons. As for military considerations and prowess, these factors underpin the backing and safety associated with the RMB as a reserve currency. Reinforcing this is Eichengreen et al. (2019) who find that military alliances influence and increase the share of a currency in its partner's FX holdings. Furthermore, these authors explain that if a country is powerful inclusive of its military prowess, this may influence the rest of the world to put their interests first and to conduct a large share of their international transactions in the currency of the powerful country.

Indeed, Weiss (2022) identifies that about 75 % of foreign government holdings of U.S. safe assets are by countries with some form of military alliance with the U.S. Within this context, Eichengreen et al. (2021) document that geopolitical alliances make international trade ties stronger, and this reinforces the military prowess and geopolitical leverage that may influence the rest of the world to conduct international trade in the currency of a powerful country. This may also influence the rest of the world to hold more deposits and assets denominated in the currency of a powerful country. Eichengreen et al. (2021) also identify that historically global trade arrangements since World War II have predominantly been between countries with military alliances, for e.g. the North Atlantic Treaty.

Therefore, concerning the RMB, the recent rapid rise in China's economic and military power, the increase in international trade and financial linkages between EMs and China and with the RoW, the rapid increase in the economic size of EMs and China relative to other AEs, the potential diversification benefits of holding and using alternative currencies and financial instruments denominated in different currencies and China's financial markets opening to global investors, these factors may influence the rest of the world to increase their international trade in RMB and influence the rest of the world to hold more currency, deposits and assets denominated in RMB.

5 Conclusion

We comprehensively examine three interrelated research questions. (i) The prospects of a common BRICS reserve currency, (ii) RMB internationalization and (iii) Progression of the RMB towards global safe asset status. We find that financial market fragmentation of the BRICS reinforced by the different macroeconomic fundamentals of each country, lack of convergence in these fundamentals,

[34] However, and as documented by Baldwin (2024), the U.S. remains the world's sole military superpower with military expenditure that exceeds the combined military expenditure of the ten highest countries after the U.S.

lack of depth and liquidity in the financial markets of the BRICS, especially relative to the financial markets of major reserve currency countries, are major constraints towards a BRICS reserve currency. This lack of convergence and harmonized macroeconomic fundamentals that can support the value of a BRICS reserve currency, are factors that matter for global investors and for reserve currency status and thus reinforce major constraints towards any progression for formulating a path concerning a BRICS reserve currency.

Second, Chinese RMB internationalization is a realization because it is part of the basket of the IMF's Special Drawing Rights and China has more trading partners in the world than the U.S. Additionally, RMB internationalization, superior Chinese macroeconomic fundamentals relative to BRIS, and active steps taken by China, show that over time the RMB may be better suited as an alternative reserve currency for BRIS. Inasmuch as China has taken active steps to internationalize the RMB, China needs to issue more RMB denominated bonds onshore and offshore and thus exhibit willingness to export safe assets while running a trade surplus, China has to improve the depth and liquidity of its bond markets and RMB denominated debt instruments should preserve their value during adverse systemic events because this will allow them to qualify and maintain the status of RMB denominated debt instruments as global safe assets. These features, along with an open capital account, generate flexible financial markets that are attractive to domestic and international investors because of the ability to move capital freely.

For future research we will examine the current trajectory and prospects of BRICS countries invoicing international trade and conducting cross-border transactions in their local currencies and possibly with the RMB becoming dominant because the infrastructure is already in place with the Chinese CIPS system that offers clearing and settlement services. With more international participants on this platform, this will make RMB transactions faster and more cost-effective.

The development of Project mBridge, a shared payment infrastructure of participating central banks (which includes the PBoC) and thus the usage of wholesale central bank digital currencies with an objective of achieving instant cross-border payments, can facilitate and speed up the process of international trade and generate new payment channels (BIS Innovation Hub, 2023). This financial innovation may encourage more international trade conducted in the RMB and may be reinforced by the strengthening trade and financial linkages between EMs and China and China with the RoW. Such features may stabilize and complement the current global trading structure and financial architecture.

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Appendix: Model Derivations for Optimal Safe Asset Price

We assume that a representative household is a risk averse global investor that derives utility from consumption and holding global safe assets as follows:

$$\max_{C_t,\ B_t^*} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \log \left[C_t + \upsilon \left(\Theta_t,\ GDP_t,\ \xi_t \right) \right], \tag{A1}$$

subject to their budget constraint,

$$P_t C_t + P_t^D D_t + S_t P_t^{B^*} B_t^* \leq D_{t-1} + S_t B_{t-1}^* + T_t, \tag{A2}$$

where the real safe asset is $\Theta_t = \frac{S_t P_t^{B^*} B_t^*}{P_t}$ and $\theta_t = \frac{\Theta_t}{GDP_t}$ is the real safe asset relative to the real income of the representative household. The utility of holding safe assets is homogeneous of degree one in the real income of the representative agent, GDP_t, as follows:

$$\upsilon \left(\Theta_t,\ GDP_t,\ \xi_t \right) = GDP_t \cdot \upsilon \left(\theta_t; \xi_t \right), \tag{A3}$$

and we assume an increasing benefit (positive marginal benefit) of holding an additional real safe asset (relative to real income), however, at a decreasing marginal rate expressed respectively as follows:

$$\frac{\partial \upsilon \left(\frac{\Theta_t}{GDP_t}; \xi_t \right)}{\partial \left(\frac{\Theta_t}{GDP_t} \right)} > 0 \text{ and } \frac{\partial}{\partial \left(\frac{\Theta_t}{GDP_t} \right)} \left(\frac{\partial \upsilon \left(\frac{\Theta_t}{GDP_t}; \xi_t \right)}{\partial \left(\frac{\Theta_t}{GDP_t} \right)} \right) = \frac{\partial^2 \upsilon \left(\frac{\Theta_t}{GDP_t}; \xi_t \right)}{\partial \left(\frac{\Theta_t}{GDP_t} \right)^2} < 0. \tag{A4}$$

This property also holds for the marginal benefit of holding an additional unit of the one-period foreign bond B_t^*, see derivation that follows and that generates eqn. (A16). The Lagrangian for the constrained optimization problem is as follows:

$$\mathcal{L} = \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[\begin{array}{c} \log \left[C_t + \upsilon \left(\Theta_t,\ GDP_t,\ \xi_t \right) \right] \\ +\lambda_t \left(\ D_{t-1} + S_t B_{t-1}^* + T_t - P_t C_t - P_t^D D_t - S_t P_t^{B^*} B_t^* \ \right) \end{array} \right]$$

The first order conditions (FOCs) with respect to consumption C_t and one-period foreign bond B_t^* are expressed as follows,

$$\lambda_t = \frac{1}{P_t[C_t + \upsilon\left(\Theta_t,\ GDP_t,\ \xi_t\right)]}, \tag{A5}$$

and

$$\frac{1}{[C_t + \upsilon\left(\Theta_t,\ GDP_t,\ \xi_t\right)]} \frac{\partial \upsilon\left(\Theta_t,\ GDP_t,\ \xi_t\right)}{\partial B_t^*} - \lambda_t S_t P_t^{B^*} + \beta \lambda_{t+1} S_{t+1} = 0. \tag{A6}$$

The real safe asset is $\Theta_t = \frac{S_t P_t^{B^*} B_t^*}{P_t}$ and $\theta_t = \frac{\Theta_t}{GDP_t}$ is the real safe asset relative to the real income of the representative household. The utility from holding safe assets is homogeneous of degree one in the real income of the representative agent and in the real safe asset holding expressed as follows:

$$\upsilon\left(\Theta_t,\ GDP_t,\ \xi_t\right) = GDP_t \cdot \upsilon\left(\theta_t; \xi_t\right) = GDP_t \cdot \upsilon\left(\frac{\Theta_t}{GDP_t}; \xi_t\right) = GDP_t \cdot \upsilon\left(\frac{S_t P_t^{B^*} B_t^*}{P_t \cdot GDP_t}; \xi_t\right) \tag{A7}$$

It then follows that

$$\frac{\partial \upsilon\left(\Theta_t,\ GDP_t,\ \xi_t\right)}{\partial B_t^*} = GDP_t \cdot \frac{\partial \upsilon\left(\theta_t; \xi_t\right)}{\partial B_t^*} = GDP_t \cdot \frac{\partial \upsilon\left(\frac{\Theta_t}{GDP_t}; \xi_t\right)}{\partial B_t^*}, \tag{A8}$$

with emphasis on $\upsilon\left(\theta_t; \xi_t\right)$, and substituting with respect to $\Theta_t = \frac{S_t P_t^{B^*} B_t^*}{P_t}$ and $\theta_t = \frac{\Theta_t}{GDP_t}$, and using the chain rule, we have the following:

$$\frac{\partial \upsilon\left(\theta_t; \xi_t\right)}{\partial B_t^*} = \frac{\partial \upsilon\left(\frac{\Theta_t}{GDP_t}; \xi_t\right)}{\partial\left(\frac{\Theta_t}{GDP_t}\right)} \cdot \frac{\partial\left(\frac{\Theta_t}{GDP_t}\right)}{\partial B_t^*} + \frac{\partial \upsilon\left(\frac{\Theta_t}{GDP_t}; \xi_t\right)}{\partial\left(\xi_t\right)} \cdot \frac{\partial\left(\xi_t\right)}{\partial B_t^*}, \tag{A9}$$

using the property that

$$\frac{\partial\left(\xi_t\right)}{\partial B_t^*} = 0, \tag{A10}$$

which shows that demand shift factors over period t are independent of the purchase of an additional unit of the one-period bond over period t. However, demand shift motives over period t that are influenced by the factors we describe and pin down in the text, can generate a portfolio rebalance in the next period, i.e. over period $t+1$. Thus, this allows us to simplify eqn. (A9) expressed as follows:

$$\frac{\partial \upsilon\left(\theta_t; \xi_t\right)}{\partial B_t^*} = \frac{\partial \upsilon\left(\frac{\Theta_t}{GDP_t}; \xi_t\right)}{\partial\left(\frac{\Theta_t}{GDP_t}\right)} \cdot \frac{\partial\left(\frac{\Theta_t}{GDP_t}\right)}{\partial B_t^*} \tag{A11}$$

Simplifying further we have:

$$\frac{\partial \upsilon\left(\frac{\Theta_t}{GDP_t}; \xi_t\right)}{\partial\left(\frac{\Theta_t}{GDP_t}\right)} \cdot \frac{\partial\left(\frac{\Theta_t}{GDP_t}\right)}{\partial B_t^*} = \frac{\partial \upsilon\left(\frac{\Theta_t}{GDP_t}; \xi_t\right)}{\partial\left(\frac{\Theta_t}{GDP_t}\right)} \cdot \frac{\partial\left(\frac{S_t P_t^{B^*} B_t^*}{P_t \cdot GDP_t}\right)}{\partial B_t^*} \tag{A12}$$

Also expressed as follows:

$$\frac{\partial \upsilon\left(\frac{\Theta_t}{GDP_t}; \xi_t\right)}{\partial\left(\frac{\Theta_t}{GDP_t}\right)} \cdot \frac{\partial\left(\frac{S_t P_t^{B^*} B_t^*}{P_t \cdot GDP_t}\right)}{\partial B_t^*} = \frac{\partial \upsilon\left(\frac{\Theta_t}{GDP_t}; \xi_t\right)}{\partial\left(\frac{\Theta_t}{GDP_t}\right)} \cdot \frac{S_t P_t^{B^*}}{P_t \cdot GDP_t} \tag{A13}$$

Substitute eqn. (A13) into (A8) delivers the following

$$\frac{\partial \upsilon\left(\Theta_t,\ GDP_t,\ \xi_t\right)}{\partial B_t^*} = GDP_t \cdot \frac{\partial \upsilon\left(\frac{\Theta_t}{GDP_t};\xi_t\right)}{\partial\left(\frac{\Theta_t}{GDP_t}\right)} \cdot \frac{S_t P_t^{B^*}}{P_t \cdot GDP_t} \tag{A14}$$

Also expressed as:

$$\frac{\partial \upsilon\left(\Theta_t,\ GDP_t,\ \xi_t\right)}{\partial B_t^*} = \frac{S_t P_t^{B^*}}{P_t} \cdot \frac{\partial \upsilon\left(\frac{\Theta_t}{GDP_t};\xi_t\right)}{\partial\left(\frac{\Theta_t}{GDP_t}\right)} \tag{A15}$$

Therefore, the marginal benefit of an additional unit of safe asset B_t^* is expressed as follows:

$$\frac{\partial \upsilon\left(\theta_t;\xi_t\right)}{\partial B_t^*} = \frac{\partial \upsilon\left(\frac{\Theta_t}{GDP_t};\xi_t\right)}{\partial\left(\frac{\Theta_t}{GDP_t}\right)} \cdot \frac{S_t P_t^{B^*}}{P_t \cdot GDP_t} > 0 \tag{A16}$$

Eqn. (A16) shows an increasing benefit of holding additional safe assets and thus positive marginal benefit of an additional unit of a safe asset. This is consistent with the assumption in eqn. (A4), an increasing benefit (positive marginal benefit) of holding an additional real safe asset (relative to real income), however, at a decreasing marginal rate. Thus, collecting terms and substituting eqn. (A15) and (A5) into (A6) and incorporating expectations we have the following:

$$\begin{aligned}&\frac{1}{\left[C_t + \upsilon\left(\Theta_t,\ GDP_t,\ \xi_t\right)\right]} \frac{S_t P_t^{B^*}}{P_t} \cdot \frac{\partial \upsilon\left(\frac{\Theta_t}{GDP_t};\xi_t\right)}{\partial\left(\frac{\Theta_t}{GDP_t}\right)} - \frac{S_t P_t^{B^*}}{P_t[C_t + \upsilon\left(\Theta_t,\ GDP_t,\ \xi_t\right)]} \\ &+ \beta \mathbb{E}_t\left[\frac{S_{t+1}}{P_{t+1}[C_{t+1} + \upsilon\left(\Theta_{t+1},\ GDP_{t+1},\ \xi_{t+1}\right)]}\right] = 0\end{aligned} \tag{A17}$$

Taking out common terms $\frac{S_t P_t^{B^*}}{P_t}$ and with some re-arranging we have the following:

$$\begin{aligned}&\frac{S_t P_t^{B^*}}{P_t} \cdot \left[\frac{1}{\left[C_t + \upsilon\left(\Theta_t,\ GDP_t,\ \xi_t\right)\right]}\right] \cdot \left[\frac{\partial \upsilon\left(\frac{\Theta_t}{GDP_t};\xi_t\right)}{\partial\left(\frac{\Theta_t}{GDP_t}\right)} - 1\right] \\ &= -\beta \mathbb{E}_t\left[\frac{S_{t+1}}{P_{t+1}[C_{t+1} + \upsilon\left(\Theta_{t+1},\ GDP_{t+1},\ \xi_{t+1}\right)]}\right]\end{aligned} \tag{A18}$$

Re-arranging further allows us to determine the optimal price of the safe asset which is positively related to the exchange rate depreciation of the global investor's local currency unit relative to the foreign currency unit (i.e. Chinese RMB), inversely related to aggregate inflation, positively related to the ratios of the marginal utilities of consumption, positively related to the demand shift motives of global investors for the safe asset and therefore positively related to the marginal benefit from holding an additional unit of the safe asset, as follows:

$$P_t^{B^*} = \left[\frac{1}{1 - \frac{\partial\left(\frac{\Theta_t}{GDP_t};\xi_t\right)}{\partial\left(\frac{\Theta_t}{GDP_t}\right)}}\right] \beta \mathbb{E}_t\left[\frac{1}{\Pi_{t+1}} \frac{S_{t+1}}{S_t}\left(\frac{C_t + \upsilon\left(\Theta_t,\ GDP_t,\ \xi_t\right)}{C_{t+1} + \upsilon\left(\Theta_{t+1},\ GDP_{t+1},\ \xi_{t+1}\right)}\right)\right]. \tag{A19}$$