

# On de-risking and de-dollarizing intra-BRICS trade via smart contracts

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## Abstract

This study explores the existing systemic barriers to intra-BRICS national currency use (“de-dollarization”) in currency swaps and trade finance. The author examines the current de-dollarization initiatives, as well as the actual levels of de-dollarization in Russia’s intra-BRICS settlements (as a representative sample), to find gaps between de-dollarization goals and current initiatives and offers a near-term phased solution to overcome these gaps and de-risk trade within BRICS. It is found that 1) the New Development Bank’s Contingency Reserve Arrangement has built-in systemic barriers which are preventing direct currency swaps between BRICS member states; 2) the Euro is replacing the Dollar as Russia’s preferred settlement currency within BRICS, indicating a gap between Russian traders’ settlement currency choice and BRICS de-dollarization priorities; and, furthermore, 3) while payment and settlement systems are being integrated and FinTech applications are being explored, efforts to fundamentally address the systemic market factors preventing national settlement use are missing. A phased solution is proposed to address the fundamental market barriers to national currencies by using smart contracts to de-risk intra-BRICS trade. Specific mechanisms are outlined to promote trade contracts in national currency and reduce dependency on both the Dollar/Euro and Western institutions (such as the IMF and Western commodities markets), a high-level architecture is proposed, and implementation considerations are discussed.

**Keywords:** blockchain, currency swap, de-dollarization, de-risking, foreign exchange, smart contract, trade finance.

**JEL:** F36, F45O24.

## Introduction

The BRICS countries adhere to the longstanding goal of *de-IMFing* and *de-dollarizing* their trade settlements and reserves in order to increase their sovereignty over transactions and

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avoid currency exchange losses, and propose the creation of a Multilateral Clearing Union to achieve this goal. The Contingency Reserve Arrangement was the implementation of the Multilateral Clearing Union, but fell short of meeting the original purpose due to its IMF linkage requirements and limited scope, symptomatic of a lack of trust between BRICS member states. Furthermore, several systemic factors prevent the wider use of BRICS national currencies in trade finance, which are elaborated upon in the following section.

## 1. Barriers to intra-BRICS de-dollarization in the CRA and trade finance: Literature review

The strategic report of the BRICS New Development Bank *The Role of BRICS in the World Economy & International Development* details a long-term vision of the direction of the BRICS countries' economic cooperation. The strategic report makes the case that reforms in existing Western institutions will not be in favor of the BRICS countries in the near future, and hence emphasizes the importance of a new Multilateral Clearing Union (MCU) that will serve as an intra-BRICS currency swap pool and tackle balance-of-payment shortcomings, trade finance, financial crisis aversion, and an overall restoration of sovereignty through de-dollarizing BRICS trade (NDB, 2017). This intention was also echoed in the 2017 BRICS Xiamen Summit declaration, which stated:

*“We agree to communicate closely to enhance currency cooperation, consistent with each central bank’s legal mandate, including through currency swap, local currency settlement, and local currency direct investment, where appropriate, and to explore more modalities of currency cooperation. We encourage the BRICS Interbank Cooperation Mechanism to continue playing an important role in supporting BRICS economic and trade cooperation. We commend the progress in concluding the Memoranda of Understanding among national development banks of BRICS countries on interbank local currency credit line and on interbank cooperation in relation to credit rating”* (UToronto..., 2017).

In parallel to the Xiamen summit, the R5+ (Real, Ruble, Rupee, Renminbi, Rand, in addition to the currencies of BRICS+ countries) currency initiative was launched, which sought to stimulate the use of national currencies for “investments, long-term projects, creation of common payment card systems and common settlement/payment systems, cooperation in promoting BRICS+ currencies towards reserve currency status” (Lissovolik, 2017).

The New Development Bank’s Multilateral Clearing Union was manifested in the form of a \$100 billion Contingency Reserve Arrangement (CRA) that BRICS countries had devised as a pool for swapping currencies in times of need and increasing the volume of settlements in national currency. The CRA included two currency swap instruments to support short-term balance-of-payment (BoP) pressures between a country’s current and capital accounts: 1) a liquidity instrument to provide support in response to current BoP gaps; and 2) a precautionary instrument to buffer against future BoP gaps. A country’s access to the shared capital funds was limited by conditionality, as only 30% of accessible funds (“de-linked portion”) were available on demand, whereas the major part, 70% of

accessible funds, requires on-track arrangements with the IMF, as the CRA's rationale document explains:

*“Where financing in excess of this 30% limit is required, an ‘IMF-linked portion’ will be made available. This will allow the country access to the remaining 70%, provided that a conditionality-based agreement with the IMF is concluded”* (Biziwick et al., 2015, p. 316).

It is worth noting that rather than having a mechanism for direct currency swaps, as was set out in the MCU strategy report, a swap transaction was defined as “the Requesting Party’s central bank purchases US dollars (USD) from the Providing Party’s central bank in exchange for the Requesting Party Currency, and repurchases on a later date the Requesting Party Currency in exchange for USD” (Biziwick et al., 2015, p. 316).

The IMF linked component and USD reserve currency status raise questions about whether there is a potential mismatch between the stated goals of the MCU and the CRA’s implementation mechanism. Karataev et al. write:

*“Though the BRICS countries have established a Contingent Reserve Arrangement... the currency swap under this arrangement is one between US dollar and local currencies of BRICS, not one among the BRICS currencies. Currently, there are few local currency swap agreements in force (between Russia and China, China and South Africa)”* (Karataev et al., 2017, p.110).

The key barriers hindering the CRA’s success in achieving its stated goals, including the CRA’s promissory model, limited size (mirroring the limited paid-in capital allocated to the BRICS New Development Bank), and linking to the IMF, stem from the CRA modeling itself after the ASEAN+3 Chiang Mai currency swap initiative, which had a limited scope, operated on a promissory model rather than an actual capital pool, and carried a significant IMF-related portion due to the lack of financial surveillance capacity and moral hazard of borrowing. On a macro level, “the CMI/CMIM arrangement has been criticized as utterly ineffective (it did not play any role in the 2008 crisis, for example), and the concern is that, by adopting its form, the CRA is condemning itself to a similar fate. Size and IMF linking (along with the lack of a rapid response facility) seem to have been major problems with the CMI/CMIM arrangement...the IMF linking seems hard to reconcile with the intention to provide a counterweight to the IMF” (Biziwick et al., 2015, p. 318). Thus, as was the case with the Chiang Mai currency swap initiative, the BRICS NDB’s CRA’s promissory model, limited size (mirroring the limited paid-in capital allocated to BRICS’ New Development Bank), and IMF linking all stem from a fundamental lack of trust among BRICS member countries regarding their self-reliance in monitoring and managing each other’s and common funds, as well as greater trust in the IMF for this purpose. Despite their stated desire to break away from IMF’s conditionalities and dollar-denominated trade, at least in the CRA, the BRICS countries have inadvertently followed the precedents set by the hegemons.

This status quo is not inevitable, and reducing the linkage to the IMF would require “developing macroeconomic monitoring capacity and modalities for a rapid crisis response facility” (Biziwick et al., 2015, p. 320). A coordinated reform of the CRA with

the introduction of an internal credit monitoring mechanism amidst swap instruments in national currencies is needed to build the foundation for true independence from the IMF and dollar-denominated transactions and restore trust in the CRA.

To supplement CRA reform, Karataev et al. outlined two key fundamental barriers to the use of national currencies to finance trade in BRICS, which need to be overcome as a supplement to intra-BRICS currency swaps. The key barriers were identified as follows:

### **1. Currency Volatility**

*Exchange rate fluctuations create uncertainty in optimizing settlement pricing and profitability at the time of contract execution, both from the perspective of exporters and importers. “Exporters will seek to denominate their contracts in foreign exchange when their national currency is devaluing. It will allow them to receive additional profits in the national currency...(whereas) importers shall be encouraged to invoice a contract price in their national currency in order to reduce costs and prevent a decline in demand as a result of rising prices.”*

### **2. Global Commodity Benchmarks**

*“Exporters of similar goods [i.e. commodities]... will seek to establish the contract price in the same currency as their competitors. That allows them to neutralize more successfully the adverse exchange rate fluctuations resulting in considerable price changes and therefore prevent the risk of reducing demand. As a result, the market price of such goods is denominated mostly in the US dollar...the global commodities exchange trade in these goods plays a significant role...if the global commodities market’s impact on the pricing model will decrease, the use of the USD as invoicing currency will decline too” (Karataev et al., 2017, pp. 20, 19).*

Hence, the dominant factors preventing the use of the BRICS currency in trade were exchange rate fluctuations forcing exporters to optimize profit margins by using foreign currency (usually denominated in dollars), as well as industry benchmarks for export goods pricing, especially the influence of global commodity exchanges denominated in dollars. Amongst the BRICS countries, this holds true for Russia’s largest energy exporters who often prefer to be paid in dollars or euros in order to maintain standardized price points and obtain additional rubles in case of depreciation (Doff et al., 2019).

However, empirical research conducted by Nakajima et al. (2020) using the vine copula method and the value-at-risk model has found that the use of BRICS currencies in energy trade resulted in more stable prices and avoided transfer risks compared to the use of dollars due to counter-balancing movements with oil prices. Thus, though dollar-denominated oil contracts may provide short-term benefits for exporters, the overall commodity trade between the BRICS countries would benefit from the use of national currencies.

## **2. Current status**

As a representative sample to measure progress in de-dollarization, we can analyze trends in the currency composition of Russia’s publicly available intra-BRICS trade settlements

since the launch of prominent de-dollarization initiatives in 2017, as shown in Figure 1 below. The percentage of Russian exports to the BRICS countries calculated in dollars fell from its peak of above 80% in the first quarter of 2018 to 33.2% in the first quarter of 2020 (CBR, 2020). While Russian exports to BRICS have recently been de-dollarized, it is apparent that instead of BRICS currencies, the Euro has replaced the Dollar as the dominant export settlement currency (Russia receives only 13% of its exports in Rubles as of Q1 2020).

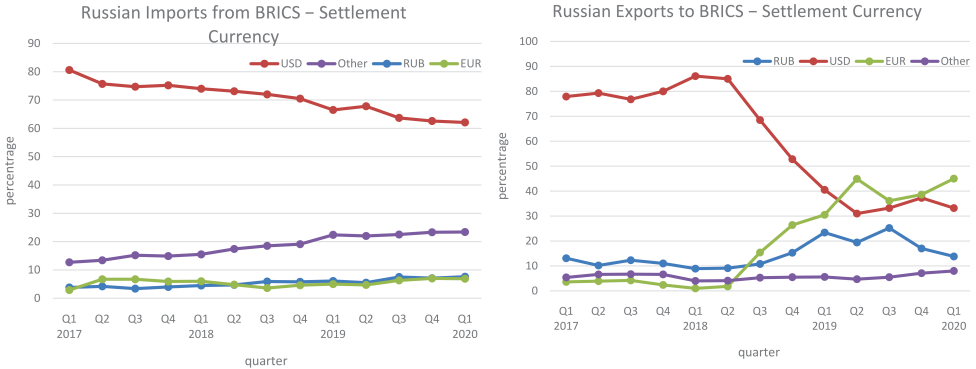


Figure 1. Percentage of settlement currency for Russian exports to BRICS<sup>1</sup>

This trend is due to the fact that Russian energy exporters currently prefer to denominate contracts in euros rather than rubles (Yagova, 2019) for the same reason they previously preferred to denominate contracts in dollars: a greater amount of rubles received in case of depreciation. By contrast, Russian imports from the BRICS countries are still largely settled in dollars as of Q1 2020, though there is a gradual de-dollarization trend present. The “other” currency slowly growing in imports settlements is most likely largely comprised of the Yuan Renminbi, as China and Russia have recently accelerated the use of the Ruble and Yuan in trade (Simes, 2020). Despite this, overall, it is noteworthy to mention that Russia’s inter-BRICS trade is mostly settled in dollars and euros, and not in rubles or any other BRICS currency, which indicates a gap between the choice of the settlement currency by Russian traders and BRICS’ de-dollarization priorities. Though the Euro replaces the Dollar as Russia’s preferred export settlement currency within BRICS, the Euro presents smaller but similar risks of being armed with sanctions, given that it is still a non-BRICS third-party currency and European Union sanctions against Russia may be expanded in the near future in light of political events unfolding in 2020 (i.e., EU-Russia differences over the protests in Belarus, the Navalny incident, etc.).

To overcome the remaining barriers to using national currencies, BRICS is currently taking the following steps: developing an in-house settlement system for trade finance based on the Russian SPFS alternative to SWIFT (Yahoo Finance, 2019), linking domestic

<sup>1</sup> Central Bank of Russia Trade Finance Settlement Data. “Credit Statistics.” [http://www.cbr.ru/vfs/statistics/credit\\_statistics/cur\\_str.xlsx](http://www.cbr.ru/vfs/statistics/credit_statistics/cur_str.xlsx) translated into English, plotted in Excel.

payment systems in order to create the New International Payment System (NIPS) (Surve, 2018), as well as researching feasibility requirements for creating a single BRICS cryptocurrency (CoinTelegraph, 2019a). In addition, while progress has been made in diversifying the NDB's loan denominations to include more local currencies with a goal of 50% project financing in the near future, according to the NDB president (Hancock, 2019), more widespread internationalization of BRICS currencies will require the creation of mature bond markets in all BRICS countries to compete with Western bond markets. This was initiated by the creation of the BRICS Local Currency Bond Fund during the declaration of the BRICS Xiamen Summit in 2017:

*“We agree to promote the development of BRICS Local Currency Bond Markets and jointly establish a BRICS Local Currency Bond Fund, as a means of contribution to the capital sustainability of financing in BRICS countries, boosting the development of BRICS domestic and regional bond markets, including by increasing foreign private sector participation, and enhancing financial resilience of BRICS countries”* (UToronto, 2017).

Though these steps are cumulatively designed to increase autonomy over intra-BRICS fund flows, they do not, however, address the fundamental gap in de-risking the barriers to the use of national currencies in BRICS settlements that constrain their wider use. Russia's Central Bank Governor Elvira Nabiullina echoed this sentiment in 2019 when she claimed that while gold-pegged cryptocurrencies were being researched, it was more important to develop international settlements using national currencies (CoinTelegraph, 2019b). Thus, while BRICS payment and settlement systems are being integrated, BRICS local bonds are being developed, direct currency swap lines are being expanded, and an intra-BRICS cryptocurrency architecture conceptualized and brought to market, a crucial intermediate supplementary step in de-dollarizing inter-BRICS trade finance is establishing de-risked and mutually trustable intra-BRICS trade contracts to expand national currency settlement, overcoming the market barriers mentioned previously.

### **3. Steps needed for de-risking trade: Gap identification**

Karataev et al. proposed a multi-tier circular system whereby national and intra-BRICS financial institutions complemented and coordinated BRICS trade settlement transactions to create a robust system for using local currencies. The component steps were outlined as following: 1) expanding direct currency trading and lowering transactions costs; 2) creating and using hedging instruments in BRICS currency pairs that would reduce risk management costs; 3) expanding swap agreements and limiting liquidity risk; 4) developing the local currency bond market in conjunction with trade and development goals; 5) reinvesting trade surplus into local bond markets; 6) diversifying bond markets and coordinating BRICS policy on the use of these instruments to achieve the goals of currency internationalization (Karataev et al., 2017, p. 111).

Of these measures, the CRA is designed to meet the needs of step 3, whereas progress has been initiated by steps 4–6, as noted previously. However, concrete initiatives are needed to fulfill steps 1 and 2. Karataev et al., in particular, specified three key exchange mechanisms that need to be established to lower transaction costs and de-risk the use of national currencies in intra-BRICS trade contracts in order to overcome the aforementioned barriers to the first two steps mentioned above:

1. BRICS interbank foreign exchange market, whereby “*companies should be able to purchase/sell a currency quickly and without additional costs to make settlements in such currency. This presumes the existence of a highly developed and liquid interbank and forex markets with large numbers of participants and convertible financial instruments*” (Karataev et al., 2017, p.18).
2. Currency hedging instruments. “*It will be necessary to encourage trading directly in BRICS currencies that will significantly contribute to lowering costs. This step [BRICS Trading pairs] has to be augmented with creation and use of hedging instruments in BRICS currency pairs which might allow to reduce risk management costs. During the first stage leading public banks of BRICS countries may function as market makers on currency pairs to provide necessary liquidity*” (Karataev et al., 2017, p.110).
3. BRICS commodity exchange. “*Launching of a Commodity Exchange or some type of an e-trading platform for trade in goods and derivatives of various kinds can be one more instrument contributing to enhancing LCY [local currency] use in settlements in the BRICS countries... raw material trade could be mediated by setting market prices denominated in local currencies. With appreciable quantity of foreign investors trading on the exchange, this will lead to internationalization of contracts denominated in local currencies*” (Karataev et al., 2017, p.112).

In addition to the above three exchanges, de-dollarization of intra-BRICS trade requires the removal of the IMF-linked portion of the CRA in order to enable direct currency swaps to take place, granted the existence of bilateral swap agreements between all BRICS countries. A necessary replacement of the current IMF arrangement must be established between the BRICS countries: a counter-party de-risking mechanism which serves as an independent source of trust to validate the eligibility criteria of trade-necessitated direct currency swaps, thus eliminating the need for on-track IMF arrangements and subsequent conversion of US dollars.

Currently, all BRICS countries are largely reliant on Western facilities for the above four types of exchanges. SWIFT largely dominates international interbank transfer settlements, with the Russian and Chinese SWIFT alternatives operating mostly domestically, though there are plans to integrate the BRICS settlement systems as mentioned previously. For mitigating currency volatility risk, the BRICS countries have yet to develop a comprehensive intra-BRICS hedging mechanism independent of dollar- and euro-denominated Western capital markets. Thus, to overcome the reluctance of BRICS traders to take trade finance loans and settle in BRICS national currencies, it is necessary to introduce forward hedging options with minimal cost of carry, so that traders can avail direct hedging options simultaneously with trading

contracts to de-risk their trading contract in national currencies. As Karatev et al. concluded, in the long term, boosting demand for BRICS direct currency settlements would itself partially smooth out some of the volatility experienced by cyclical flight of Western capital, thus lowering the risk premium and cost of carry for forward contracts and making BRICS currencies a natural preferred choice in trade finance (Karataev et al., 2017, p.110).

After a currency options market, a BRICS commodity exchange should be created where commodity prices are denominated in national currencies and accompanied by derivatives and other risk hedging options that minimize the combined effect of currency and commodity price fluctuations, essentially serving as a favored market for BRICS commodity importers and exporters who set contracts in national currencies and have instruments to de-risk any expected volatility. The most significant example of a local currency commodity exchange within BRICS is the Petro-Yuan futures market launched in China in 2016, which served as a viable alternative to the dominant dollar-denominated WTI and Brent oil exchanges. Though Russia has created a similar exchange in the form of the Ural oil futures market, there is still work to be done to achieve maturity and use at the level of established commodity exchanges.

Combined with direct currency swap lines and an intra-BRICS free trade zone, the implementation of the above mechanisms will reduce the transaction cost of settlements in the national currencies of the BRICS countries by lowering the risk premium for importers and exporters when entering into contracts in national currencies amidst exchange rate uncertainty. In this way, these exchanges will fulfill the BRICS goals of “focus[ing] joint efforts on providing companies engaged in foreign trade from BRICS countries with the same, or lower transaction (compliance) costs, guarantees of settlement and risk management that they currently have in utilizing the dollar, euro or yen” (Karataev et al., 2017, p.110–111).

#### **4. Role of smart contracts in de-risking trade**

In the context of the above steps necessary to de-risk the use of national currency in intra-BRICS trade, special attention must be paid to the recommendation of experts from the Chinese Academy of Social Sciences:

*“...establishing the BRICS cross-border interbank payment system on the basis of Blockchain technology might be a key step of BRICS cross-border financial infrastructural construction. Such infrastructure would not only significantly improve the efficiency of cross-border interbank payment among the BRICS countries but also exert a fundamental impact on the international monetary and financial system. Given that Blockchain is safe, transparent, distributed and tamper resistant, the trust model between financial systems would no longer rely on intermediation and many banks will establish “decentralized” ties and realize real-time digital transactions. The removal of the intermediary link of the third-party financial institution means cross-border payment will no longer depend on such systems as SWIFT and CHIPS” (Karataev et al., 2017, p.113).*



Furthermore, in 2018, export-oriented development banks from all BRICS countries signed a MoU aimed at enhancing the understanding of distributed ledger or blockchain technology, with the aim of identifying areas to improve operational efficiencies and tackle common financial challenges (InfoBRICS, 2018). In 2019, the BRICS business council formed a working group studying the possibility of creating a special trade-facilitating BRICS cryptocurrency to ensure uninterrupted paperless document flow for trade obligations, as per State Duma's expert council member Nikita Kulikov (CoinDesk, 2019).

In fact, in order to achieve the BRICS goal of de-risking trade settlements in national currency there is no need to create a specialized cryptocurrency for document flow. The simplest, yet most advanced and low-cost blockchain feature that enables the aforementioned four exchanges to take place directly between BRICS traders and banks (and allows a seamless disintermediation of transactions between separate parties without the need for outside third parties such as the IMF) is smart contracts, an original feature of Ethereum networks later adapted by other blockchain networks. Smart contracts allow multiple parties to program and pre-set conditional criteria for contracts based on fulfillment of services or market conditions, as well as automate the verification of fulfillment criteria via decentralized external verification mechanisms known as oracles, which are blockchain middleware that creates a secure connection between smart contracts and various off-chain resources required for fulfillment. Funds needed to execute the contract can be temporarily pre-stored in a linked virtual escrow-like account associated with the contract to guarantee fund availability at the time of execution (XRP Ledger, 2020). Once the contract execution date arrives and conditional fulfillment checks are completed, smart contracts self-execute and disburse associated payments to the contracting parties, automating execution and settlement, as well as eliminating contractual disputes and risks of non-fulfillment of obligations by counter-parties.

Due to their automated execution capabilities and disintermediation of third-party legal and settlement entities, smart contracts are starting to gain momentum in Western consortiums for trade finance, currency trading, and commodity trading in the mainstream dollarized economy. Trade finance systems based on smart contracts currently allow to reduce costs by an average of 35% and eliminate 1–2 weeks of settlement processing time, as well as eliminate the possibility of manual errors (Blockdata, 2019). However, rather than piling up existing Western (mostly American and European) trade platforms, which unfortunately carry similar jurisdictional and U.S.-influenced control barriers as SWIFT (especially given the expanding reach of U.S. regulatory bodies into digital currencies and alternative payment industries), the BRICS countries can chart an independent path free from potential financial weaponization by developing a comprehensive in-house system of smart contracts and distributed ledger trade incorporating the essential elements of trade finance, currency trading, and commodity trading, as well as linking it to the new intra-BRICS settlement and payment systems under development. In such a system, smart contracts will allow for comprehensive BRICS interbank loans for trade finance with a set of conditional parameters, including forex options and futures contracts, coupled with a special BRICS-only commodity exchange with its own commodity futures options for

intra-BRICS buying. BRICS traders will act as counter-parties to all contracts, which eliminates the risk of using currency and commodity trading for speculative purposes and enhances trust.

## **5. Key requirements and stages of smart contract implementation: Results**

To ensure comprehensive large-scale implementation of smart contracts and distributed ledgers for such an all-in-one platform for BRICS traders independent from existing Western platforms, and to build new intra-BRICS exchanges to de-risk trade finance, a pilot step can begin with an intra-BRICS Trade Finance Smart Contract Fulfillment system distributed app (aka “Dapp,” as blockchain apps are known) that replaces traditional letters of credit between merchants and banks, and uses automatic production and shipment data, rather than traditional bills of lading as a source of fulfillment verification.

In parallel, another smart contract based distributed app for facilitating direct interbank transactions should be developed, replacing traditional correspondent-account based bilateral bank loans with decentralized smart contracts for interbank transfers for trade finance in accordance with the corresponding NDB CRA currency swap limit.

Ideally, once these two pilot systems are up and running, both systems should be prevented from using SWIFT or Western transfer services to ensure financial security free from external interference. Instead, they become operationally interwoven with intra-BRICS payment and settlement systems currently under development, integrated using Ethereum middleware such as ChainLink to connect to a BRICS private distributed ledger network, either developed in-house or with tailored application layers on an existing open-source private enterprise Ethereum platform such as Quorum or Hyperledger Besu.

Once such an integration proves reliable, parallel distributed apps should be designed on the BRICS private distributed ledger to establish intra-BRICS-only exchanges for currency options and commodity futures associated with trade transactions. Such an exchange will serve as a preferred market for de-risking national currency settlements within the framework of BRICS trade finance and will have restrictive access to prevent speculative manipulation of both currency and commodity rates. The key requirements for such an exchange are:

- Seamless integration and interoperability with Central Bank, Commercial Bank, New Development Bank swap lines and intra-BRICS settlement systems
- Live feed-in to market pricing data when setting up a contract and prior to its execution
- Integration with cargo delivery data to change the order execution date
- Pre-set call/put and contract amount limits set by the BRICS NDB
- Support for large volume contracts with minimal latency
- Scalability to further expand transaction throughput

- Decentralized oracle system for contract fulfillment verification via market data
- Temporary storage of funds in special accounts via distributed ledger
- Secure permitted access. Not subject to SWIFT-like constraints.

The author proposes a high-level architecture for a decentralized all-in-one BRICS trade finance system, as illustrated below. The high-level steps involved would take place as follows:

1. Smart trade contracts are set up through the dedicated BRICS trade finance distributed app for execution after a fixed period tied to goods delivery (e.g. on the next business day after the anticipated delivery date).
2. Simultaneously, traders set up desired currency hedging options and commodity futures contracts as applicable through the respective dapps, in line with the pre-set call/bid margins and cost-of-carry limits for all combinations of BRICS currency pairs established by the BRICS NDB, and use live market data to aid them. They are coded as smart contracts designed to mature on the same date as the trade delivery.
3. The NDB CRA direct pair currency swap lines are reviewed daily to ensure the adequacy of swap amounts for upcoming contracts maturing over the next 30-day period, and those contracts that fall outside of the credit swap limits are given an option to mutually annul the contract and use a third-party currency for fulfillment instead.
4. At fixed intervals of 7 days, 3 days, and 1 day prior to the initial anticipated delivery date, the delivery status is tracked to ensure timeliness. In case of anticipated delays, contract fulfillment date is pushed back and updated in the smart contract.
5. Initially, with the aim of building trust and de-risking, no margin purchases would be allowed. Full funds will be required prior to settlement. Thus, 3 days prior to the contract fulfillment date, the smart contract will output a “worst-case scenario” fulfillment amount under the contract terms, and the new interbank settlement system will allocate funds to special accounts stored in the BRICS distributed ledgers. After a successful 1-year pilot project where trust is established, this step can be eliminated to allow traditional trade loans.
6. As soon as the goods delivery is confirmed, market data, including current direct exchange rates, commodity prices, and other live rate data will be refreshed in the decentralized oracle network at the time of contract maturity to compute the execution amount for both the trade settlement and the associated currency option and purchased commodity future.
7. The oracle network will execute the contracts and release the final settlement to the seller in its exporting currency (or, if previously agreed, in importing currency as an exception) – the difference between the worst-case maximum funds and the actual fulfillment amount will be refunded to the buyer’s account (if desired, it can be retained for future purchases). In the future, traders will have options of redeeming funds through the integrated P2P payment systems of BRICS or the BRICS cryptocurrency, allowing small and medium sized e-commerce traders to have the same access to the BRICS market.

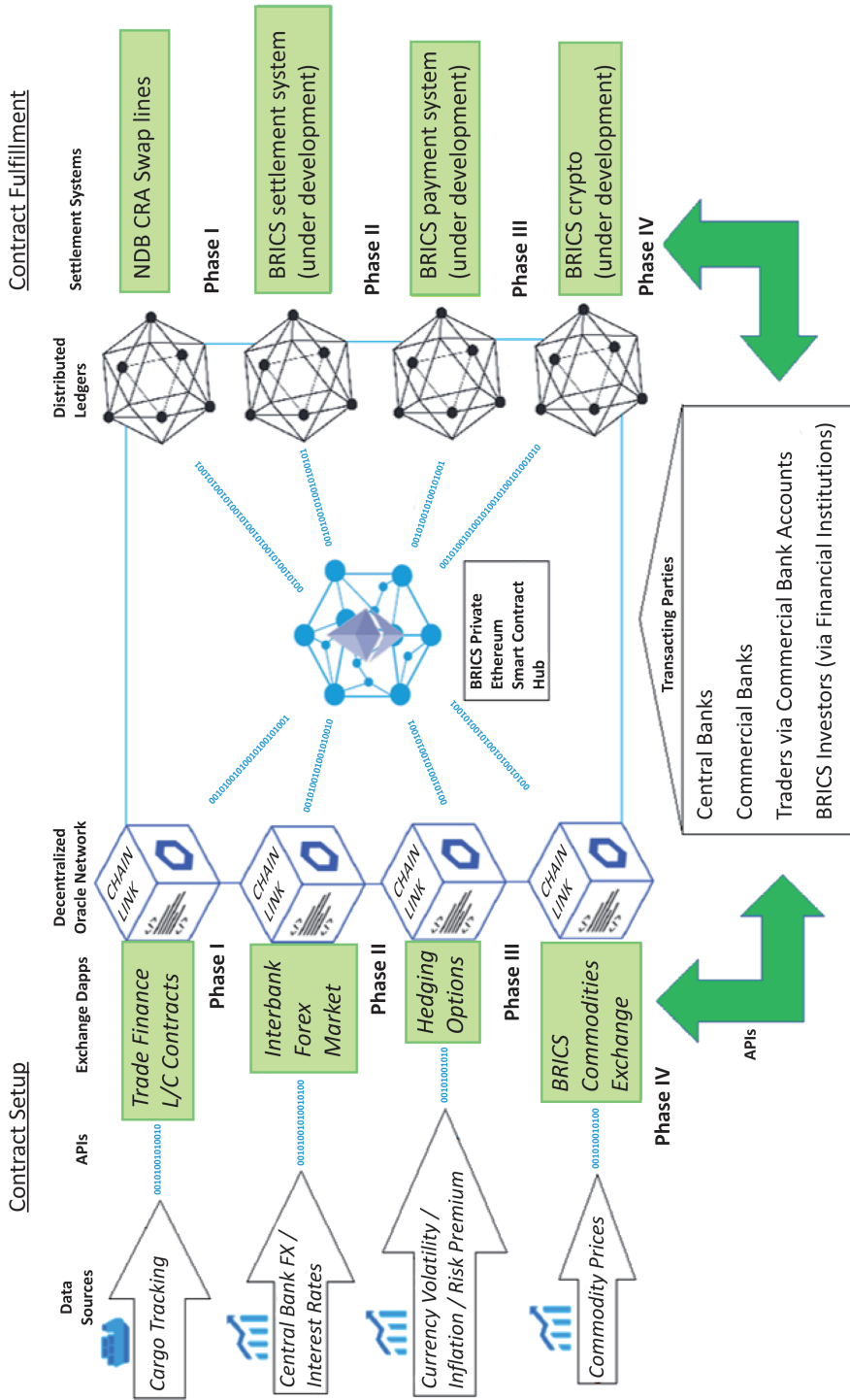


Figure 2. Phased smart contract BRICS trade finance architecture

## 6. Implementation considerations: Discussion and recommendation

Key considerations when designing and implementing a distributed multi-functional large-scale integrated solution, such as the one described above on blockchain, are: 1) latency and throughput; 2) interoperability, scalability, and versatility; 3) data privacy and security, and finally; 4) energy consumption costs and token fees.

To address these concerns, it is necessary to integrate the latest developments into protocols underway. Ethereum 2.0, to be released in November 2020, will increase transaction throughput from the current bottlenecked 14/second to 100,000/second, as well as move computations from an energy-intensive proof-of-work blockchain to a proof-of-stake one and enhance data security (DeCrypt, 2020). Furthermore, it will be necessary to deploy scriptable smart contracts for both program variable fulfillment criterion and tie-in with external data. Chainlink has a modular “middleware” for external data connectivity, as well as a decentralized oracle network which is necessary for trust validation amongst participants in BRICS transactions. For data access control, BRICS-only dapps can be built on a permissioned version of the enterprise blockchain and integrated using secure APIs for the intra-BRICS payment systems. Current western trade finance tracking systems such as MAERSK’s Tradelens, IBM’s WeTrade, and R3’s Marco Polo use enterprise blockchains, including Hyperledger Fabric and CORDA; BRICS may be interested in either adapting these existing platforms or developing its own, depending on its core requirements and integration requirements with the BRICS settlement interbank messaging systems.

There is, however, an inherent issue of token fees, which in Ethereum are known as gas fees, to compensate for the cost of energy use to facilitate transactions. With the Ethereum native token Ether (ETH) constantly growing in price, and Ethereum 2.0 not bringing a viable solution to increasing gas fees, intermediary layer computational solutions and third-party APIs are currently being developed to offload transaction processing off the Ethereum mainnet network (CoinTelegraph. 2020). An alternative implementation is possible by using smart contracts with a centralized ledger, without blockchain, tokenization or distributed ledgers. The world’s biggest commodity pricing firm, S&P Global Platts, has implemented such an exchange (TradeVision), sacrificing an additional level of security and verification in exchange for significantly lowered cost and efficiency (Ng, 2019). BRICS may be interested in tracking this model for feasibility, using its own centralized ledger instead.

When assessing steps for implementation of this integrated all-in-one solution to de-risk trade finance, the BRICS Business Council Blockchain Working Committee, initiated during the 2017 Xiamen Summit, should conduct a gap analysis of key requirements for an ideal comprehensive intra-BRICS trade finance solution, supplementing some of the key issues outlined in this paper. The most important factor to keep in mind is interoperability between all the BRICS trade, settlement, payment, and crypto solutions under development, individual Central and commercial

banks, as well as the NDB CRA's swap line facilities. Though this proposal suggests a particular implementation scheme, it is recommended that the BRICS Blockchain Working Committee assess the merits of all implementation design options, including centralized vs. decentralized ledgers, on vs. off ledger fund flow allocation, ledger access control between commercial and Central banks and individual traders, margin funding of large volume serial contracts, and funding guarantee requirements. Only then can a comprehensive IT architecture be performed, followed by pilot/sandbox testing of individual components and project budgeting before commissioning such a solution on a BRICS private network, either developed in-house on the private Ethereum network, or with tailored application layers on an existing corporate Ethereum platform such as Quorum, depending on BRICS' preference regarding the degree of isolating the solution partially or entirely from Western platforms. This is a high-level proposal to outline key considerations in that direction, in the hope that smart contracts will be used to disintermediate and de-risk BRICS trade finance in the near future.

## Conclusion

The primary barriers to de-dollarization of intra-BRICS trade were identified as: 1) the lack of an independent CRA credit monitoring mechanism (and hence relegation to IMF for this purpose, resulting in dollar intermediation of CRA currency swaps); 2) currency volatility causing uncertainty in currency conversion amongst traders when exporters take advantage of dollar and euro denominated contracts in the event of devaluation; and 3) the lack of a non-Western commodity exchange which would allow national currency pricing and a futures market for energy trading. To address these barriers in BRICS currencies and de-risk trade, a phased solution based on smart contracts was devised to create more efficient intra-BRICS exchanges which supplement existing BRICS settlement and payment integration efforts.

The phased creation of smart contract-based trade finance, interbank market, currency risk hedging, and commodity exchanges within BRICS will serve as a source of mutual trust amongst BRICS Central and commercial banks and traders, encouraging national currency settlements for trade. BRICS traders will act as counter-parties to all contracts in a closed ecosystem which eliminates the risk of currency and commodity trading being used for speculative purposes, something all BRICS countries wish to avoid. Thereby, the exchanges will facilitate bringing the NDB CRA currency swap mechanism to its original goal by eliminating the need for IMF-linked on-track arrangements and de-dollarizing the currency swaps themselves. In the long term, the exchanges will facilitate greater intra-BRICS demand for the currencies themselves, which will help smooth out at least some of the volatility of exchange rate fluctuations. In parallel, smart contracts can be used to automate trust in BRICS fund flows beyond trade, i.e. mutual intra-BRICS investment and NDB loans for infrastructure and sustainable development.

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