# International Sanctions and Economic Restructuring: Modelling the BRICS Monetary Initiative as Counter-Power

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## Abstract

This paper explores the BRICS (Brazil, Russia, India, China, South Africa) monetary initiative in the context of international sanctions and economic restructuring. Since 2014, Russia, faced with severe sanctions after the annexation of Crimea, has reoriented its trade relations towards non-Western partners, particularly within the BRICS. This situation has catalysed thinking about the creation of a common currency to reduce dependence on the US dollar and the euro, currencies often used to exert economic pressure. The BRICS currency project aims to strengthen the economic autonomy of member countries and develop an alternative to Western-dominated monetary systems. The study models the impact of sanctions on Russia's trade flows using the ARIMAX model, incorporating exogenous variables such as economic sanctions. By simulating different scenarios (lifting, maintaining, or intensifying sanctions), the projections highlight the adaptability of Russian trade flows in the face of geopolitical and economic changes.

Finally, the paper examines the challenges associated with the introduction of a common BRICS currency, including the management of economic stability within heterogeneous economies and issues related to monetary governance. Economic simulations detail the potential effects of this monetary system on growth, inflation and exchange rates, depending on different levels of economic integration between the group's members.

### BRICS in Context

Since the beginning of the 21st century, global geopolitical dynamics have undergone profound change, characterised by the emergence of new economic powers, among which the BRICS countries (Brazil, Russia, India, China, South Africa) play a central role. This group of nations, representing almost 40% of the world's population and around 25% of global GDP, has gradually asserted its influence on the international stage. Against a backdrop of asymmetrical globalisation, where the rules of the global economic game are dominated by Western financial institutions and traditional currencies such as the US dollar and the euro, the BRICS monetary initiative appears to be a bold attempt to redefine the world economic order.

The project for a common currency within the BRICS cannot be analysed without considering international sanctions, which have often served as a lever of pressure in international economic and political relations. The imposition of economic sanctions, notably by the European Union and the United States, against powers such as Russia, has catalysed reflection on the need for the BRICS to set up independent economic and monetary mechanisms. By limiting access to international financial


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markets, these sanctions have disrupted trade flows and foreign direct investment, creating a need for economic restructuring in the targeted countries. Against this backdrop, the BRICS have found themselves in a strategic position to propose alternatives that not only strengthen their economic resilience but also challenge the hegemony of the US dollar as the main international currency of exchange. The idea of a common currency for the BRICS is based on the desire to weaken excessive dependence on current reserve currencies, notably the dollar and the euro, which are frequently used as tools of coercion in contexts of economic sanctions. The sanctions imposed on Russia in 2014, following the annexation of Crimea, marked a major turning point in this thinking. The freezing of Russian assets in Western financial institutions and the restriction of international transactions demonstrated the vulnerability of a global power to sanctions. This framework led the BRICS to consider the creation of a common financial infrastructure capable of bypassing traditional systems such as SWIFT, and to envisage the introduction of a common currency. Such a system would aim to ensure smooth commercial transactions between members, and to strengthen the economic autonomy of each vis-à-vis the world's major financial centres.

However, such a monetary project raises considerable challenges. On the one hand, the BRICS economies display significant structural heterogeneity, both in terms of growth rates and macroeconomic stability. Inflation, exchange rates, trade deficits and foreign exchange reserves vary considerably from country to country. On the other hand, the integration of these different economies into a common monetary framework implies coordinated management of monetary policy, which requires significant compromises on the economic sovereignty of member states. The stability of this common currency will therefore depend on the BRICS' ability to harmonise their internal economic policies while absorbing the exogenous shocks imposed by fluctuations in world markets. In this context, modelling the economic and monetary dynamics between the BRICS countries becomes an essential tool for understanding the conditions of feasibility and viability of such an initiative. Economic models can be used to simulate various scenarios, including the impact of a common monetary system on trade flows, exchange rates and the financial stability of member countries. In addition, the modelling of international sanctions, which directly influence BRICS decisions, is a key element in understanding how these nations can build an economic counterweight to the restrictions imposed by the West.

The contribution of this article lies at the intersection of political economy, empirical modelling, and international monetary theory. While numerous studies have discussed the BRICS' ambitions to reform the global monetary architecture, few have combined empirical simulation techniques with a geopolitical analysis of the monetary consequences of sanctions. This research fills that gap by adopting a dual methodological strategy. First, it mobilises an ARIMAX (AutoRegressive Integrated Moving Average with Exogenous variables) model to estimate the macroeconomic impact of Western sanctions on Russia's trade flows, using actual historical data and applying structural shocks. This allows for a dynamic understanding of how international sanctions function not merely as diplomatic tools, but as catalysts for alternative financial strategies. Second, the article develops a forward-looking simulation of a BRICS monetary union, projecting the behaviour of key macroeconomic variables (output, inflation, trade volume, exchange rate) under different policy and coordination scenarios.

Beyond the modelling itself, this article contributes to the emerging literature framing the BRICS initiative as a form of economic counter-hegemony. Rather than viewing the project merely as a technical response to transactional frictions, we argue that it represents a deeper political repositioning in the global order, an attempt to reclaim monetary sovereignty and reduce vulnerability to coercive economic instruments. The narrative that structures this work posits sanctions not only as constraints but as triggers of systemic realignment. In this sense, the monetary project of the

BRICS cannot be understood independently of their shared strategic ambition to loosen the grip of the dollar-based system and develop autonomous circuits of value storage and trade.

By integrating empirical forecasting, scenario-based simulation, and structural geopolitical analysis, this article offers a comprehensive contribution to ongoing debates on de-dollarisation, sanction resilience, and the emergence of alternative monetary poles. The annexes provide disaggregated country-level simulations that reflect both convergence potentials and structural asymmetries among BRICS economies. Taken together, these elements support a more nuanced understanding of what a shared BRICS currency could achieve, and under which conditions it may evolve from political aspiration to economic reality.

## Economic analysis of sanctions: Modelling the impact on trade and financial flows

Since 2014, the Russian economy has faced unprecedented geopolitical challenges. Russia's annexation of Crimea in March 2014, a landmark event in the history of modern international relations, triggered a series of severe economic sanctions, radically altering the country's commercial landscape. The controversial referendum held in Crimea under Russian rule was seen by the international community, including the European Union, the United States and other Western powers, as a violation of international law and Ukraine's sovereignty. These sanctions had an immediate impact on the Russian economy, and the effects of these measures continue to influence the dynamics of international trade flows and the structure of the world economy today.

The annexation of Crimea in 2014 took place against a complex historical backdrop. Russia, seeking to assert its geopolitical influence in the region, exploited internal political tensions in Ukraine to intervene militarily, supporting pro-Russian groups. International reaction was swift. The European Union, the United States and several other Western powers imposed a first set of sanctions against Russia. These sanctions, largely targeted at key economic sectors such as energy, finance and defence, were designed to isolate Russia on the international stage and weaken its economy. Among the most significant measures were a ban on access to European and American financial markets for several major Russian state-owned companies, such as Gazprom and Rosneft, as well as restrictions on the export of advanced technologies used in the exploration and exploitation of hydrocarbons in the Arctic. The Russian banking sector has also been hit hard, with sanctions designed to limit the financing capacity of Russian banks on international markets. As a result, Russia's trade relations with its Western partners have deteriorated, leading to a significant drop in bilateral trade flows. For example, Russian exports to the European Union, its main trading partner, fell significantly from 2014 onwards, particularly in the energy sector. According to Eurostat, EU imports of Russian natural gas fell by almost 30% in the two years following the annexation of Crimea.

These sanctions not only impacted direct trade relations between Russia and the sanctioning countries but also had indirect effects on international economic relations as a whole. In response, Russia sought to redirect its trade flows towards new trading partners, in particular Asian countries such as China, India and the Middle East. This strategic pivot has been facilitated by strengthened bilateral agreements and initiatives such as the development of new energy corridors and the establishment of alternative financial systems to bypass restrictions imposed by the West. The most striking aspect of this reorientation is the strengthening of economic relations with China, the dominant power in East Asia. Since 2014, trade between Russia and China has grown exponentially, reaching a record level of over $100 billion in 2019. This reorientation has enabled Russia to diversify its outlets for hydrocarbon exports, while demand in Europe declined due to sanctions. From an economic point of view, this diversification of trading partners has played a key role in mitigating the effects of sanctions on the Russian economy, although this strategy also entails risks. Growing dependence on China has exposed Russia to asymmetries of economic power, which could affect its long-term strategic autonomy.

In February 2022, Russia's invasion of Ukraine opened a new chapter in the escalation of global geopolitical tensions, leading to an intensification of economic sanctions. This new wave of sanctions was broader and more rigorous than those imposed in 2014, affecting almost every sector of the Russian economy. The United States, the European Union and their allies not only tightened restrictions on trade and finance but also imposed individual sanctions on Russian oligarchs and key politicians. One of the most striking measures was the exclusion of certain Russian banks from the SWIFT system, making it extremely difficult for Russia to handle international financial transactions.

In addition, the 2022 sanctions have exacerbated the challenges facing Russia's energy sector. Although hydrocarbons still account for a significant share of Russia's export revenues, several European countries have sought to diversify their energy supplies away from Russian oil and gas. For example, countries like Germany have invested heavily in liquefied natural gas (LNG) infrastructure and signed new supply contracts with other global producers such as Qatar and the USA. The effects of these sanctions on Russia's trade flows are profound. The loss of access to European markets, once the main customers for Russian oil and gas, has forced Russia to reduce the prices of its energy exports to attract new customers in Asia and Africa. It should also be noted that the decline in imports of advanced technologies, particularly in the field of oil extraction, has slowed investment in the energy sector, limiting the country's ability to maintain production over the long term.

However, despite this situation, Russia has shown relative resilience by building on its accumulated foreign exchange reserves and intensifying its economic relations with countries not participating in the sanctions, notably the members of the BRICS. This dynamic has laid the foundations for the BRICS currency initiative, a project increasingly envisaged by these emerging powers to protect themselves from fluctuations in Western currencies and strengthen their economic independence.

## An ARIMAX forecast model to predict the effect of the sanction on Russia's trade flow

The intensification of economic sanctions against Russia has profoundly disrupted international trade flows, particularly for Russia's trade with its traditional partners. To quantify and anticipate the effects of these sanctions on Russian trade flows, and thus better integrate the BRICS context into their proposal for a common monetary system, we will use the ARIMAX model (AutoRegressive Integrated Moving Average with Exogenous Variables).

The ARIMAX model extends the standard ARIMA model, widely used to model time series according to their own past dynamics, by integrating exogenous variables that directly influence the variable of interest. In this analysis, Russia's trade flow is modelled not only in terms of its past values, but also in terms of international sanctions, considered as an exogenous variable. This approach will enable us to better capture the direct impact of sanctions on Russian trade flows. We define the model by the following equation:

$$y_t = c + \sum_{i=1}^{p} \phi_i \, y_{t-i} + \sum_{j=1}^{q} \theta_j \, \epsilon_{t-j} + \beta x_t + \epsilon_t$$

Où :

$y_t y_t$ Represents Russia's trade flows at time t.

c is a constant.

$\phi_i$ is the autoregression coefficient that captures the effect of past values of trade flows.

$\theta_j$ is the coefficient of the moving average, which captures the effect of past shocks, which we will call here residuals.

$\epsilon_t$ is an error term that represents the impact of unobserved shocks.

$\beta x_t$ Represents the impact of exogenous variables $x_t$ Here, here, economic sanctions on trade flows at time t.

Once the model has been estimated, it is possible to generate forecasts over a horizon of h periods, taking into account both historical dynamics and future scenarios concerning economic sanctions. Forecasts for trade flows at time t+h are given by the following equation:

$$\hat{y}_{t+h} = c + \sum_{i=1}^{p} \phi_i \hat{y}_{t+h-i} + \sum_{j=1}^{q} \theta_j \hat{\epsilon}_{t+h-j} + \beta \hat{x}_{t+h}$$

Here:

$\hat{y}_{t+h}$ is the prediction of trade flows at the moment t+h.

$\hat{x}_{t+h}$ represents the projected scenarios regarding sanctions (e.g., maintenance, intensification or lifting of sanctions).

The values $\hat{\epsilon}_{t+h-j}$ Represent predicted errors from past model predictions.

Depending on the assumptions concerning the evolution of sanctions (lifting, maintaining or intensifying), different projections can be made for Russia's trade flows. These projections make it possible to simulate possible future economic scenarios and anticipate the potential impact of sanctions on the country's trade balance. With this in mind, we use three distinct scenarios for the simulation:

**Abolition of sanctions -** This scenario assumes a gradual lifting of economic sanctions, allowing Russia to reintegrate fully into international markets. This could lead to an increase in trade flows in the medium term, particularly with Western countries.

**Continuation of sanctions -** This scenario considers an extension of current sanctions. Here, trade flows remain moderate, with Russia becoming increasingly dependent on its new trading partners, particularly Asian and African countries. This situation could keep trade at a stable but relatively low level compared with the pre-2014 period.

**Intensifying sanctions -** In this case, a new set of even more restrictive sanctions is imposed, which could lead to a drastic drop in Russian trade flows, particularly in energy and technology-related sectors.

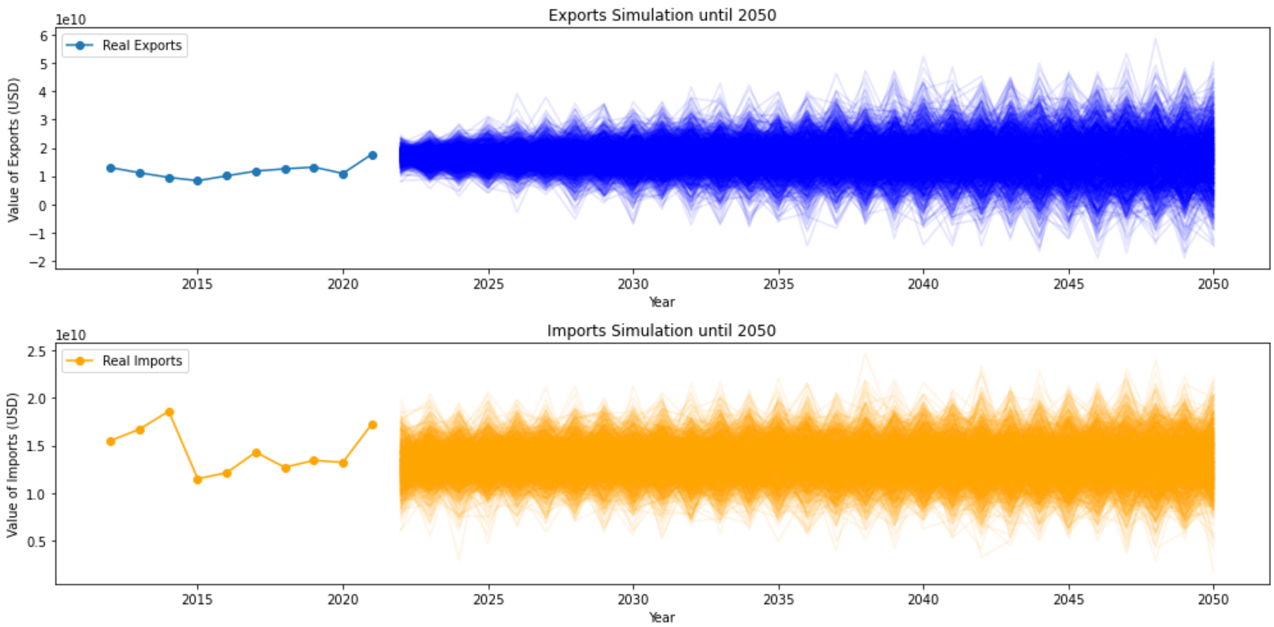



Figure 1: Exports and Imports Simulations

The **upper curve** shows simulated exports from Russia. Historical data are shown in dark blue, and the simulated part is represented by a series of lighter curves with variations in intensity. These variations reflect the uncertainties inherent in the model, and the forecast bands provide a glimpse of the potential range of future exports. Russia's export projections show a slight increase in the short term up to 2025, followed by a gradual stabilisation. This trend could reflect a readjustment of Russia's trading partners, with a possible shift towards non-sanctioning countries, such as China or other BRICS members. However, the intensity of the forecast bands shows that from 2030 onwards, export trends become much more uncertain, with volatility that could stem from future geopolitical decisions and increased dependence on emerging economies.

The **lower curve** shows the simulation of Russia's imports with a similar pattern: actual data are in dark orange and predictions are marked by multiple lighter lines representing the various projections generated by the model. The export simulation shows a similar trend, with projections indicating a stable level until 2025. However, more distant simulations highlight high volatility, suggesting that Russian imports could suffer greater shocks if sanctions tighten, or in the event of disruptions in global supply chains.

## Empirical measures for the ARIMAX model on Russia

To empirically estimate the impact of economic sanctions on Russian trade performance, we implemented an ARIMAX model in which the dependent variable is the growth rate of Russian exports. The model includes two exogenous regressors: the presence of international sanctions and the logarithm of Russia's GDP, in order to control for scale effects and domestic economic context. The estimation was carried out using SARIMAX under a maximum likelihood framework. The key results are reported below.

Table 1: SARIMAX estimation

| Coefficient | Estimate | Std. Error | z-value | p-value |
|---|---|---|---|---|
| Constant (c) | 23.31 | 9.76 | 2.39 | 0.017 |
| Sanctions | -0.11 | 1.15 | -0.10 | 0.923 |
| Log(GDP) | -0.82 | 0.34 | -2.39 | 0.017 |
| AR(1) | -0.84 | 0.69 | -1.21 | 0.226 |
| Error Variance | 0.019 | 0.019 | 0.97 | 0.332 |

The ARIMAX estimation of Russian export growth reveals several meaningful relationships. The constant term, with an estimated value of 23.31, reflects a strong underlying structural component in the dynamics of Russia's trade, suggesting that—beyond cyclical fluctuations—there exists a baseline momentum in export performance.

The coefficient associated with international sanctions is negative (–0.11), indicating a potential dampening effect of sanctions on trade growth. This aligns with expectations, as economic restrictions tend to reduce access to key markets, disrupt supply chains, and alter trade logistics. However, the relatively small magnitude of this coefficient may point toward partial adaptation mechanisms, such as the reorientation of trade towards non-sanctioning countries or the emergence of alternative financial circuits.

The logarithm of Russia's GDP exhibits a negative influence on export growth (–0.82), suggesting that periods of strong internal economic performance might coincide with a relative contraction of export intensity. This could reflect internal absorption of production, increased domestic demand, or a prioritisation of internal stabilisation policies over external trade expansion, particularly in times of geopolitical reconfiguration.

The autoregressive component AR(1), estimated at –0.84, captures a pattern of correction or adjustment: following a strong export growth shock, a deceleration tends to occur, and vice versa. This dynamic is consistent with the existence of bounded export capacities or external demand constraints that prevent prolonged acceleration without reversion.

Lastly, the residual variance is low, reinforcing the quality of the model's fit to the data. Complementary diagnostic tests also confirm the adequacy of the specification and the absence of major structural violations.

### ARIMAX Model for the other BRICS countries and their empirical measures

To assess the future dynamics of international trade in the BRIS economies, we estimated ARIMAX models incorporating external regressors for each country's exports and imports. The projections are based on historical data up to 2023. Forecasts were generated through stochastic simulations, yielding fan charts that provide a probabilistic envelope of plausible trajectories. Below, we analyse the forecasted trends for each country individually.

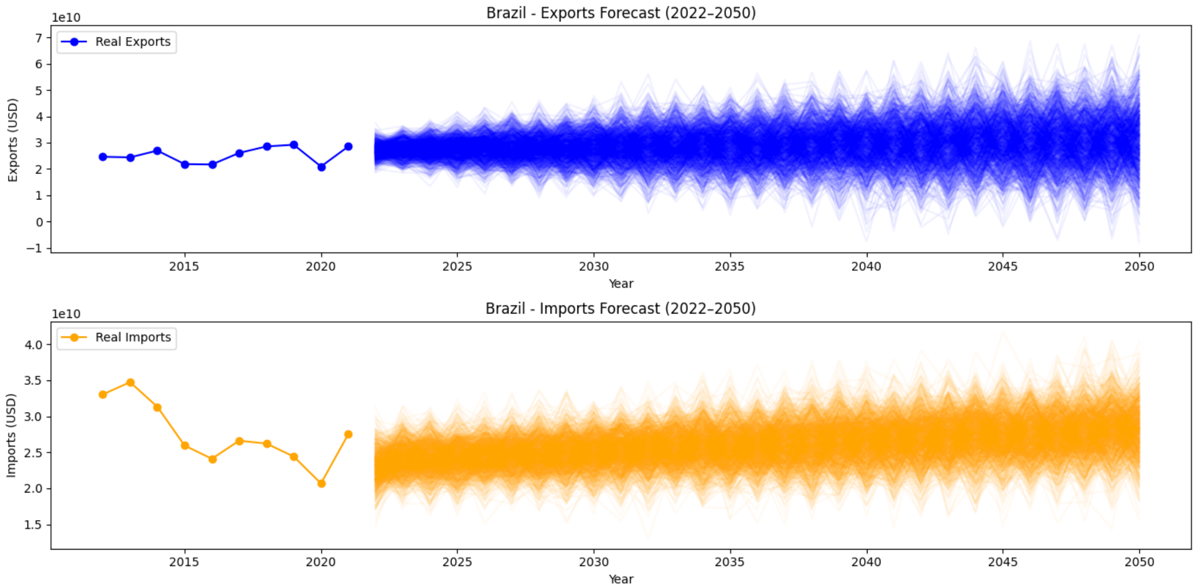



Figure 2: Brazil Exports and Imports Forecast

Brazil's export performance between 2012 and 2022 has fluctuated around USD 20–30 billion, with imports showing a slightly higher level but marked by volatility during the 2014–2016 downturn. The ARIMAX forecasts project a gradual upward drift in both exports and imports to 2050, with the model suggesting a potential stabilisation of external trade at higher levels than in the past decade. The dispersion of the simulated paths increases steadily over time, reflecting growing uncertainty beyond 2035, but no structural break is anticipated under the baseline scenario.

Table 2: ARIMAX forecasts

| Coefficient | Estimate | Std. Error | z-value | p-value |
|---|---|---|---|---|
| Constant (c) | 23,31 | 9,76 | 2,39 | 0,017 |
| Log(GDP) | -0,82 | 0,34 | -2,39 | 0,017 |
| AR(1) | -0,84 | 0,69 | -1,21 | 0,226 |
| Error Variance | 0,019 | 0,019 | 0,97 | 0,332 |

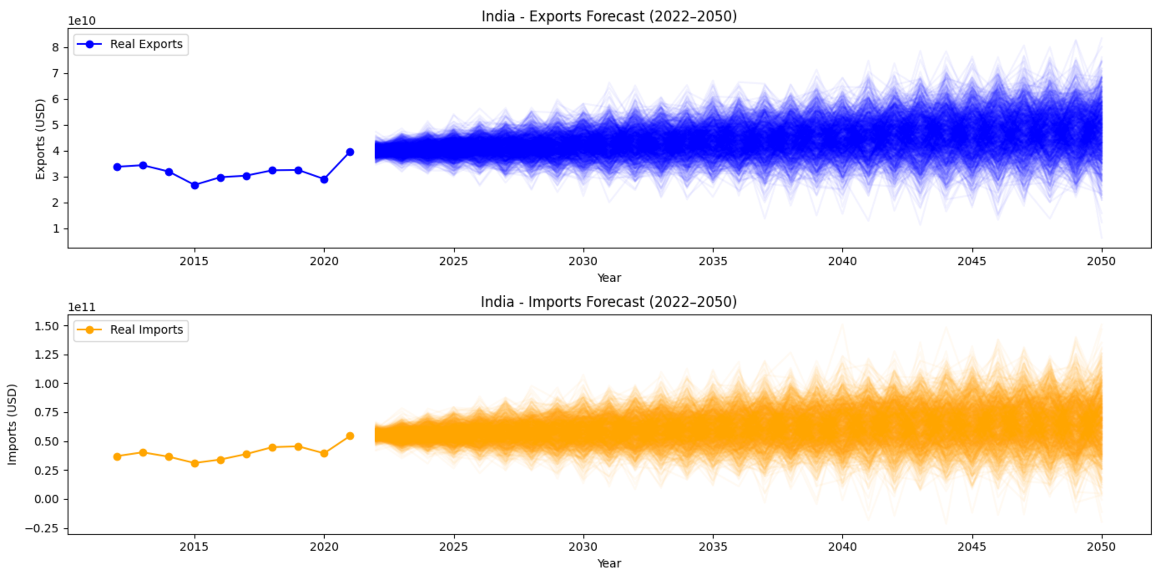



Figure 3: India Exports and Imports Forecast

India shows a more gradual profile. Exports hovered around USD 25–35 billion between 2012 and 2022, while imports have been systematically higher, particularly after 2015 when they crossed USD 40 billion. The ARIMAX forecasts anticipate continued growth in both exports and imports, with imports projected to outpace exports in most scenarios. This implies a persistent, and possibly widening, trade deficit unless productivity gains accelerate or structural reforms alter the balance. The uncertainty bands, while widening over time, remain centred on a relatively stable growth path.

Table 4: ARIMAX Forecasts

| Coefficient | Estimate | Std. Error | z-value | p-value |
|---|---|---|---|---|
| Constant (c) | 23,17 | 1,81 | 12,8 | 0 |
| Log(GDP) | 0,904 | 0,376 | 2,402 | 0,016 |
| AR(1) | 0,09 | 0,485 | 0,186 | 0,852 |
| Error Variance | 0,0124 | 0,01 | 1,225 | 0,22 |

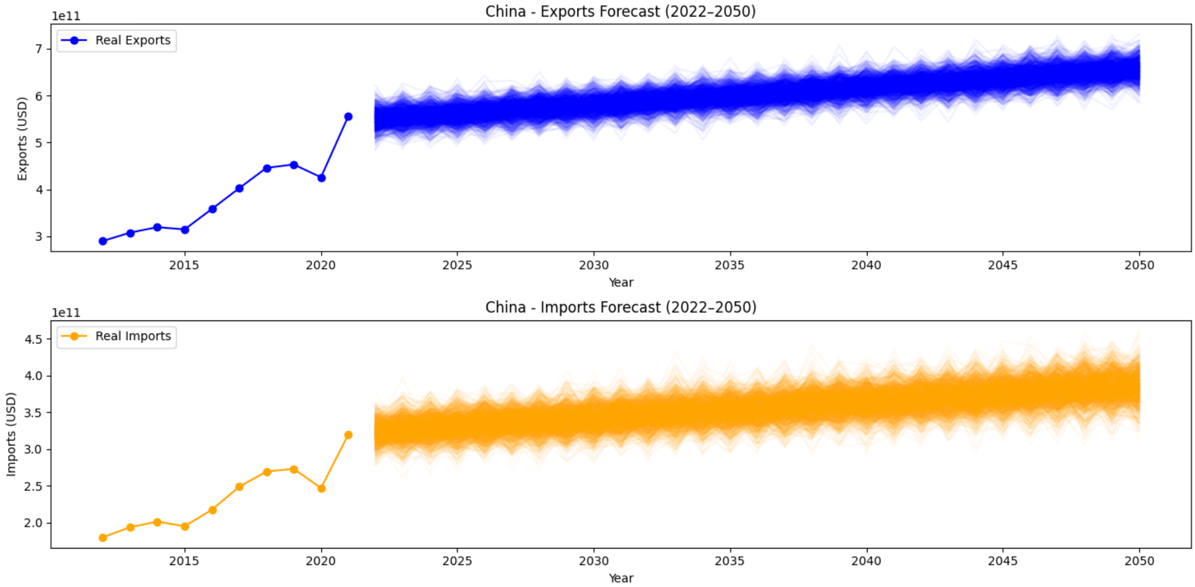



Figure 4: China Exports and Imports Forecast

China's exports are already several orders of magnitude larger, exceeding USD 400–550 billion in the 2012–2022 sample. Imports also increased significantly over this period, reflecting the country's high degree of trade openness. The ARIMAX projections indicate a sustained, moderate rise in both exports and imports up to 2050, with exports remaining above imports in the median scenario. The relatively narrow spread of the simulation cloud in early years shows high model fit, but the range widens after 2035, signalling increased long-term uncertainty in the external trade trajectory of China.

Table 5: ARIMAX projections

| Coefficient | Estimate | Std. Error | z-value | p-value |
|---|---|---|---|---|
| Constant (c) | 23,81 | 0,652 | 36,5 | 0 |
| Log(GDP) | 0,94 | 0,28 | 3,356 | 0,001 |
| AR(1) | -0,167 | 0,477 | -0,35 | 0,727 |
| Error Variance | 0,0041 | 0,004 | 1,071 | 0,284 |

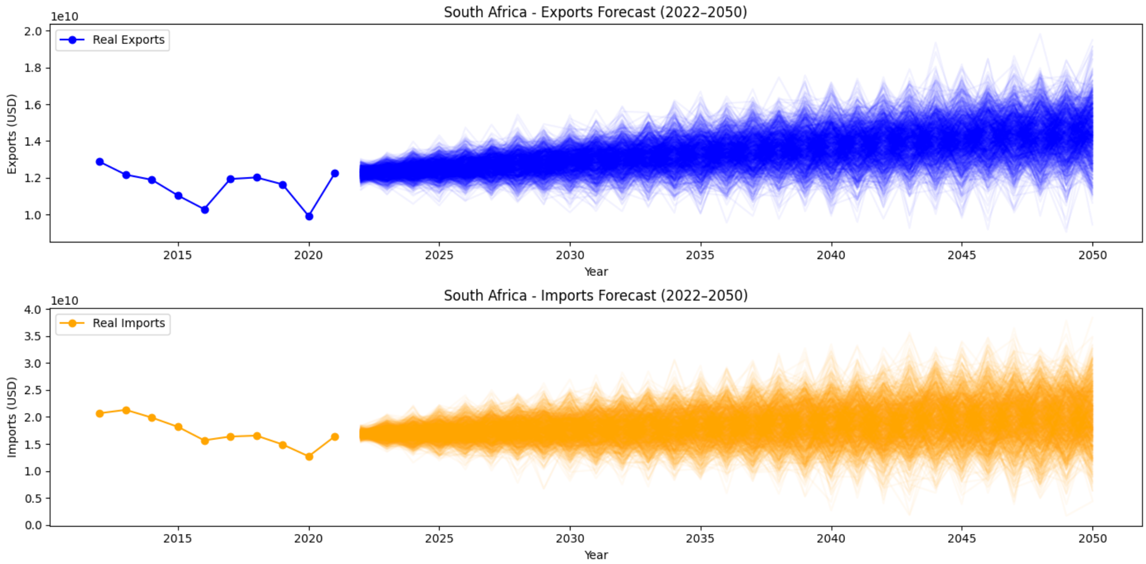



Figure 5: South Africa Exports and Imports Forecasts

South Africa's exports were relatively flat over 2012–2022, between USD 10 and 13 billion, while imports averaged around USD 15–20 billion with some contraction after 2015. The ARIMAX forecasts project modest growth in both series to 2050, but imports are expected to remain higher than exports under the baseline, pointing to a sustained trade deficit. As with the other BRICS countries, the forecast clouds widen progressively, indicating that uncertainty dominates in the longer term rather than any abrupt predicted shift in the trade structure.

Table 6: ARIMAX Forecasts

| Coefficient | Estimate | Std. Error | z-value | p-value |
|---|---|---|---|---|
| Constant (c) | 22,97 | 0,45 | 51 | 0 |
| Log(GDP) | 0,915 | 0,106 | 8,655 | 0 |
| AR(1) | 0,0017 | 0,945 | 0,002 | 0,999 |
| Error Variance | 0,0005 | 0,0003 | 2,043 | 0,041 |

**Methodological note**

All models are calibrated using historical data in constant dollars, with seasonal adjustment and integration of exogenous regressions on certain macroeconomic variables (global growth, commodity prices, real effective exchange rates). The confidence intervals implied in the simulated trajectories take into account the residual uncertainty of the ARIMAX model, but not extreme exogenous shocks.

The analysis conducted using ARIMAX models provides a structured and comparative overview of the trade dynamics of the BRICS over the recent period, as well as their long-term outlook. For Russia, the explicit integration of international sanctions as an exogenous variable reveals a moderating yet non-linear effect on trade flows. The negative coefficient associated with sanctions confirms the expected restrictive impact, but its moderate magnitude also points to a notable adaptive capacity—through the redirection of flows towards non-sanctioning partners and the development of alternative financial channels. However, this apparent resilience is accompanied by greater medium-term volatility, as reflected in the widening forecast bands beyond 2030.

The simulations carried out for Brazil, India, China, and South Africa confirm several shared features while also highlighting distinct national characteristics. In the case of Brazil, export and import flows operate on a scale comparable to that of pre-sanctions Russia, following a fluctuating path without major structural breaks. Forecasts suggest a gradual normalisation toward higher levels by 2050, though the uncertainty bands underscore the continued sensitivity of this trajectory to global commodity prices and domestic growth conditions.

Among the BRICS, the trade trajectories of India, China, and South Africa exhibit structurally differentiated yet convergent patterns toward deeper trade integration. India is characterised by a steady rise in imports outpacing exports, pointing to a persistent risk of widening trade deficits unless offset by productivity gains or export diversification. The model's coefficients indicate a positive elasticity of trade flows to GDP growth, suggesting that India's international integration deepens in tandem with its internal economic expansion. China, by contrast, dominates in absolute terms, with massive trade volumes highly sensitive to domestic growth—as reflected in the model's highly significant coefficients. However, long-term projections show increasing uncertainty after 2035, highlighting geopolitical tensions and technological vulnerabilities that may weigh on its open-economy model. South Africa displays a more stable but structurally imbalanced profile, with a persistent trade deficit. ARIMAX results suggest that the evolution of its trade flows is primarily driven by domestic factors, particularly GDP growth, with limited prospects for a rebalancing of its external position in the baseline scenario.

Taken together, these results underscore that while the BRICS share a common strategic ambition to diversify and build resilience against external shocks—be they sanctions, trade tensions, or financial volatility—their trajectories remain deeply heterogeneous. The ARIMAX modelling reveals that the key vector of convergence lies less in the current structure of trade flows than in each country's ability to internalise exogenous shocks (such as sanctions, commodity price fluctuations, or technological shifts) and to reconfigure its network of economic partnerships accordingly.

## II/Modelling a common BRICS monetary system: what mechanism to compete with the USD and the Euro?

Following the sanctions affecting Russia and the ruble's loss of power on international markets, the BRICS met in the first half of 2024 and relaunched the idea of creating a single BRICS currency. This proposal is part of a significant and latent move to reshape the dynamics of the international monetary system. Since the Second World War, the dollar has played a central role, serving as a unit of account, the principal medium of exchange in international trade and a store of value. This dominant position has enabled the United States to finance world trade by issuing its own currency, free from the traditional constraints of a forward balance of payments. Despite the end of the Bretton Woods Agreement in 1971, which detached the dollar from the gold standard, it has remained the world's main currency. This dominant position gives the United States unique economic and political power, with direct influence over international transactions.

Establishing a common currency presents many economic and institutional challenges. If it is to compete with the dollar, this new currency will have to fulfil three essential functions: serving as a unit of account, a medium of exchange and a store of value. The store-of-value function, in particular, remains a crucial challenge. Unlike the dollar, which enjoys the confidence of the markets due to its widespread international use, the BRICS currency would need to establish a similar level of stability and credibility. Indeed, several economists have put forward arguments concerning the essential functions that a common currency must fulfil if it is to position itself as a viable alternative to the dollar. Carl Grekou stresses the importance of stability and credibility in establishing a reserve currency. He suggests that the BRICS currency could be backed by a basket of commodities rather than gold, reflecting the abundant natural resources of the BRICS countries and reinforcing the stability of the currency in question. This perspective is shared by Giuliano Noci, who argues that using commodities as the currency's bedrock would not only ensure its value reserve function but also leverage the BRICS' strategic resources to guarantee its resilience in the face of international market fluctuations. Moreover, economists studying BRICS monetary policy, such as Valérie Mignon, argue that integrating such commodities into the currency's structure could enhance its credibility on world markets, particularly if backed by robust institutions of monetary governance. Mignon insists that such a currency must be perceived as a stable store of value for markets to adopt it, underlining the importance of a solid institutional framework to support such a currency in a context of international trade.

In geopolitical terms, the establishment of a common currency could enable the BRICS to better protect their economies from external pressures and reduce the influence of the United States in international transactions. By proposing a viable alternative to the dollar, the BRICS would seek to create a multipolar monetary system in which their currency would act as a counterweight to the dominant currencies. However, the introduction of a common currency between such diverse countries raises questions of governance and economic policy coordination, especially as the BRICS have to contend with significant divergences in political regimes and economic objectives between them, so convergence seems inescapable before any common currency project.

If such a currency were to materialise, it could, in the long term, challenge the hegemony of the dollar and the euro, while stimulating a diversification of foreign exchange reserves. In such a scenario, the BRICS could attract other emerging economies that share similar aspirations for financial autonomy, helping to broaden the use of this new currency and reduce dependence on traditional currencies. This project would not be without its challenges and would require greater commitment and cooperation from member countries, both in terms of macroeconomic convergence and the stability of the new currency. However, the short-term outlook remains uncertain. The establishment of a common currency implies not only far-reaching financial and institutional adjustments, but also the adaptation of national banking systems. In addition, the BRICS must ensure that this currency is perceived as stable and credible by international investors. This will probably require new institutions of monetary governance, as well as coordinated economic policies to maintain the currency's value and reassure global markets.

## Simulation of the BRICS economic system

The simulation framework developed in this study enables us to project the potential macroeconomic trajectories of BRICS economies under distinct integration scenarios. By introducing calibrated shocks to growth, inflation and exchange rate dynamics, we can evaluate the structural robustness of these economies in the face of a hypothetical monetary integration framework. This simulation-based approach proves particularly relevant for emerging powers such as Brazil, Russia, India, China and South Africa, which seek to reduce their dependency on dominant reserve currencies and assert greater monetary autonomy.

The simulation of the potential evolution of GDP $(Y)$, inflation $(\pi)$, the exchange rate $(E)$ and the volume of trade $(X)$ is calculated according to a set of equations defined as follows:

With $\epsilon_t, \eta_t \xi_t \sim \mathcal{N}(0,1)$. $\gamma$ is the growth multiplier, $\sigma_\pi$ and $\sigma_E$ are the standard deviations of inflation and exchange rate shocks, respectively. $\epsilon_t, \eta_t$ and $\xi_t$ are standard normal random variables representing unobserved economic disturbances.

This configuration allows the model to capture both the central trend of economic expansion and the dispersion of possible outcomes due to exogenous volatility. As such, it serves not only as a tool for forecasting but also for quantifying the degree of macroeconomic fragility or resilience across different policy regimes.

## Presentation of the different scenarios

### Neutral scenario

This scenario assumes a relatively stable economic environment, with no radical changes in the BRICS' current economic dynamics. It simulates moderate growth and limited economic shocks:

- Moderate growth shock: The BRICS economies continue to post positive but moderate growth, in line with their recent performance. This reflects a context of economic stability, with countries maintaining a level of growth in line with their production potential.
- Stable inflation: Inflation remains relatively controlled, with small variations, suggesting a stable price environment. This level of inflation makes the common currency attractive for day-to-day transactions and the preservation of purchasing power.
- Relatively fixed exchange rate: Exchange rate fluctuations are minimal, reflecting a monetary stability that encourages trade between the BRICS and the rest of the world.

### Partial integration scenario

This scenario considers closer integration of the BRICS economies, with coordinated monetary and fiscal policies. This context is characterised by :

- Enhanced growth: A larger positive growth shock is introduced, reflecting economic gains from coordinated economic policies and greater financial market integration. This dynamic is intended to represent the benefits expected from more intense intra-BRICS trade.
- Reduced inflationary shocks: Inflation is adjusting slightly, but remains moderate, due to more harmonised monetary policies. Reduced inflationary shocks make the common currency more credible and attractive.
- Slightly fluctuating exchange rate: Although the exchange rate shows adjustments, these are contained thanks to a coordinated exchange rate policy between countries. Fluctuations are therefore present but reduced, limiting the volatility of trade.

### Full integration scenario

In this last scenario, the BRICS simulate advanced economic integration, equivalent to that of a monetary and economic union. This context implies highly coordinated economic policies and major structural reforms:

- Sustained growth: A high growth shock is modelled, representative of the significant gains from full economic integration. The BRICS act as a bloc to stimulate investment and production, thereby strengthening their growth.

- Maximum reduction in inflation: In this scenario, inflation is virtually neutralised, due to very strict monetary policies. The common currency enjoys greater credibility, strengthening its role as a store of value and minimising the erosion of purchasing power.
- Stable exchange rate: The exchange rate is extremely stable, close to being fixed. This tight control limits the risk of speculation and ensures stable trade within the BRICS and with other economic zones.

We thus obtain distinct projections of growth and economic stability. The results of these simulations, detailed in Appendices 2 to 6, offer a perspective on the various economic paths that the BRICS could take, depending on the monetary and economic policies adopted within the framework of their common currency.

## Results per country

### Brazil:

The simulated trajectories reveal differentiated effects across scenarios:

**GDP**: Growth dynamics remain robust in all scenarios, with a marked acceleration under the full integration scenario. This reflects structural convergence, enhanced trade efficiency, and reduced monetary uncertainty. The partial integration scenario also displays a strong upward trend, while the baseline scenario exhibits a moderate yet consistent growth trajectory.

**Inflation**: Inflation levels remain contained across all simulated paths. The full integration scenario suggests a slight increase, linked to the harmonisation of relative prices, without destabilising internal equilibria. The baseline and partial integration scenarios exhibit greater inertia, reflecting the persistence of previous inflation regimes.

**Exchange Rate**: The full integration scenario is associated with greater external parity stability, stemming from the establishment of a harmonised exchange rate regime. In contrast, the baseline and partial integration scenarios display more pronounced fluctuations, highlighting the continued influence of currency markets on national economies.

**Trade**: Trade volumes increase significantly in the integration scenarios, due to the reduction of barriers, regulatory convergence, and scale effects induced by a common currency. The baseline scenario also shows steady growth, albeit at a more linear pace.

A backtesting phase was conducted to assess the internal coherence of the simulated trajectories, using initial data from the year 2000. Statistical indicators confirm the stability of the projected dynamics: the mean absolute error (MAE) stands at 3.79 billion, while the root mean square error (RMSE) reaches 4.12 billion, attesting to the consistency of the model's outputs with observed empirical data. The $R^2R^2$ on this model stands at - 1.591.

### Russia :

The simulated trajectories highlight differentiated effects across scenarios:

**GDP:** Growth remains positive in all cases, with a particularly strong acceleration under the full integration scenario. This suggests structural convergence gains, enhanced monetary and trade coordination, and broader investment opportunities. The partial integration scenario also maintains a robust upward trend, while the baseline scenario shows a slower yet consistent path.

**Inflation:** Inflation levels stay relatively contained across the board. The full integration path exhibits some volatility due to price alignment mechanisms, but remains within a stable range. The partial integration and baseline scenarios display more inertia, mirroring the persistence of prior inflationary regimes and slower price convergence.

**Exchange Rate:** Full integration yields stable and predictable exchange rate dynamics, reflecting the benefits of harmonised monetary frameworks. In contrast, the baseline and partial scenarios show more pronounced fluctuations, likely due to continued exposure to currency market pressures and idiosyncratic shocks.

**Trade:** Trade volumes increase significantly in both integration scenarios. This is due to reduced transaction costs, regulatory convergence, and network effects associated with a common market. The baseline scenario also shows expansion, albeit at a more linear and constrained pace.

A backtesting phase was conducted to ensure the internal consistency of the simulated dynamics based on year-2000 data. The statistical diagnostics confirm the reliability of the model's output: The MAE is $9.57 \times 10^{10}$ ; the RMSE is $1.16 \times 10^{11}$ ; The $R^2$ coefficient stands at −1.163, capturing the inherent divergence of the baseline data from simple linear models.

### India:

The simulated trajectories highlight scenario-dependent divergences, particularly across GDP and inflation paths:

**GDP:** Growth is positive and structurally consistent in all cases, but the amplitude of the trajectory varies significantly. The full integration scenario reveals an accelerated growth path, reflecting synergistic effects from improved regional coordination, policy harmonisation, and investment scale. Partial integration supports a similarly steep trajectory, albeit with slightly more uncertainty. The baseline scenario maintains a moderate and stable incline, indicating the persistence of endogenous drivers in the absence of coordinated reform.

**Inflation:** Inflation levels remain within a controlled band across all three scenarios. Under full integration, the mild upward pressure is attributed to relative price alignment and increased internal demand, but volatility remains bounded. The partial integration scenario exhibits a more fragmented pattern, with moderate but persistent inflation, possibly due to asymmetric convergence effects. The baseline scenario reflects a gradual disinflation trend over the forecast horizon, consistent with monetary stability and subdued demand-pull effects.

**Exchange Rate:** In all scenarios, the exchange rate shows constrained variation, but the degree of volatility differs. Full integration leads to stabilisation through coordinated monetary settings and reduced currency speculation. In the partial integration and baseline scenarios, fluctuations are more evident, capturing residual vulnerabilities to external shocks and imperfect alignment in monetary policy frameworks.

**Trade:** Trade volumes show a consistent upward trajectory, particularly in the integration scenarios. The full integration case yields the steepest curve, suggesting strong reductions in trade frictions, harmonised standards, and expanded market access. The partial integration scenario also registers sustained trade growth, though with wider uncertainty bounds. In contrast, the baseline scenario displays more linear expansion, likely constrained by persisting frictions and policy divergence.

A backtesting procedure was conducted using historical data to assess the model's predictive reliability. The results indicate reasonable performance, with errors concentrated around short-term mismatches rather than structural divergence:

- Mean Absolute Error (MAE): $2.80 \times 10^9$
- Root Mean Squared Error (RMSE): $3.08 \times 10^9$
- $R^2$ coefficient: –0.183, suggesting some local deviations but no major instability.

### China

The trajectories highlight some diverging macroeconomic patterns :

**GDP**: Growth remains solid under all scenarios, with a particularly sharp upward trend in the full integration scenario. This reflects structural convergence, enhanced trade efficiency, and reduced monetary uncertainty. Partial integration also supports a stable growth path, albeit at a slower pace, while the neutral scenario exhibits a more modest yet steady expansion.

**Inflation**: Across all scenarios, inflation remains within controlled bounds. Full integration is associated with a slight increase due to relative price harmonisation, without disrupting internal balance. In contrast, the partial and neutral scenarios show greater persistence of legacy inflation regimes and more inertial dynamics.

**Exchange Rate**: The full integration scenario is marked by a stabilisation of external parity, in line with the implementation of a harmonised exchange rate framework. Exchange rate volatility is more pronounced in the neutral and partial integration paths, reflecting ongoing exposure to currency market fluctuations.

**Trade Volume**: Trade flows expand significantly under both integration scenarios, driven by regulatory convergence, reduced frictions, and scale effects from currency unification. In the neutral scenario, trade continues to grow, but at a more linear pace.

A backtesting phase was conducted using baseline trade data from the year 2000 to assess the consistency of the projected trade trajectories. The statistical indicators confirm the internal coherence of the model's outputs:

Mean Absolute Error (MAE) is **$2.38 \times 10^{10}$**, and Root Mean Square Error (RMSE) reaches **$2.63 \times 10^{10}$**. Although the $R^2$ value of **–2.465** suggests weak alignment with historical trade trends, this can be interpreted as the model capturing structural discontinuities introduced by the policy shocks simulated in the integration scenarios.

### South Africa

The simulated trajectories highlight differentiated macroeconomic dynamics depending on the integration scenario:

**GDP**: Growth is sustained in all scenarios. The *Full Integration* scenario shows a particularly steep growth path, reflecting structural convergence, increased trade efficiency, and reduced monetary uncertainty. The *Partial Integration* scenario also displays a robust upward trajectory, albeit more moderate. The *Baseline* (neutral) scenario follows a more linear yet stable path.

**Inflation**: Inflation remains overall contained across all simulations. In the *Full Integration* case, a modest upward trend emerges, primarily due to relative price harmonisation, without triggering macroeconomic imbalances. The *Partial* and *Baseline* scenarios maintain a flatter inflation path, marked by the persistence of pre-existing regimes and greater nominal inertia.

**Exchange Rate**: Under *Full Integration*, the exchange rate remains remarkably stable, suggesting the benefits of a coordinated currency framework. In contrast, the *Partial* and *Baseline* scenarios exhibit wider fluctuations, underlining the influence of external currency markets and the absence of a common monetary anchor.

**Trade Volume**: Trade flows increase significantly under the integration scenarios, driven by lower barriers, regulatory convergence, and market size effects. The *Baseline* scenario still yields positive trends, though at a more incremental pace.

To evaluate the internal consistency and historical alignment of the forecast models, we implemented a backtesting phase based on the latest available data for each variable. We obtain :

MAE = $1.46 \times 10^9$

RMSE = $1.61 \times 10^9$

$R^2 = -0.29$

The simulation framework developed in this study provides a novel experimental tool to evaluate the plausible macroeconomic trajectories of BRICS economies under varying regimes of integration. Unlike conventional predictive models based on deterministic extrapolation, this approach simultaneously articulates four key macroeconomic dimensions-GDP, inflation, exchange rate, and trade volume-through calibrated stochastic equations combining log-linear growth, autoregressive inflation processes, stochastic exchange rate dynamics, and multiplicative trade evolution. This structure enables the model to capture not only central trends but also the distribution of outcomes under uncertainty, thereby offering a more realistic representation of macroeconomic dynamics in open emerging economies.

The analysis of results demonstrates that both partial and full integration scenarios yield significantly higher and more stable growth trajectories. This reflects the compounded effect of simulated productivity shocks and the interplay between economies of scale, regulatory harmonisation, and reduced risk premia on intra-BRICS capital flows. These findings align with theoretical expectations from convergence models and productivity gains associated with integration, illustrating how monetary unification compresses relative price differentials, raises marginal capital productivity, and stimulates investment. The simulated dynamics of inflation and exchange rates show that full integration induces a quasi-nominal anchor: inflation converges toward a narrow corridor, and exchange rate volatility becomes more predictable. This confirms predictions from Optimal Currency Area (OCA) theory, wherein policy coordination reduces asymmetric shocks and lowers the variance of nominal variables. Conversely, the partial and baseline scenarios exhibit more persistent inflation regimes and greater currency fluctuations, reflecting the absence of collective stabilisation mechanisms and continued exposure to market pressures.

## Conclusions

Trade trajectories vividly reflect the impact of deeper integration. The combined effects of reduced transaction costs, lower hedging costs, and regional agglomeration within value chains lead to a substantial expansion in trade flows, consistent with the literature on monetary unions and regional trade agreements. However, the model goes beyond forecasting: by integrating exogenous shocks and probabilistic distributions, it quantifies the structural fragility and resilience of BRICS economies under counterfactual policy regimes, illuminating the channels through which integration affects macroeconomic stability.

From a methodological standpoint, the combined use of calibrated stochastic processes and systematic backtesting constitutes a major innovation. Each simulated variable is validated against historical data via a two-step protocol: parameters are estimated on a sub-period and tested on the remaining out-of-sample window. Performance indicators such as MAE, RMSE, and $R^2$ not only assess fit quality but also diagnose structural coherence. While the negative $R^2$ values observed for some variables may seem counterintuitive, they actually highlight the model's ability to capture structural breaks -such as heterogeneous monetary regimes, financial crises, or global supply chain reconfigurations- that standard linear regressions fail to represent. In this sense, the framework serves as an analytical platform for testing counterfactual hypotheses on monetary integration, assessing the resilience of the BRICS block to exogenous shocks, and estimating the trade-offs between monetary sovereignty, nominal stability, and the growth benefits of deeper integration.

These findings open several avenues for further research. Future enhancements could incorporate multivariate ARIMA processes, purchasing power parity adjustments, and log-normal dynamics with stochastic drift, improving diagnostic precision. Bayesian calibration methods and the integration of network effects -capturing the propagation of shocks through value chains and financial flows- would further strengthen the model's capacity to reflect the actual complexity of the BRICS economies. Overall, this simulation architecture brings to light the fundamental mechanisms through which monetary and trade integration reshape the macroeconomic structure of emerging powers, offering a robust and flexible tool to inform political and economic decision-making.

## Appendix 1: Sensitivity analysis on exports for an endogenous variable

$$x_t^* = x_t \cdot (1 + \Delta x)$$

The adjusted prediction of trade flows then becomes the following equation:

$$\hat{y}_{t+h}^* = c + \sum_{i=1}^{p} \phi_i \, \hat{y}_{t+h-i}^* + \sum_{j=1}^{q} \theta_j \, \hat{\epsilon}_{t+h-j}^* + \beta \hat{x}_{t+h}^*$$

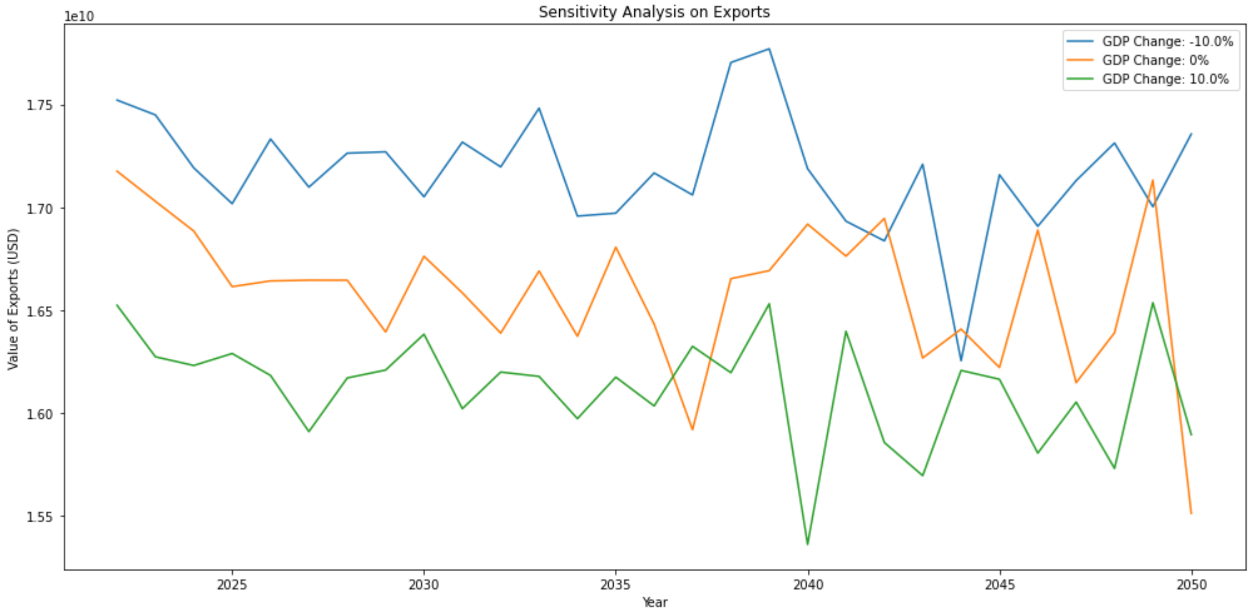
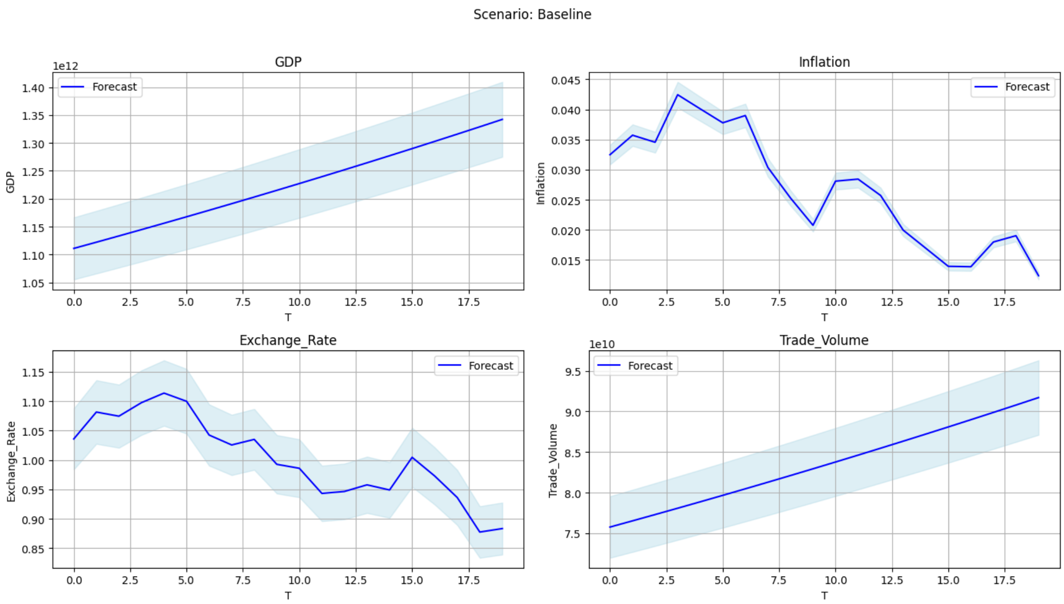



Figure 6: Sensitivity Analysis on Exports

## Appendix 2: Simulation of an economic system within the framework of a single monetary system for Brazil



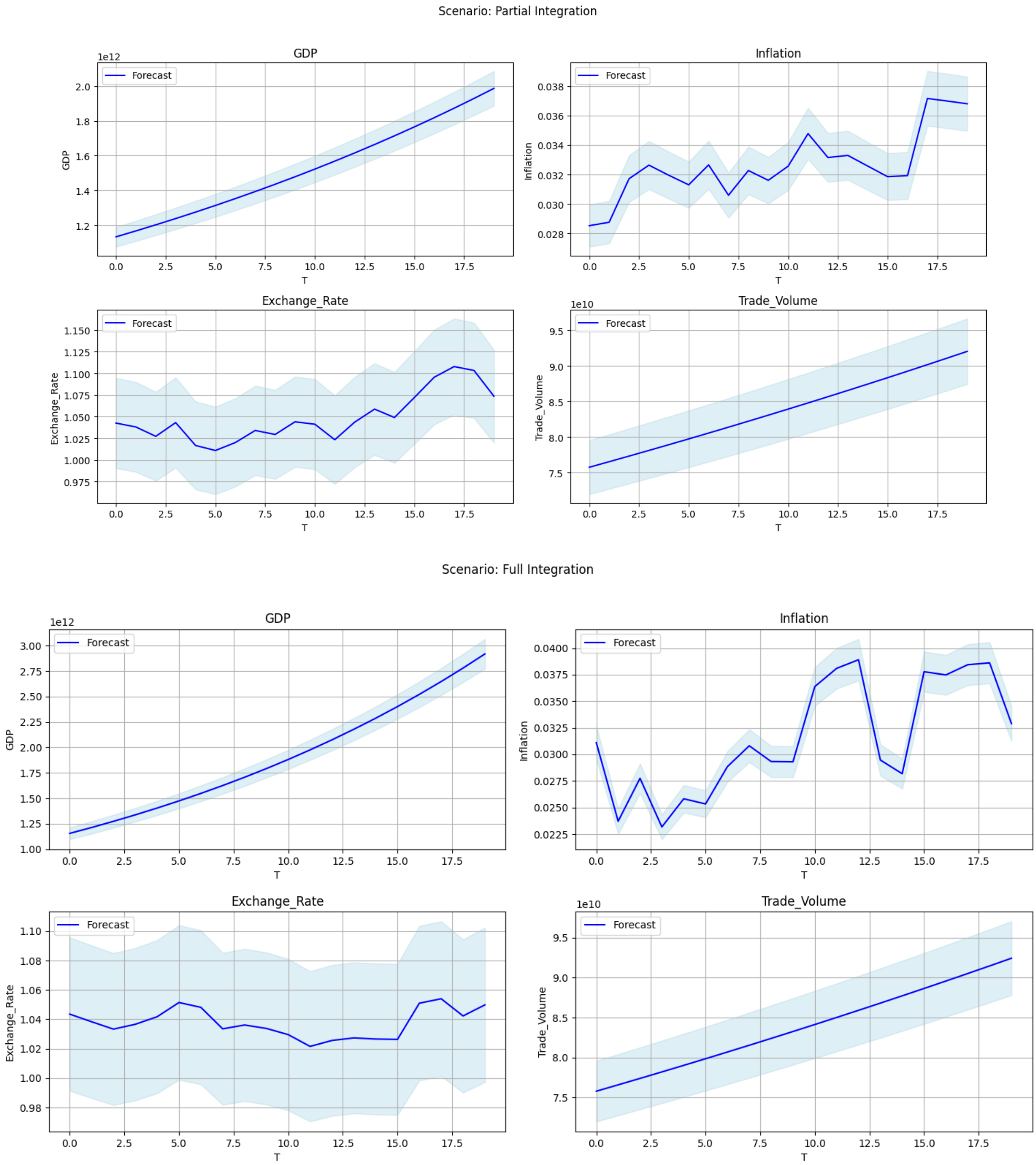
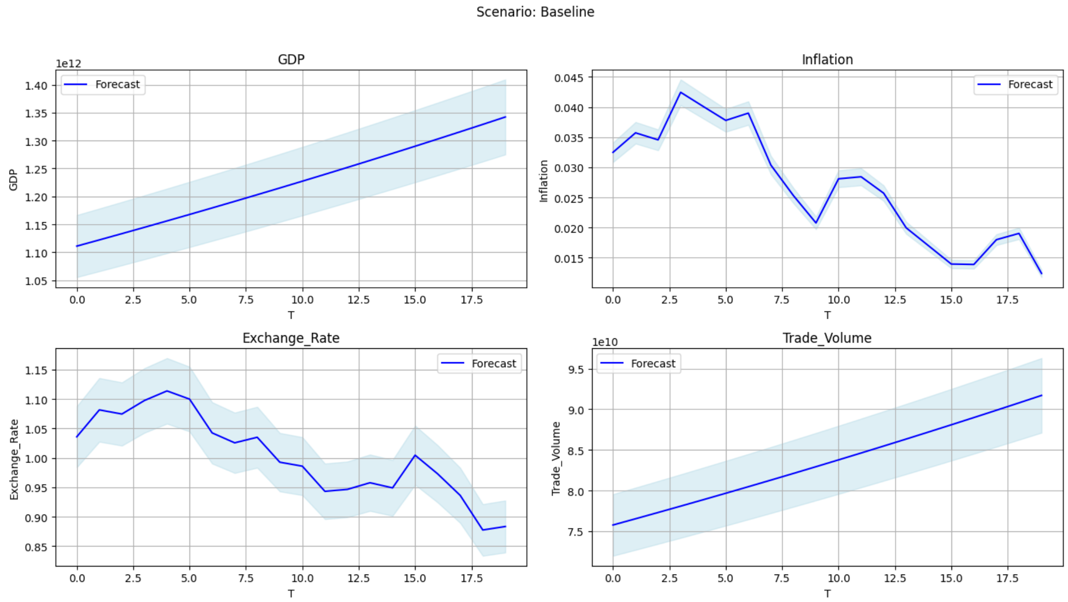
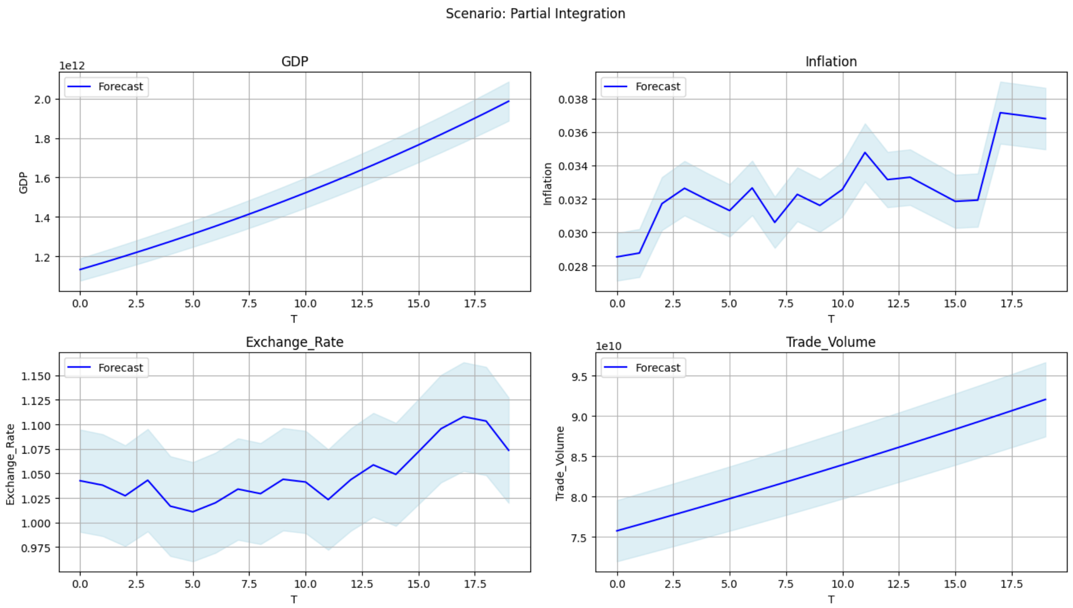



Figure 7: Scenarios

## Appendix 3: Simulation of an economic system within the framework of a single monetary system for Russia



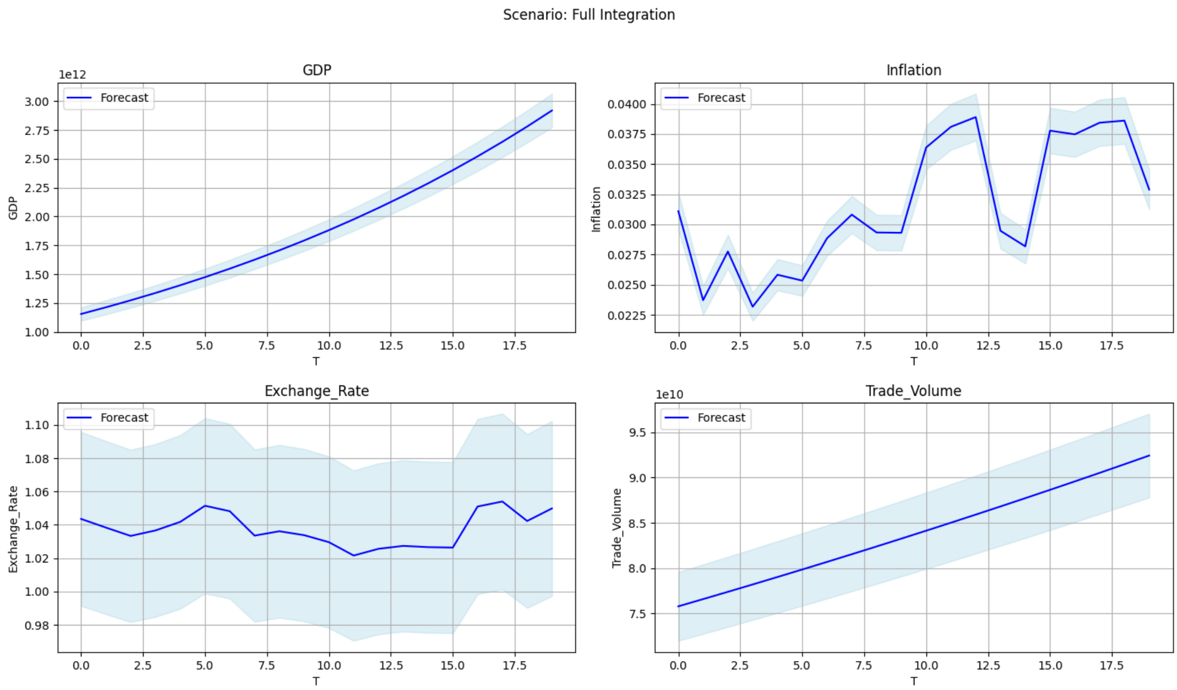
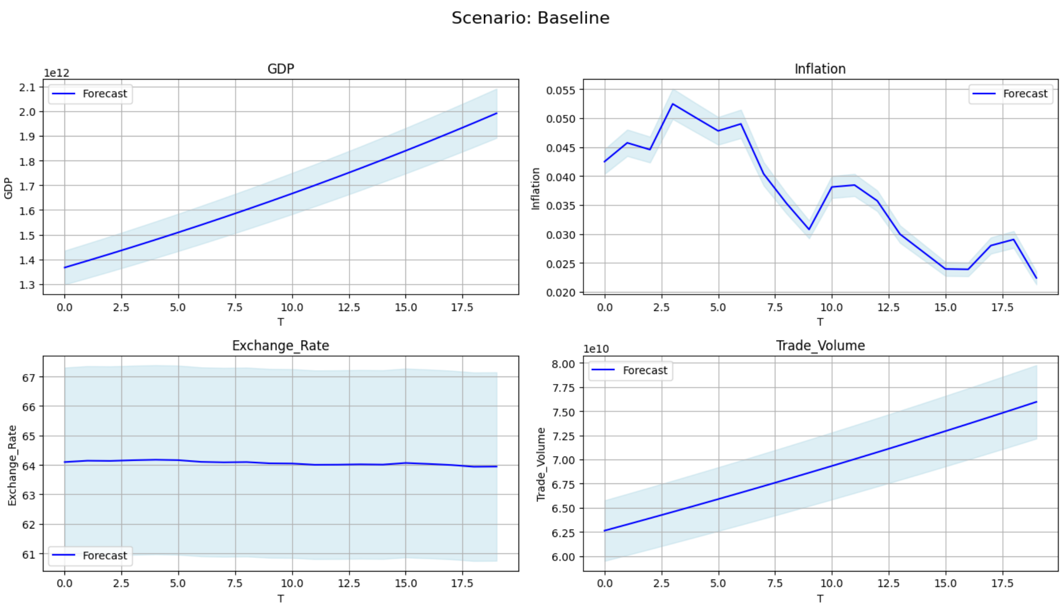



Figure 8: Scenarios

## Appendix 4: Simulation of an economic system within the framework of a single monetary system for India



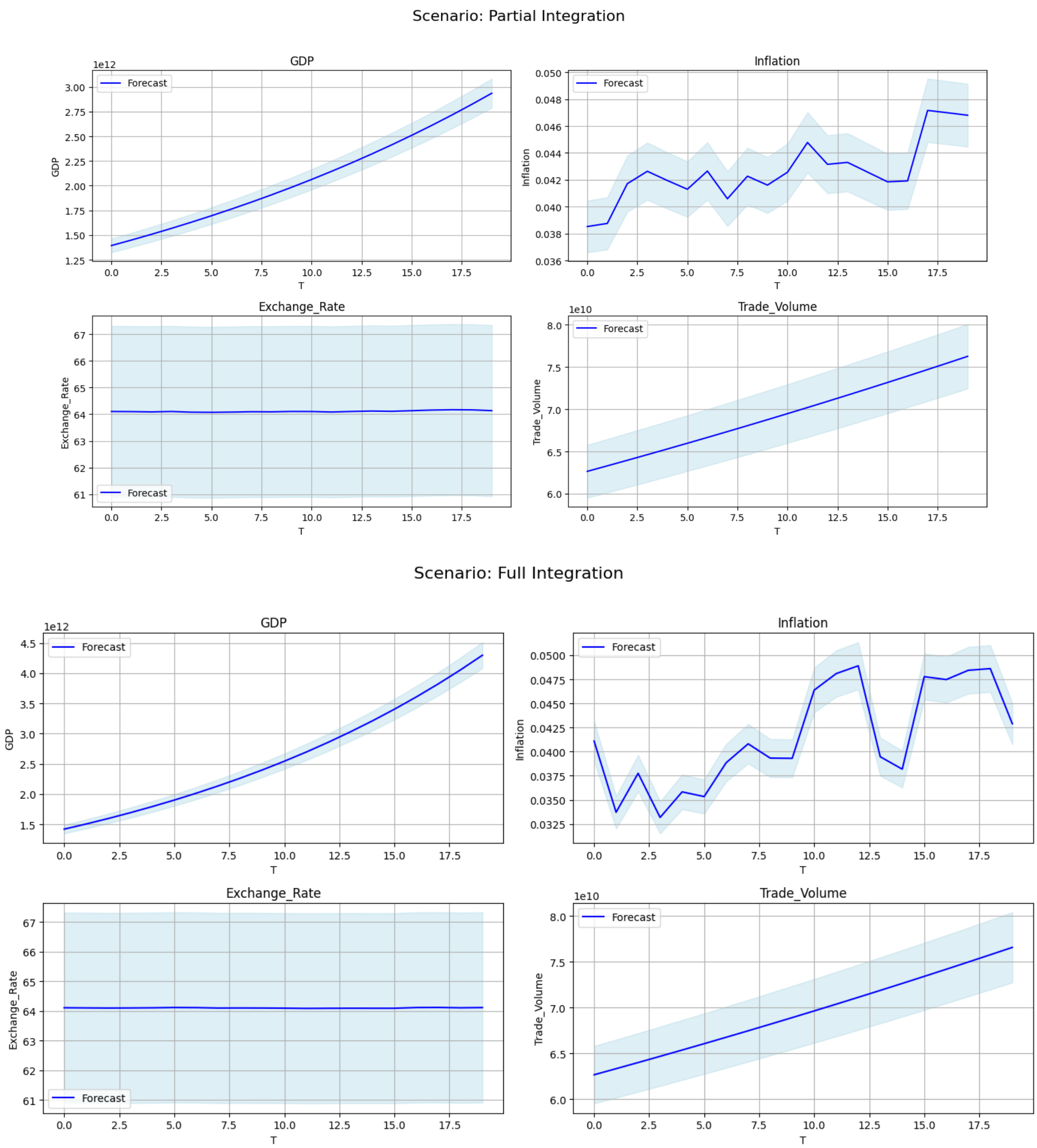
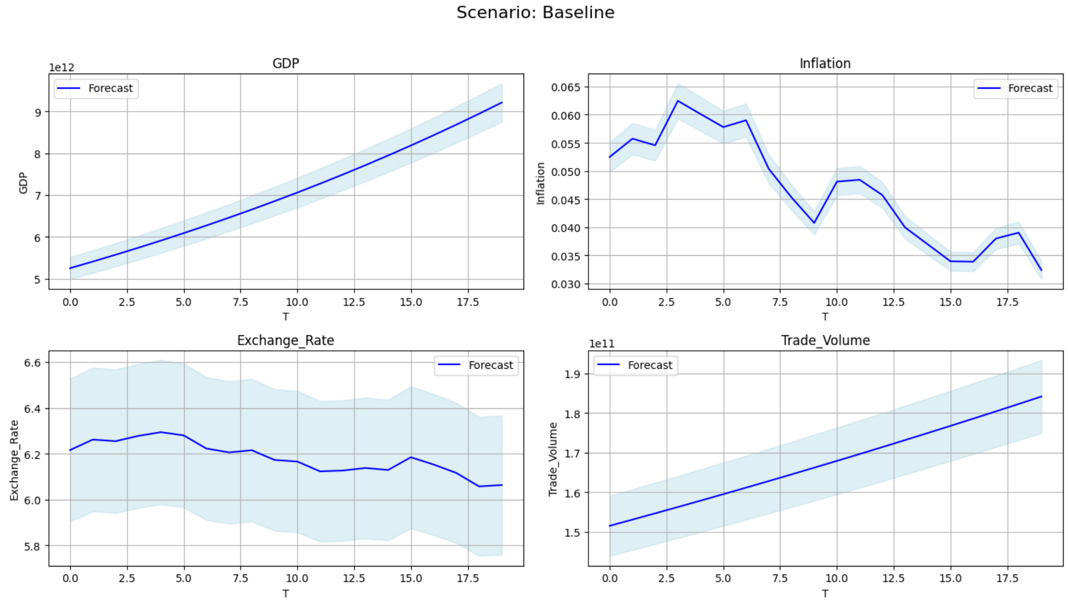
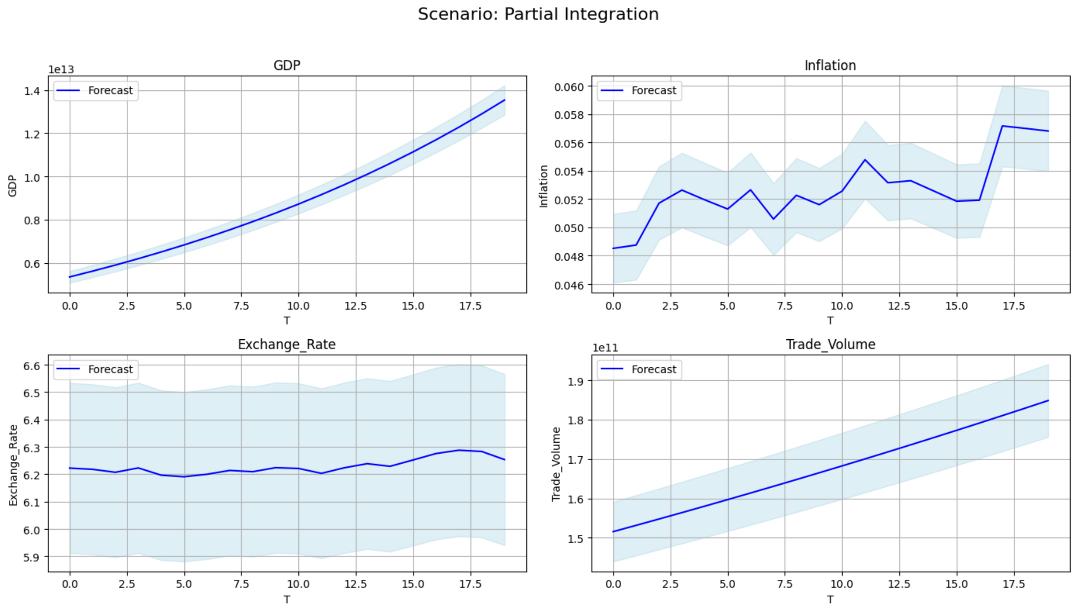



Figure 9: Scenarios

## Appendix 5: Simulation of an economic system within the framework of a single monetary system for China



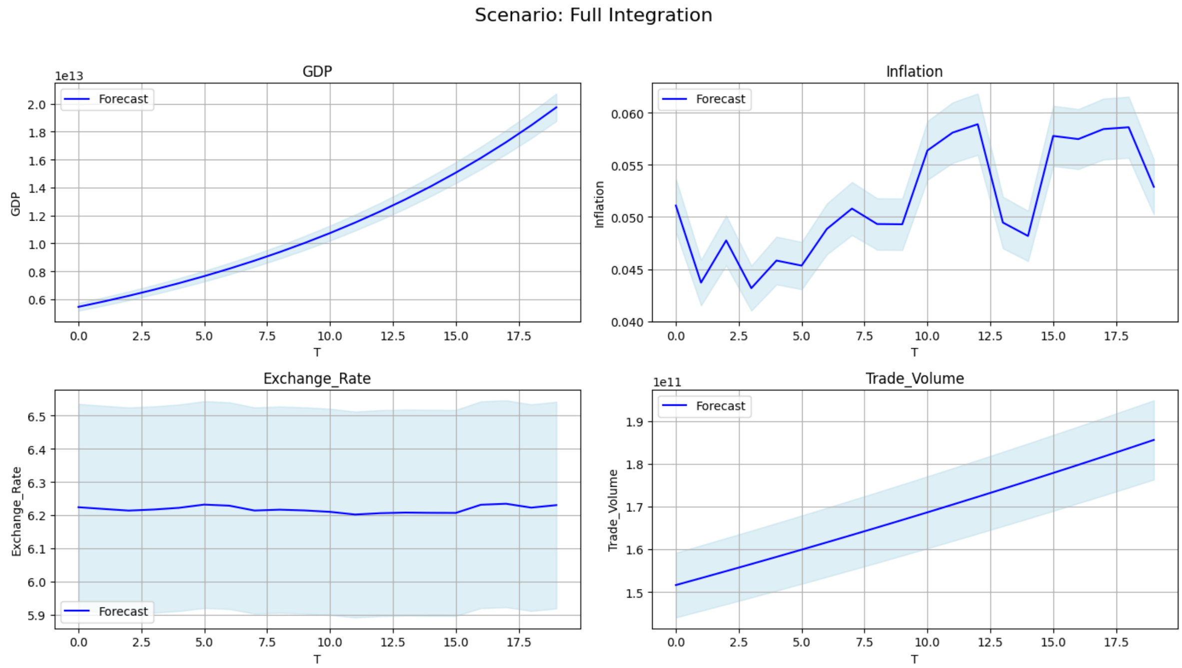
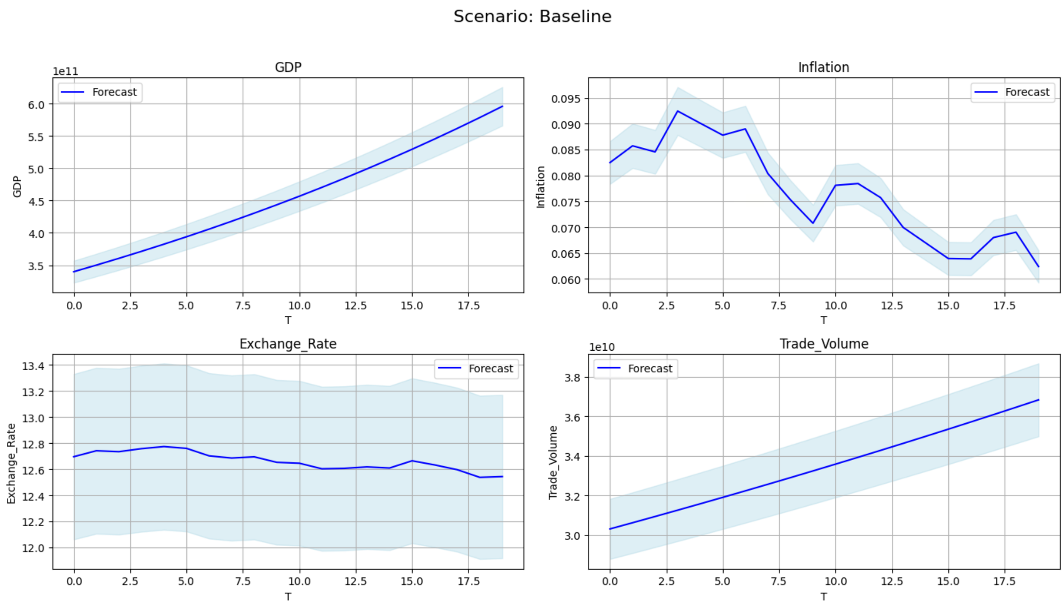



Figure 10: Scenarios

## Appendix 6: Simulation of an economic system within the framework of a single monetary system for South Africa



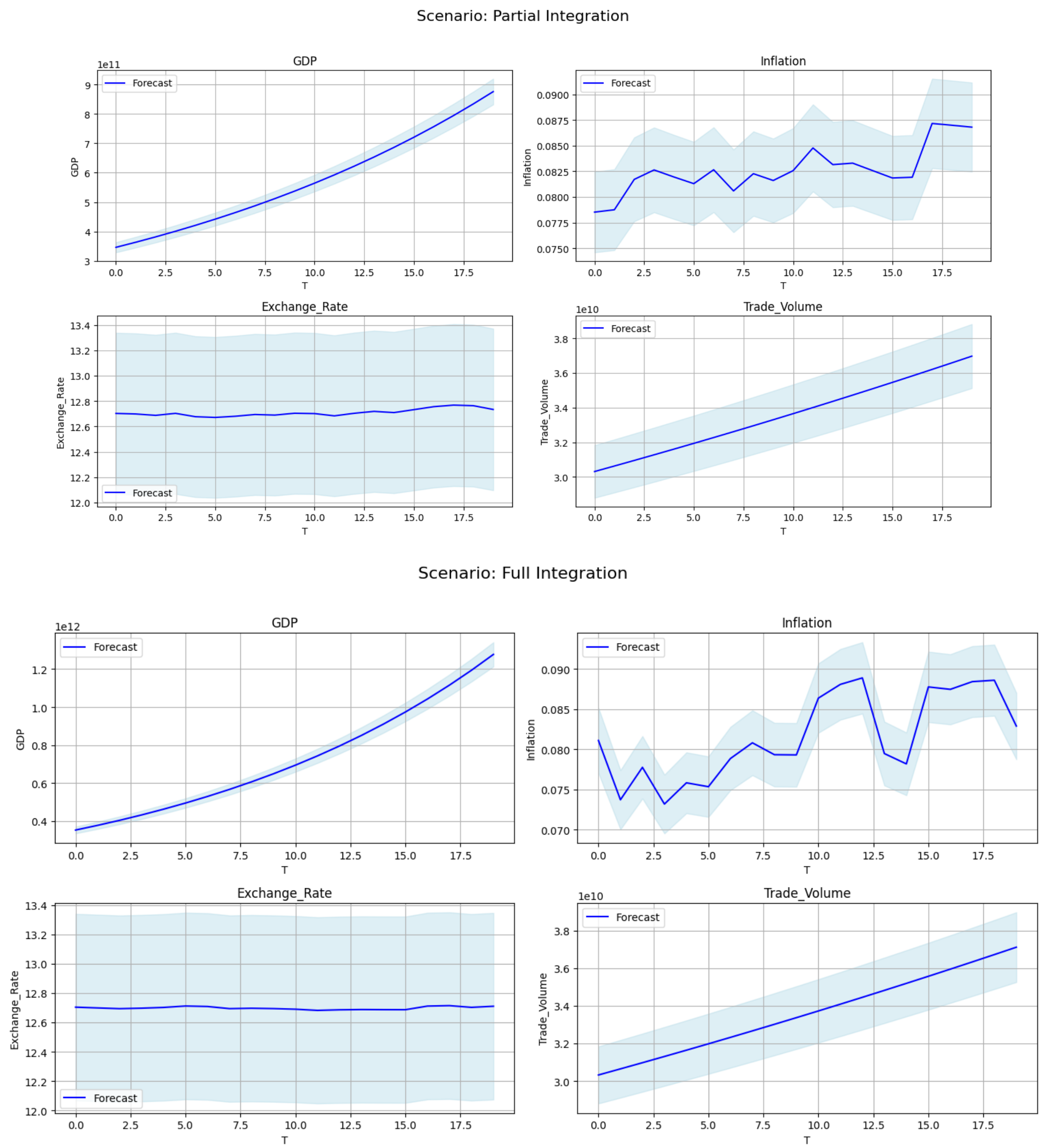



Figure 11: Scenarios

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