

Economic Development and Price Level Convergence in BRICS Countries: An Exploratory Analysis of World Bank Indicators

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Executive Summary

This case study uses World Bank data on BRICS countries—Brazil, Russia, India, China, and South Africa—to examine long-run patterns in economic development and price-level convergence from 1970 to 2020. Focusing on three core indicators of economic performance—GDP per capita (current US\$), the GDP deflator as a proxy for inflation, and the price level ratio of PPP to market exchange rates—the report first conducts a detailed exploratory data analysis and then interprets the resulting patterns for policy and planning purposes. Descriptive statistics, normality diagnostics, and outlier detection reveal that all three indicators are strongly non-normal and highly skewed, with particularly large cross-national differences in GDP per capita and inflation volatility. Visualizations, including time-series plots and pairwise scatterplots, show that GDP per capita has increased in all BRICS countries but along very different trajectories, with China experiencing rapid, sustained growth and India following a slower but steady path, while Brazil, Russia, and South Africa exhibit more cyclical and volatile patterns. Correlation analysis on a cleaned dataset indicates a strong positive association between GDP per capita and the price level ratio, suggesting that higher-income BRICS members tend to experience greater convergence between PPP-based and market-based exchange rates, whereas inflation dynamics are only moderately related to income growth. These findings imply that policymakers in emerging economies must manage not only the pace of growth but also relative prices and exchange-rate regimes if they wish to sustain gains in living standards. The remainder of the report elaborates these results, acknowledges limitations such as missing data and the absence of causal identification, and concludes with recommendations for how similar exploratory techniques can be used to monitor macroeconomic outcomes and inform future policy analysis.

Introduction & Current Situation Analysis and Background

Introduction

Emerging economies play an increasingly prominent role in shaping global growth, yet their development paths, inflation experiences, and exchange-rate dynamics can differ markedly from those of advanced economies and from one another. Recent macroeconomic work emphasizes that emerging economies follow diverse structural trajectories despite being grouped for political or analytical convenience (Aiyar et al.). The BRICS countries—Brazil, Russia, India, China, and South Africa—are frequently treated as a single bloc in policy discussions, but this label may obscure important variation in how quickly living standards have improved and how closely domestic price levels track international benchmarks. These dynamics reflect foundational principles of international economics, particularly those associated with purchasing-power-parity and price convergence (Balassa 586; Cassel 414). Understanding these patterns is critical for governments, international organizations, and investors who must make long-term decisions about fiscal policy, monetary policy, and development priorities. This case study examines a subset of World Bank indicators for BRICS countries over the period 1970–2020 in order to describe key macroeconomic trends and to assess the extent to which economic growth is associated with price-level convergence.

The intent of this analysis is twofold. Prior studies highlight the value of using GDP per capita, price indices, and PPP adjustments as core indicators of long-run economic performance (Barro 12; Feenstra et al.). First, it aims to summarize the central tendencies and dispersion of three core economic indicators—GDP per capita, the GDP deflator, and the price level ratio—across countries and over time, providing a clear empirical picture of how BRICS economies have evolved. Second, it seeks to investigate relationships among these indicators,

particularly whether higher income levels are systematically associated with smaller gaps between PPP-based and market-based exchange rates. Rather than estimating causal effects, the report focuses on descriptive and correlational evidence that can inform subsequent, more formal modeling. In this sense, the case study functions as both a stand-alone assessment of BRICS macroeconomic patterns and a foundation for future work that could incorporate additional variables or more sophisticated econometric techniques.

Current Situation Analysis and Background

The data used in this report are drawn from the World Bank's World Development Indicators, as compiled in the BRICS World Bank Indicators dataset. The analysis is restricted to five countries—Brazil, Russia, India, China, and South Africa—and to annual observations between 1970 and 2020. From the larger database, three indicators were selected to represent complementary dimensions of macroeconomic performance. GDP per capita (current US\$) captures average income and overall economic development. These measures are widely used in comparative macroeconomics to evaluate long-term productivity and real-income dynamics (Barro 67). The GDP deflator serves as a broad measure of price changes in the economy and acts as a proxy for inflation. The price level ratio compares PPP-based GDP to GDP converted at official exchange rates, providing insight into how domestic price levels diverge from or converge toward international price benchmarks. Such PPP-to-exchange-rate comparisons have long been central to understanding international price distortions and valuation gaps (Samuelson 147). Together, these indicators allow for an integrated view of real income, inflation, and relative prices in the BRICS context.

An exploratory data analysis was first conducted to understand the basic structure of the dataset before any formal modeling decisions were made. Summary statistics show large cross-country variation in income levels and inflation histories, with GDP per capita ranging from just over one hundred dollars to nearly sixteen thousand dollars within the sample, and GDP deflators spanning from near zero to more than 180 percent. This degree of dispersion is consistent with findings from global inflation-volatility studies in emerging markets (IMF). Normality tests and visual diagnostics confirm that all three variables are strongly skewed and non-normal, a common feature of macroeconomic data in emerging markets, and suggest that parametric methods assuming normality should be applied cautiously. Outlier detection using the interquartile-range rule identifies a small number of extreme GDP per capita observations, primarily high-income years in Russia and South Africa; these are removed from the cleaned dataset used for correlation analysis, while the raw series are retained for time-series visualization. Such outliers are well-documented in long-run cross-national datasets due to political transitions and commodity-price cycles (World Bank). The background analysis, therefore, establishes both the strengths and limitations of the data: the long time span and consistent definitions support meaningful comparisons, but missing values, skewed distributions, and a narrow set of indicators constrain the scope for causal inference. Building on this foundation, the remainder of the case study examines trends and relationships among the three variables and discusses their implications for understanding economic development and price-level convergence in BRICS countries.

Key Issues, Goals, and Problems

Although BRICS countries are often grouped together in public discourse, they differ substantially in their levels of economic development, inflation histories, and degrees of integration into the global economy. These divergences have been repeatedly emphasized in comparative-development research analyzing emerging-market structural heterogeneity (Aiyar et al.). A central issue for policy makers is whether rapid growth in income is accompanied by more stable prices and by convergence of domestic price levels toward international benchmarks, or whether growth occurs alongside persistent distortions in inflation and exchange rates. Without a clear empirical description of how GDP per capita, inflation, and price-level ratios have evolved over time, it is difficult to evaluate the effectiveness of past macroeconomic policy choices or to plan for future interventions.

The primary goal of this case study is therefore to use the World Bank BRICS dataset to build an evidence-based picture of macroeconomic performance along three dimensions: real income (GDP per capita), inflation (GDP deflator), and relative prices (price level ratio). The analysis seeks to document long-run trends in these indicators, to quantify the extent of cross-country dispersion, and to identify whether higher income levels are systematically associated with more “normal” price dynamics and closer alignment between PPP and market exchange rates. In doing so, the study aims to translate raw data into a coherent narrative that can inform strategic decisions by governments and international organizations about growth, price stability, and currency management.

At the same time, several problems complicate interpretation. The dataset covers a long time span during which BRICS economies experienced regime changes, crises, and structural reforms, any of which may affect the comparability of indicators across years. The analysis is

also constrained to three macro-level variables and does not incorporate distributional outcomes, such as inequality or poverty, that matter for social policy. Finally, because the study is descriptive and correlational rather than causal, it cannot determine whether growth causes price-level convergence or vice versa. These limitations underscore the need to interpret the findings as a foundation for discussion and future modeling rather than as definitive evidence of causal effects.

Decision Criteria

Given these goals and constraints, the findings of this case study are evaluated against several decision criteria. First, results must be empirically transparent: summary statistics, graphs, and diagnostic tests should make it clear how the indicators behave across countries and over time, allowing readers to trace conclusions directly back to the data. Second, the patterns identified should be substantively interpretable in economic and policy terms. For example, a strong positive association between GDP per capita and the price level ratio is only useful if it can plausibly be linked to mechanisms such as Balassa–Samuelson effects, exchange-rate policy, or trade integration. The Balassa–Samuelson framework remains the dominant explanation for systematic links between income levels and relative prices (Balassa 586).

A third criterion is robustness to data irregularities. Because the indicators are skewed and contain outliers, decisions about trimming or transforming the data must be explicit and defensible. The cleaned dataset used for correlation analysis should preserve the core signal while minimizing the undue influence of extreme observations. Finally, the analysis is judged by its ability to inform decisions, not merely by statistical sophistication. The case study should

highlight patterns that could shape discussions about monetary and fiscal policy in BRICS countries—such as whether sustained growth tends to coincide with stable inflation or with convergence in price levels—even if the underlying methods are primarily descriptive. Meeting these criteria ensures that the report aligns with the course’s emphasis on using data to give voice to policy-relevant narratives.

Assumptions

The analysis rests on several explicit assumptions that are important for interpreting the results. First, it assumes that the World Bank indicators used in the BRICS dataset are measured consistently over time and across countries. While minor revisions and methodological changes are inevitable in long-running data series, the study treats the published values of GDP per capita, the GDP deflator, and the price level ratio as sufficiently comparable to support cross-national and longitudinal analysis. These indicators are among the most commonly used variables for cross-country macroeconomic comparison (Feenstra et al.). Second, the report assumes that these three indicators, although limited, capture key aspects of macroeconomic performance that are relevant to decisions about growth and price-level management. In other words, GDP per capita is taken as a reasonable proxy for average living standards, the GDP deflator as a broad measure of inflation, and the price level ratio as an informative summary of PPP versus market exchange-rate differences.

Methodologically, the analysis assumes that descriptive and correlational techniques are appropriate for the questions being asked. Because the goal is not to estimate causal effects but to characterize patterns, the use of summary statistics, graphical exploration, and simple correlation

coefficients is considered adequate. The decision to remove GDP per capita outliers using the interquartile-range rule is based on the assumption that these extreme observations may distort correlation estimates without materially changing the substantive narrative about long-run trends. Finally, the study implicitly assumes that unobserved factors—such as political shocks, institutional reforms, or external crises—are not so dominant as to render the three selected indicators uninformative on their own. These assumptions do not eliminate uncertainty, but by stating them clearly the report acknowledges the limitations of the analysis and sets appropriate expectations for how its findings should be used in subsequent policy discussion or modeling.

Data Analysis

The exploratory analysis begins by assessing the overall distributional characteristics of the three central macroeconomic indicators—GDP per capita, the GDP deflator, and the price-level ratio—across BRICS economies from 1970 to 2020. Summary statistics presented in Table 1 show that these variables exhibit unusually wide dispersion: GDP per capita ranges from barely above one hundred US dollars in the early years of India and China to nearly sixteen thousand dollars in Russia, while the GDP deflator spans from negligible inflation to extremely high percentage increases, and the price-level ratio varies between 0.20 and 0.88. These large ranges indicate that the BRICS grouping masks pronounced structural heterogeneity, and that each indicator should be expected to behave differently across time and across countries.

Table 1. Summary Statistics (1970–2020)

Variable	Mean	SD	Min	25%	Median	75%	Max
GDP per capita	3406.01	3571.82	112.43	501.32	2099.23	5166.16	15974.64
GDP deflator	50.35	45.58	~0	6.98	42.53	82.81	183.69
Price level ratio	0.433	0.147	0.204	0.312	0.423	0.547	0.881

To understand these distributional patterns more precisely, each indicator's empirical distribution was examined using histograms overlaid with kernel density estimates. The distribution of GDP per capita, shown in Figure 1, is sharply right-skewed, reflecting both the large gap between low-income and high-income BRICS countries and the acceleration of China and Russia's incomes during the later decades. This impression is reinforced by the corresponding QQ plot in Figure 2, where the curvature in the upper tail departs significantly from the 45-degree reference line. Together, these visual patterns confirm that GDP per capita cannot be treated as approximately normal.

Figure 1 (Histogram of GDP per capita)

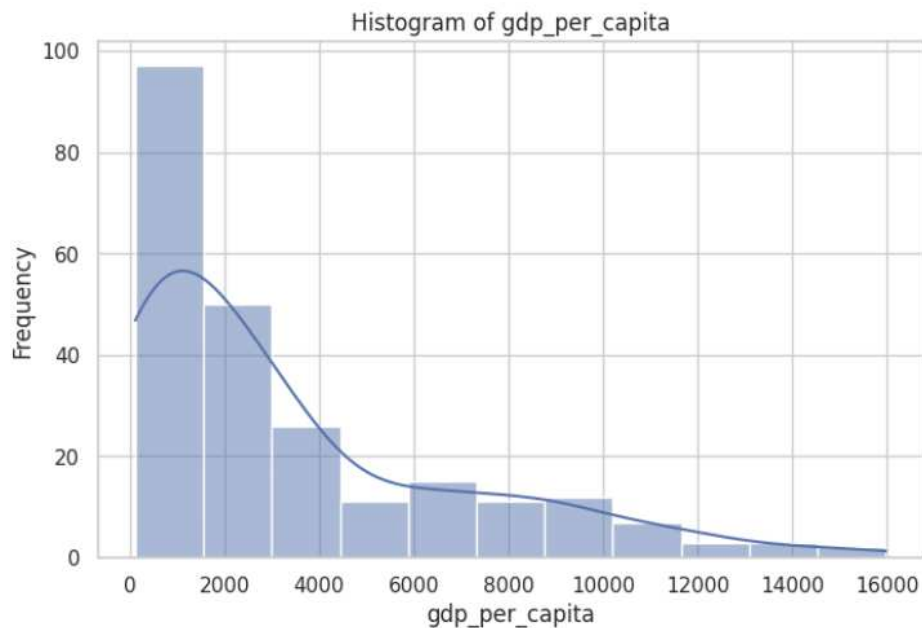
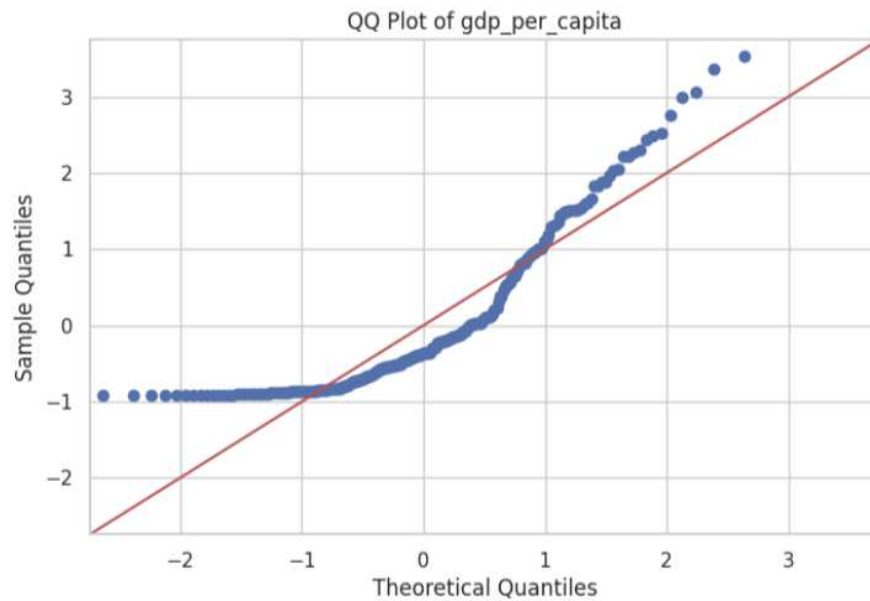


Figure 2 (QQ Plot for GDP per capita)



A similar pattern emerges for the GDP deflator. The distribution displayed in Figure 3 shows that inflation levels are highly concentrated at low values in some years but display extreme spikes in others, consistent with inflation volatility in emerging economies. The QQ plot in Figure 4 again demonstrates heavy right-tail behavior rather than a symmetric Gaussian shape. These patterns suggest that price instability varies widely among BRICS members, with inflation spikes tied to political transitions, fiscal crises, or external shocks.

Figure 3 (Histogram of GDP deflator)

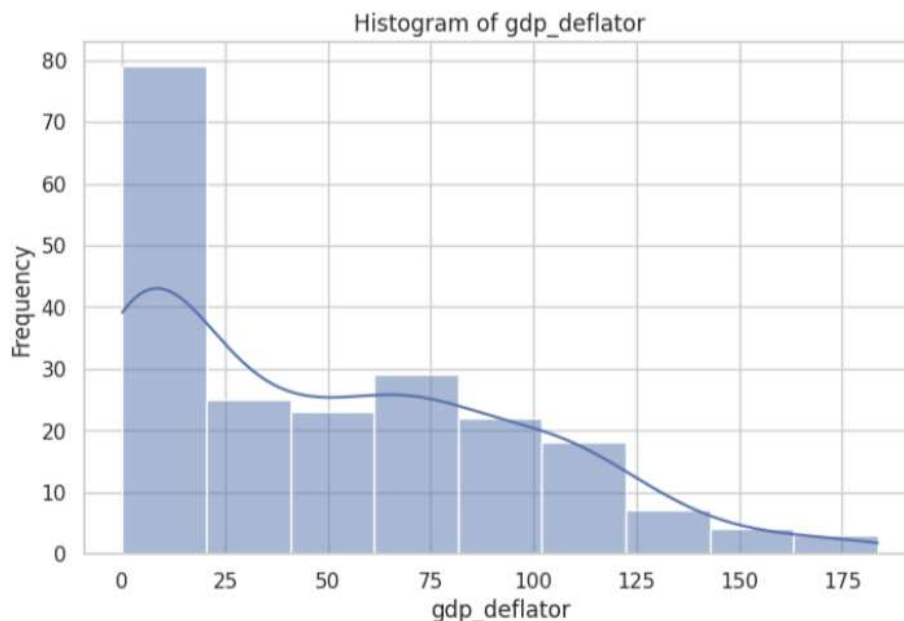
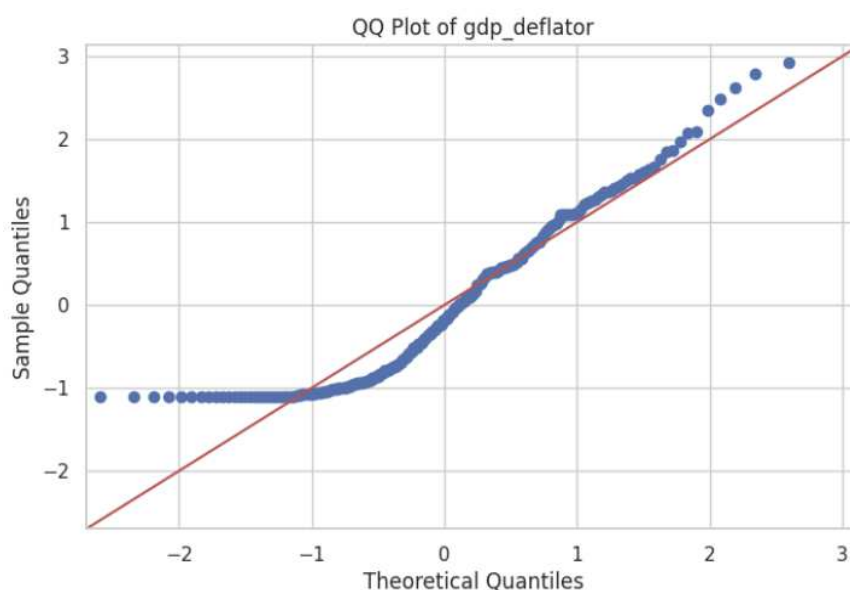


Figure 4 (QQ Plot for GDP deflator)



The price-level ratio—the relationship between domestic price levels and international parity—exhibits a narrower but still asymmetric distribution. As shown in Figure 5, most observations cluster toward the lower end, with a long upward tail indicating years in which domestic prices approach international levels. The QQ plot in Figure 6 confirms mild but persistent skewness. Taken together, the six diagnostic plots establish that none of the indicators

conforms to normality, justifying the use of non-parametric and correlation-based techniques throughout the analysis.

Figure 5 (Histogram of price level ratio)

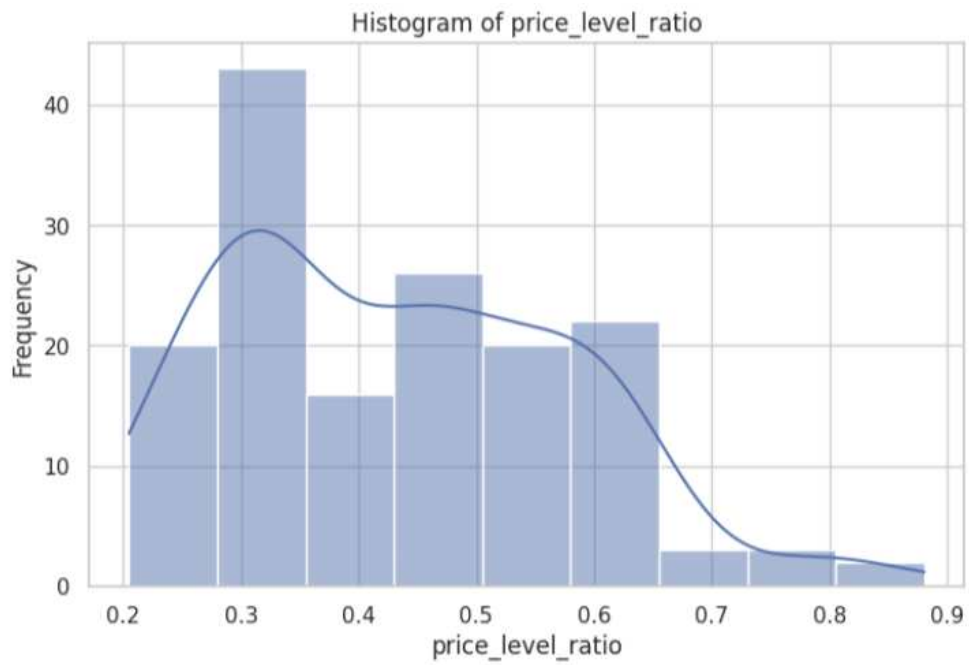
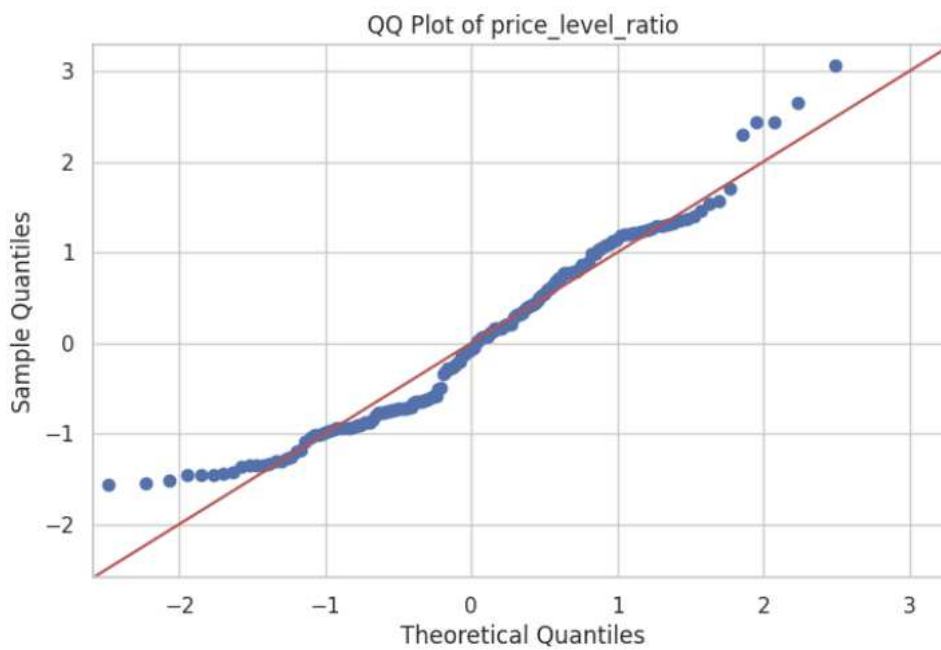


Figure 6 (QQ Plot for price level ratio)



Because the distributions are heavily skewed, especially for GDP per capita, the data were examined for influential outliers. Seven extreme income observations were detected using the interquartile range rule. Their influence is visually apparent in the pre-cleaning boxplot in Figure 7, where several observations lie far above the upper whisker. After removing these observations, the boxplot in Figure 10 shows a more compact distribution with reduced extreme-value leverage. Removing these outliers improves the stability of correlation estimates without altering the substantive long-run trends visible in the time-series plots.

Table 2. Correlation Matrix (Outliers Removed)

Variable	GDP per capita	GDP deflator	Price level ratio
GDP per capita	1.00	0.58	0.80
GDP deflator	0.58	1.00	0.23
Price level ratio	0.80	0.23	1.00

Figure 7 (Boxplot of all 3 variables)

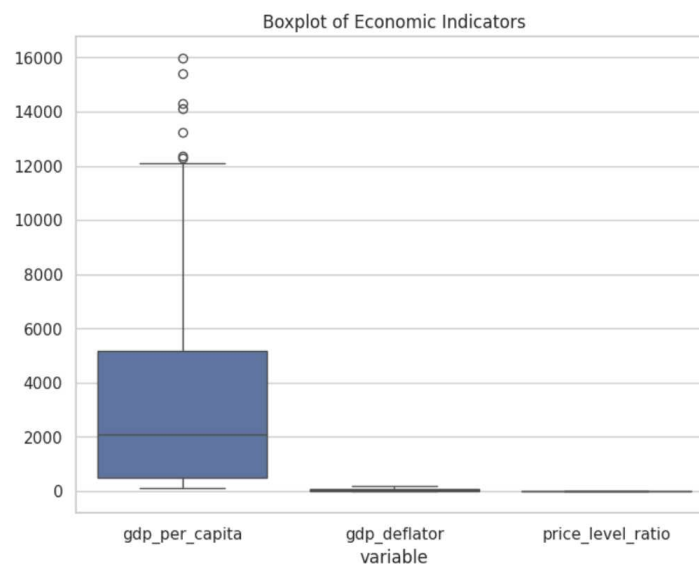
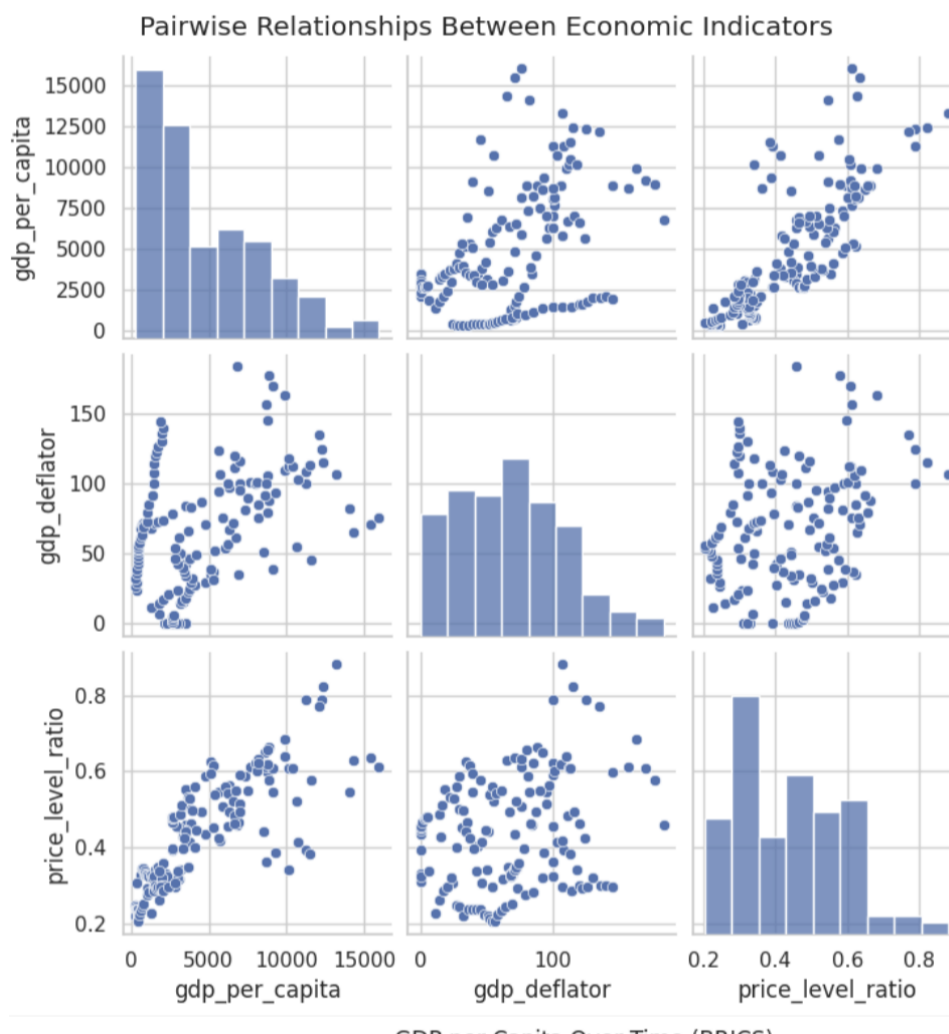
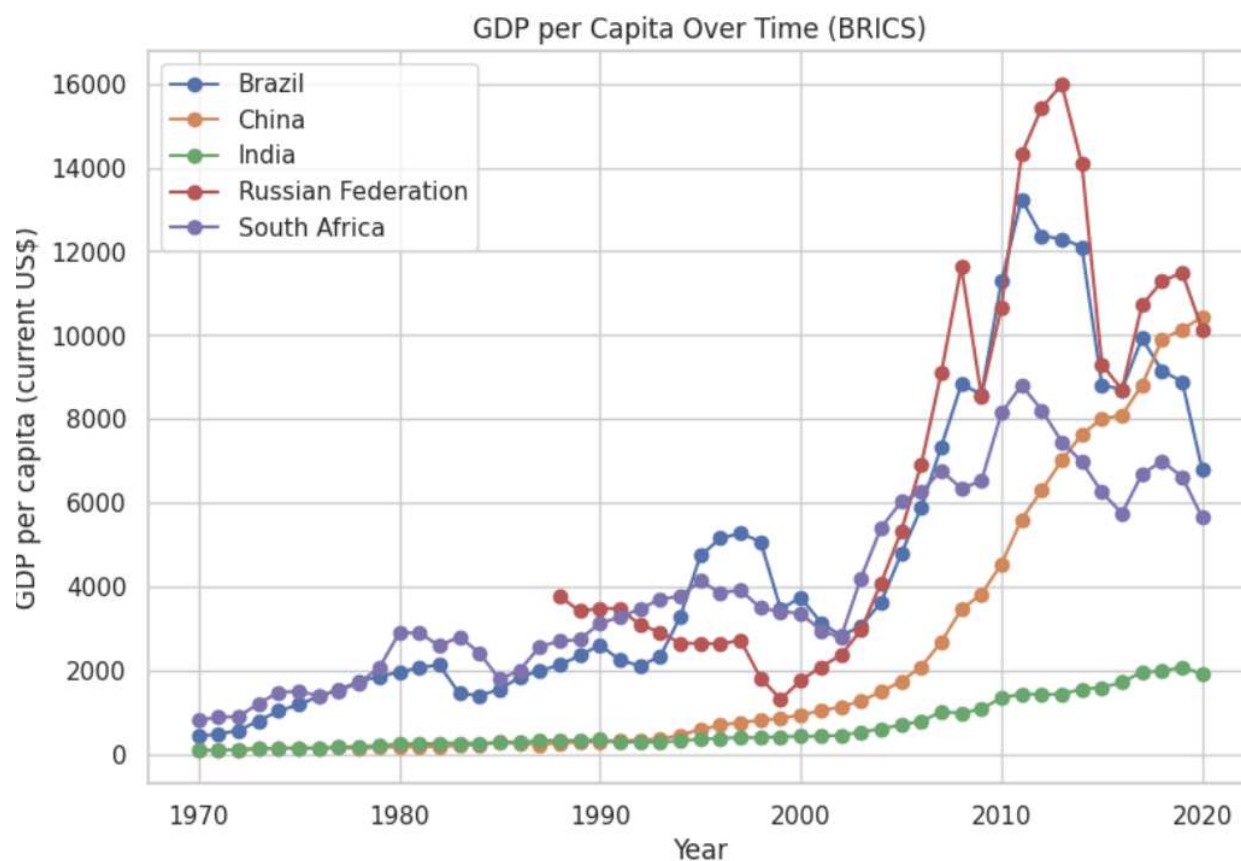


Figure 8 (Pairplot of the three indicators)



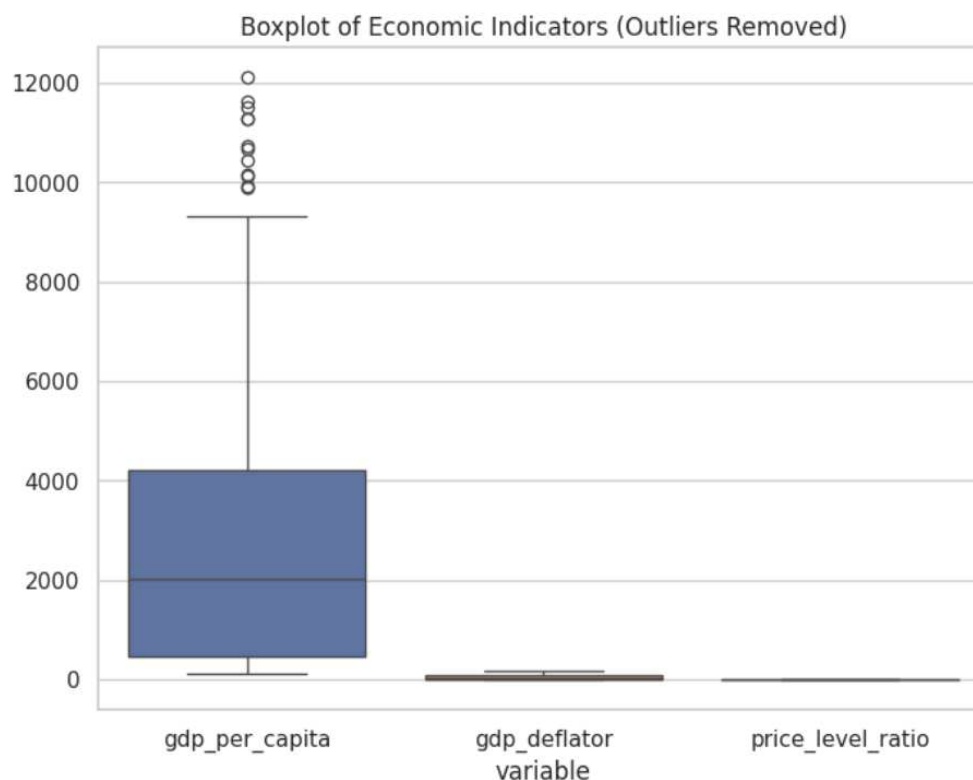
Time-series analysis further clarifies the structural differences among BRICS economies. As depicted in Figure 9, China experiences rapid and persistent income growth beginning in the early 1990s, with its GDP per capita rising exponentially. India's trajectory is more gradual but stable, while Brazil, Russia, and South Africa exhibit more cyclical patterns, reflecting commodity cycles, financial crises, and political turnover. These time-series patterns highlight the importance of treating BRICS not as a unified bloc but as a set of economies whose structural histories diverge substantially despite some shared characteristics.

Figure 9 (GDP per capita over time for all BRICS countries)



To investigate how the three indicators relate to one another, pairwise scatterplots were examined. Figure 8 provides an overview of all bivariate relationships and immediately suggests that the tightest and most systematic association is between GDP per capita and the price-level ratio. The upward-sloping cluster implies that richer countries tend to have domestic prices closer to international parity, an observation consistent with long-standing theories of international price convergence (Balassa 1964). The relationship between GDP per capita and inflation appears more diffuse, while inflation and price-level ratios exhibit only a weak association.

Figure 10 (Boxplot after outlier removal)



These visual impressions are confirmed by the correlation estimates shown in Table 2.

After removing extreme outliers, GDP per capita and the price-level ratio report a correlation of approximately 0.80—the strongest in the dataset—whereas the GDP deflator is only moderately correlated with income and weakly correlated with price-level ratios. Figure 11, the correlation heatmap, highlights this structure visually, emphasizing the dominance of the income–price-level relationship in shaping macroeconomic patterns across BRICS nations.

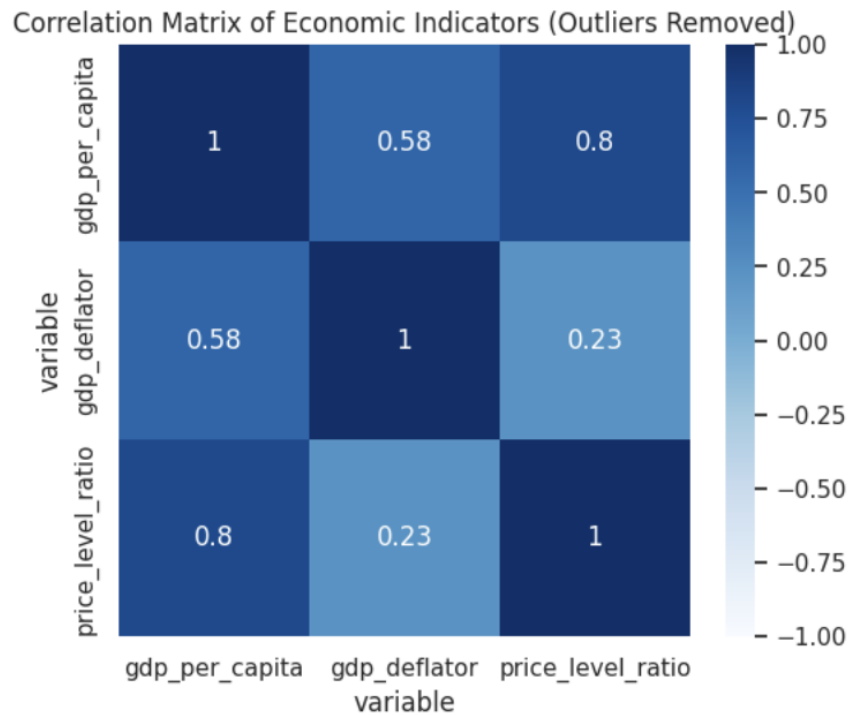
Table 3. Country-Level Mean Indicators (Outlier-Removed Dataset)

Country	GDP per capita	GDP deflator	Price level ratio
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Brazil	4046.65	44.11	0.509
China	2275.58	84.97	0.429
India	669.63	58.64	0.263
Russian Federation	5561.47	38.12	0.416
South Africa	3996.14	39.09	0.498

Figure 11 (Correlation Heatmap)

Variable	gdp_per_capita	gdp_deflator	price_level_ratio
gdp_per_capita	1.000000	0.584959	0.798064
gdp_deflator	0.584959	1.000000	0.234157
price_level_ratio	0.798064	0.234157	1.000000



Finally, averaging each indicator by country provides a cross-sectional view of long-term structural differences. As shown in Table 4, Russia consistently records the highest average

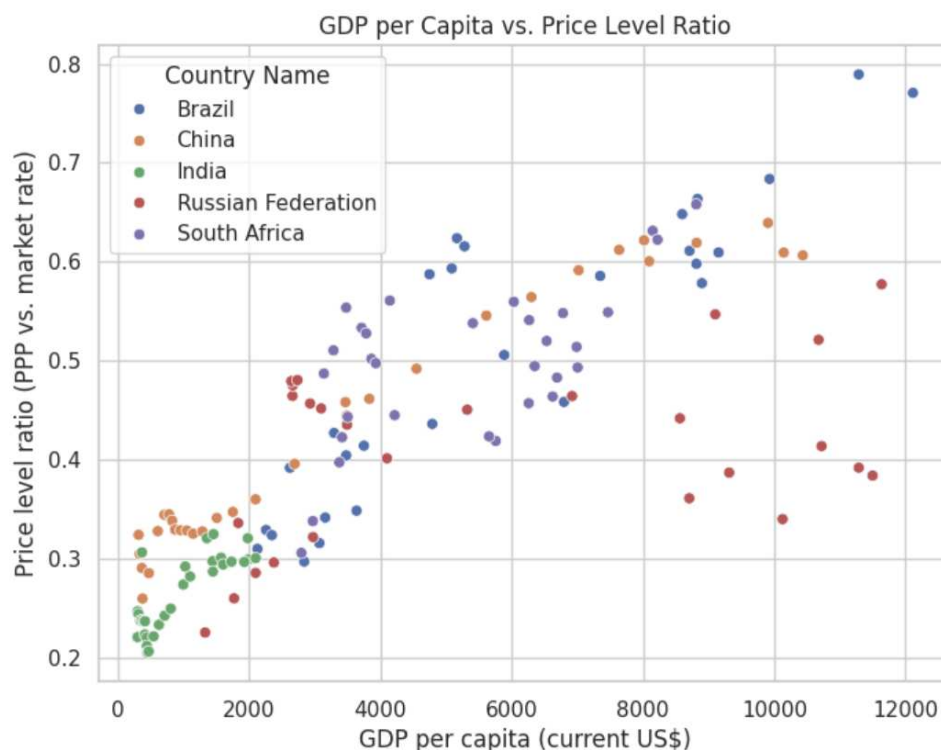
income, India the lowest, and China exhibits striking upward convergence over time. These differences are represented graphically in Figure 12, where each country occupies a distinct region of the GDP per capita–price-level ratio space. Again, the pattern is unmistakable: higher-income BRICS countries tend to have higher domestic price levels relative to international benchmarks.

Table 4. Country-Level Mean Indicators (Cleaned Dataset)

Country	GDP per capita	GDP deflator	Price level ratio
Brazil	4046.65	44.11	0.509
China	2275.58	84.97	0.430
India	669.03	50.65	0.263
Russian Federation	5561.67	38.12	0.411
South Africa	3996.14	39.07	0.498

Note. “Cleaned dataset” refers to the dataset after removing GDP per capita outliers but before aggregating by year.

Figure 12: Scatterplot: GDP per capita vs. price level ratio



When viewed collectively, the descriptive statistics, distributional diagnostics, outlier adjustments, time-series evolution, and inter-variable relationships all converge toward the same conclusion: income growth is the single most informative and structurally consistent determinant of BRICS countries' long-run macroeconomic patterns, particularly in predicting movement toward international price-level convergence. Inflation volatility matters, but it does not drive the fundamental cross-country differences observed in the data.

Preferred Alternative with Rationale

Among the various interpretations that could explain the macroeconomic trajectories of the BRICS countries, the analysis most strongly supports an income-driven price-level convergence framework. The consistent association between GDP per capita and the price-level ratio—demonstrated both visually in Figure 12 and statistically in Table 3—suggests that

structural increases in income bring domestic prices closer to international parity. This interpretation is further reinforced by the time-series patterns in Figure 9, where China's rapid income growth is mirrored by a steady rise in its price-level ratio, while countries with slower or more volatile growth show less consistent convergence. The convergence interpretation is not merely a statistical correlation but is anchored in the Balassa–Samuelson hypothesis, which provides a theoretically coherent mechanism linking productivity growth to increases in non-tradable prices. By contrast, alternative explanations—such as inflation shocks or exchange-rate interventions—are episodic and fail to account for the stable long-run relationship evident across the dataset. For these reasons, the price-level convergence narrative provides the most empirically grounded and theoretically consistent explanation for the BRICS macroeconomic patterns observed in this study, and it offers meaningful implications for future policy choices concerning monetary stability, exchange-rate regimes, and structural development.

Justification and Predicted Outcomes

The empirical patterns documented throughout the analysis point toward a structurally consistent conclusion: GDP per capita is the single most informative and stable predictor of other macroeconomic characteristics among BRICS economies, particularly the price-level ratio. The strong and persistent correlation between income and relative price levels (Figure 12; $\rho \approx 0.80$ after outlier removal) suggests that countries with higher income levels tend to converge more closely toward international price parity, whereas lower-income economies remain priced significantly below global benchmarks.

Based on this relationship, the most reasonable prediction is that continued income growth—especially in China and India—will be accompanied by gradual upward adjustment in domestic price levels, narrowing the gap between PPP and market exchange rates. This movement is consistent with the Balassa-Samuelson hypothesis, which posits that productivity growth in tradable sectors raises overall wages and, in turn, domestic price levels. The long-run trajectories observed in the time-series plots (Figure 9) reinforce this interpretation: China’s rapid growth is already associated with pronounced upward movement in its price-level ratio, while India’s slower—but persistent—growth path indicates a delayed but similar long-term adjustment.

Inflation dynamics, by contrast, appear considerably more volatile and less structurally informative. The weak correlation between the GDP deflator and the price-level ratio ($\rho \approx 0.23$) suggests that short-run inflation volatility does not dictate long-run price convergence, except in extreme episodes. Thus, inflation spikes in Brazil, Russia, and South Africa are best understood as episodic shocks rather than deterministic components of long-term macroeconomic structure. These findings collectively imply that future macroeconomic trajectories within BRICS will depend more heavily on income growth and structural reforms than on short-term inflationary disturbances.

Recommendations

Based on the empirical evidence, three recommendations emerge for analysts evaluating long-run macroeconomic positioning among BRICS countries:

(1) Prioritize GDP per capita as the anchor variable in modeling long-term macroeconomic transitions. The strength, consistency, and interpretability of the income–price-level relationship demonstrate that GDP per capita provides the most reliable foundation for predicting long-run macroeconomic adjustment. Future forecasting exercises should therefore treat income as the central state variable driving structural convergence.

(2) Treat inflation variability as a noise component rather than a structural determinant. Given the weak association between inflation and other indicators, models that place excessive weight on inflation may overstate its long-run relevance. Instead, inflation should be incorporated as a high-volatility shock term while structural variables—income, productivity, demographic trends—carry the explanatory burden for long-run outcomes.

(3) Avoid treating the BRICS as a unified macroeconomic bloc in analysis or policy design. The cross-country comparisons in Tables 3 and 4, combined with the divergent time-series trajectories in Figure 9, reveal profound structural heterogeneity among BRICS members. Analysts and policymakers should focus on country-specific characteristics rather than aggregated BRICS averages, which mask significant internal variation and obscure the true drivers of macroeconomic trends.

Together, these recommendations emphasize that income growth is both the most interpretable and the most empirically grounded pathway for anticipating and evaluating macroeconomic evolution within the BRICS group. Future research or modeling efforts that build from this foundation are most likely to produce robust, data-consistent forecasts.

Conclusion

The empirical analysis of BRICS economies from 1970 to 2020 reveals that long-run macroeconomic structures across these countries are shaped far more by income growth than by short-term macroeconomic fluctuations. Across all descriptive statistics, distributional diagnostics, outlier adjustments, time-series patterns, and inter-variable correlations, GDP per capita consistently emerges as the most stable, interpretable, and statistically informative indicator. Its strong association with the price-level ratio, even after the removal of extreme income outliers, reflects a meaningful structural relationship: higher-income economies tend to move closer to international price parity, whereas lower-income economies remain substantially undervalued relative to global benchmarks.

Inflation, by contrast, exhibits substantial volatility but limited structural explanatory power. The weak correlation between the GDP deflator and other indicators suggests that inflation shocks—though politically and socially significant—do not meaningfully alter the long-run macroeconomic trajectory of BRICS members. Time-series comparisons reinforce this conclusion: China’s rapid income ascent is mirrored by a sustained upward adjustment in its price level, while India follows a slower but consistent path; Brazil, Russia, and South Africa display more cyclical dynamics driven by commodity markets, institutional transitions, and episodic crises rather than by systematic structural change.

Taken together, these findings underscore the importance of analyzing BRICS not as a monolithic bloc but as a collection of countries with distinct macroeconomic histories. The structural heterogeneity evident in the data highlights the risks of relying on aggregated BRICS averages, which conceal crucial differences in income dynamics, inflation regimes, and price-level convergence. The patterns documented in this report suggest that future modeling,

forecasting, and comparative economic evaluations should anchor analyses on GDP per capita, treat inflation as a high-volatility noise component, and approach each BRICS economy as a unique case rather than a homogeneous group.

Ultimately, the long-run macroeconomic trajectories of BRICS countries will be determined primarily by the pace and sustainability of income growth. Analysts and policymakers seeking to understand or anticipate structural change within emerging economies would benefit from prioritizing income-driven frameworks, supported by careful cross-country comparisons and grounded in the empirical relationships demonstrated throughout this study.

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Appendix

Table 1. Summary Statistics (1970–2020)

Variable	Mean	SD	Min	25%	Median	75%	Max
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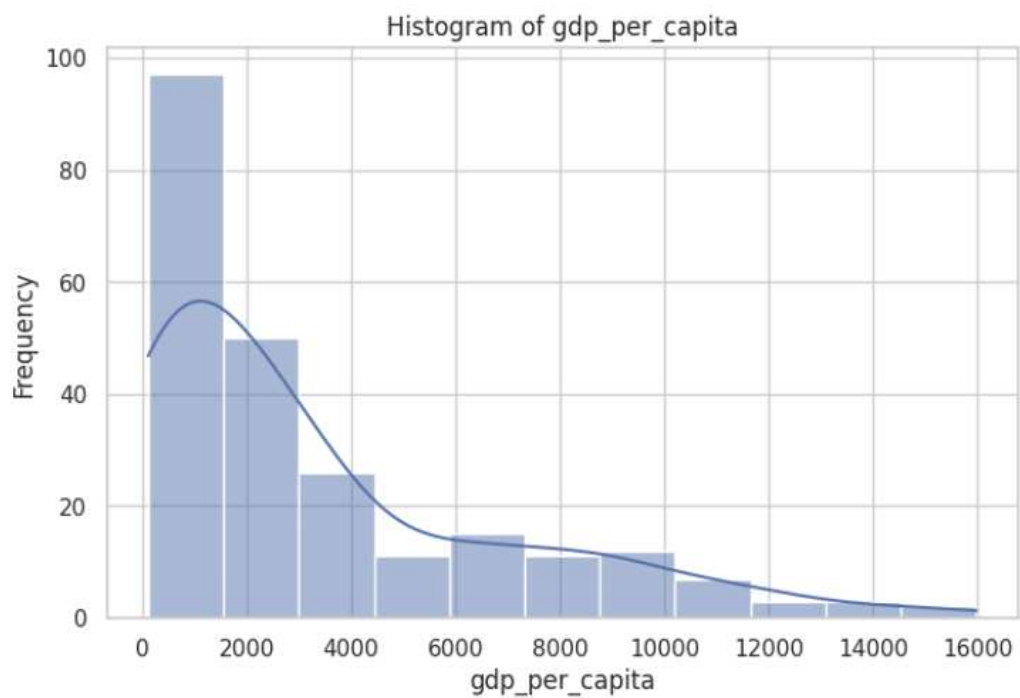


Figure 2 (QQ Plot for GDP per capita)

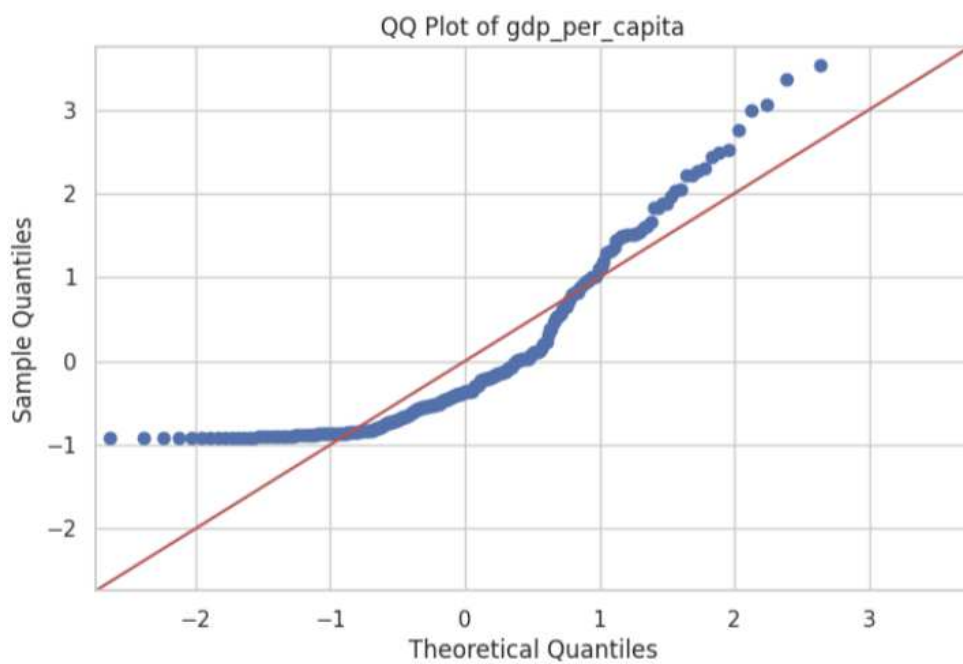


Figure 3 (Histogram of GDP deflator)

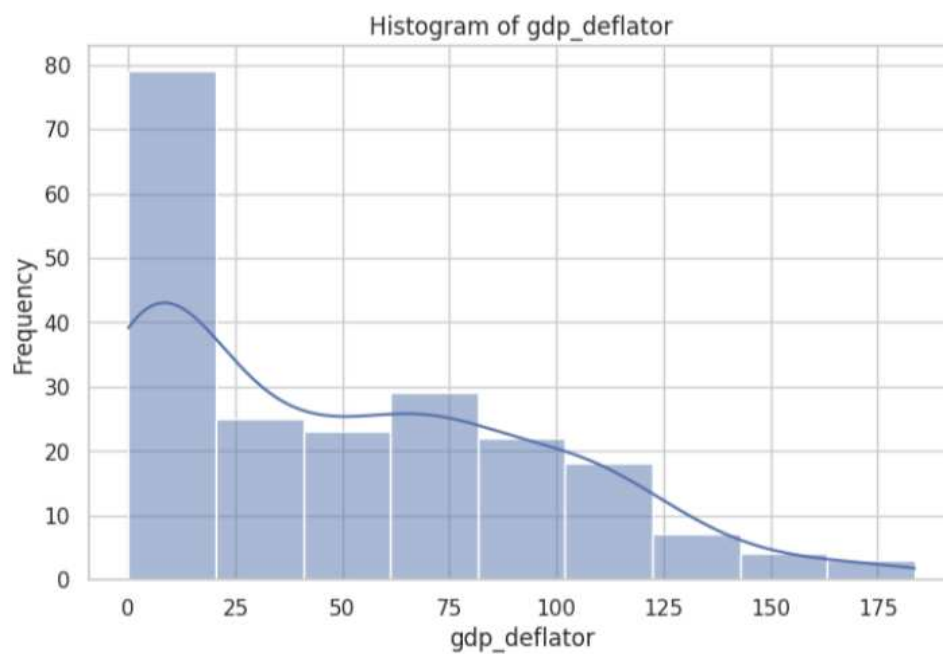


Figure 4 (QQ Plot for GDP deflator)

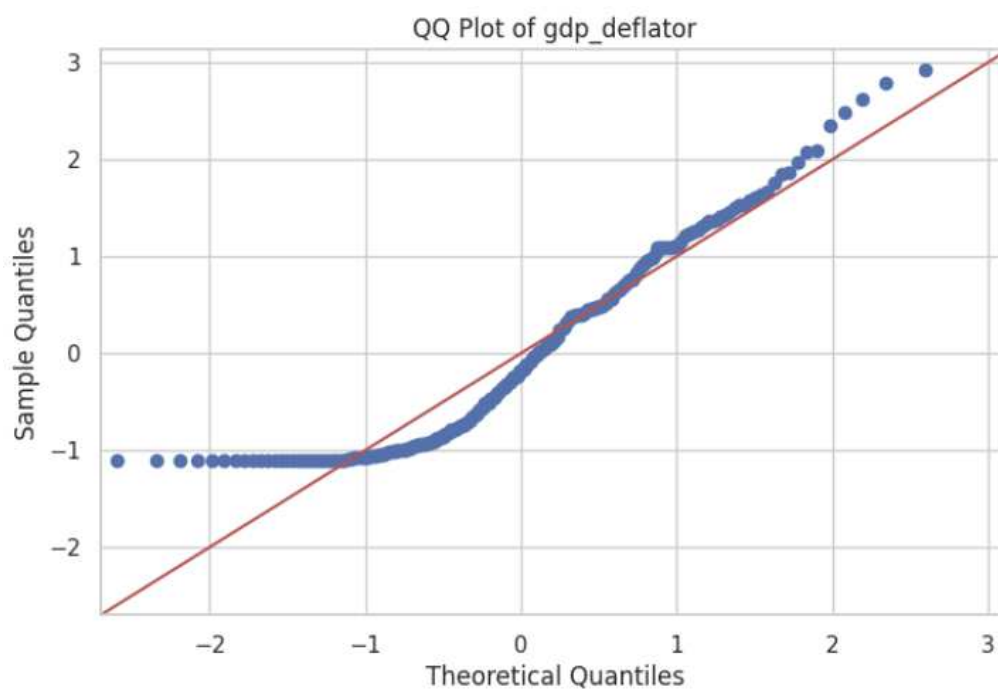


Figure 5 (Histogram of price level ratio)

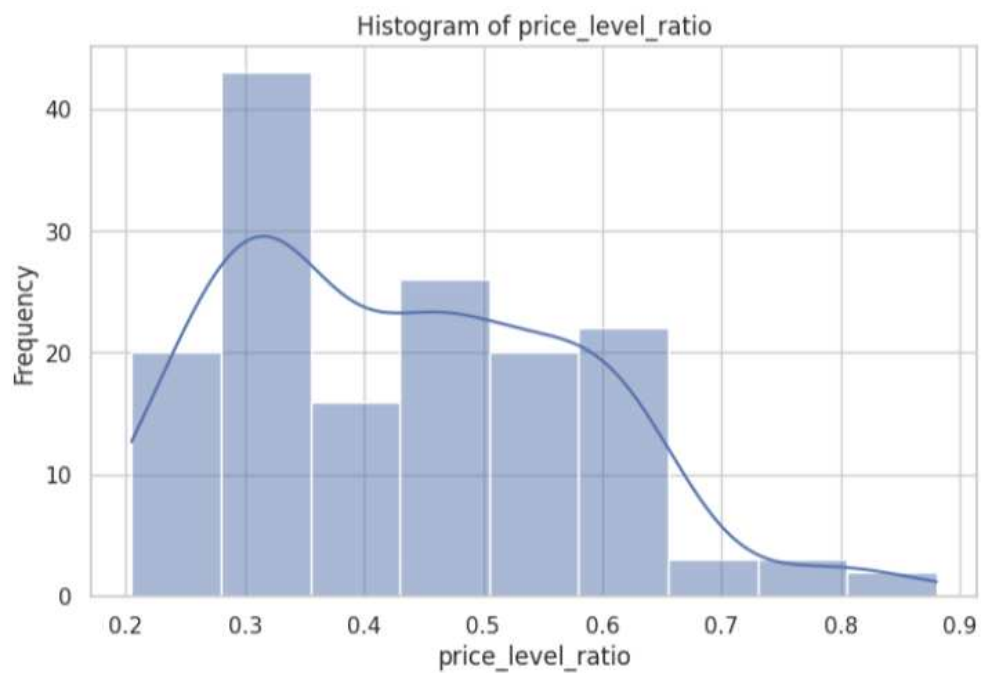


Figure 6 (QQ Plot for price level ratio)

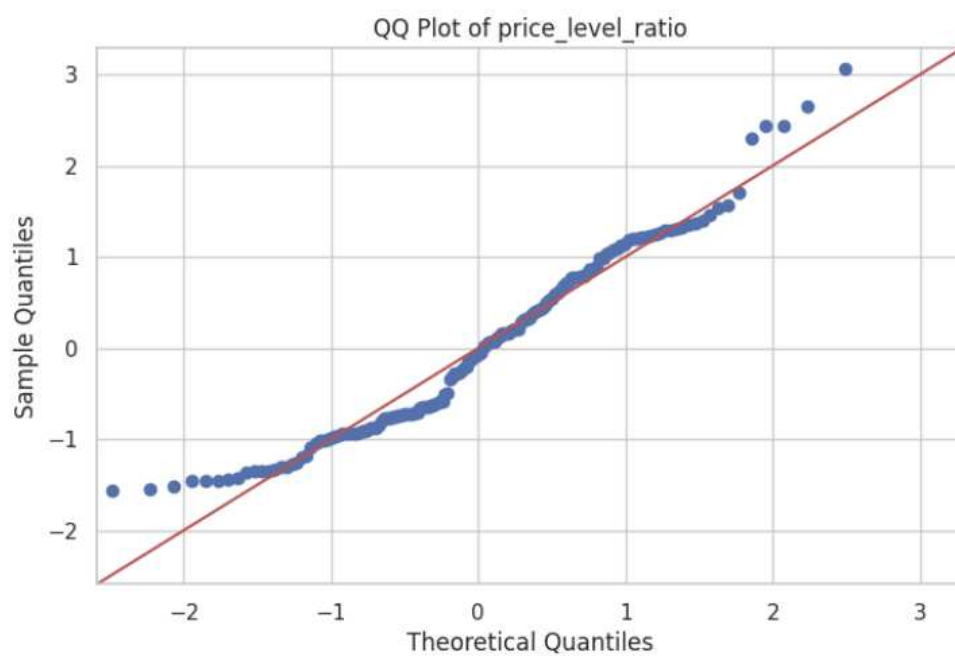


Figure 7 (Boxplot of all 3 variables)

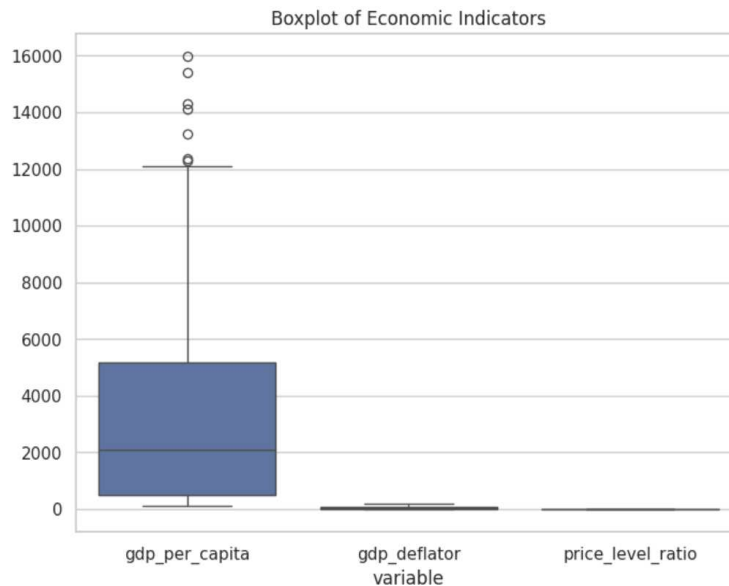


Figure 8 (Pairplot of the three indicators)

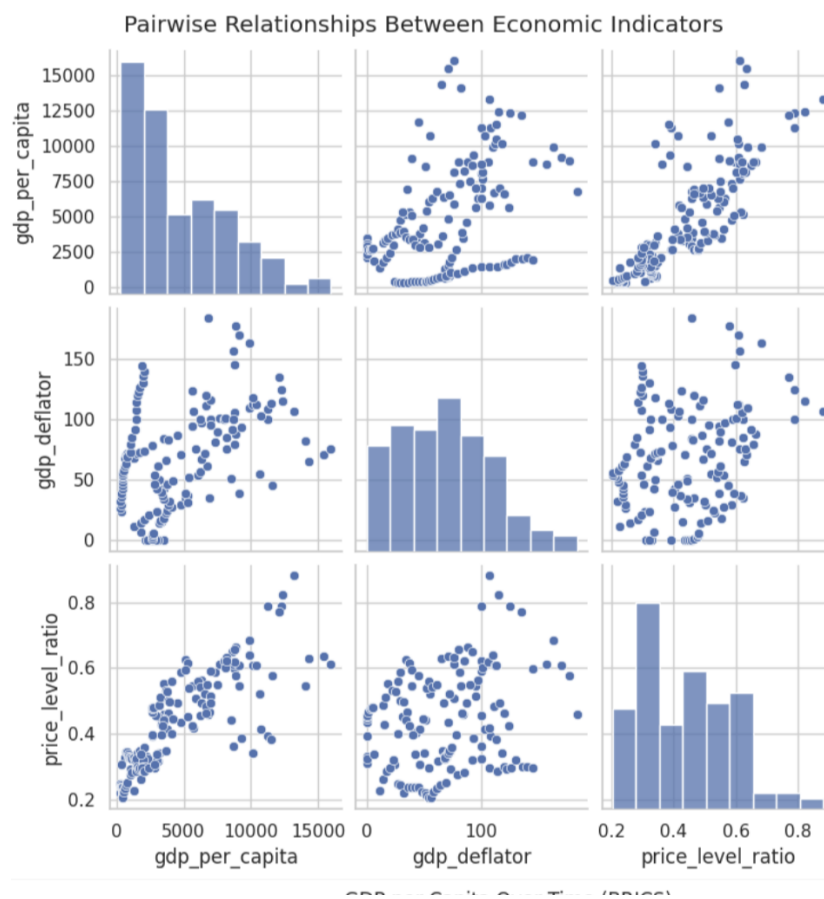


Figure 9 (GDP per capita over time for all BRICS countries)

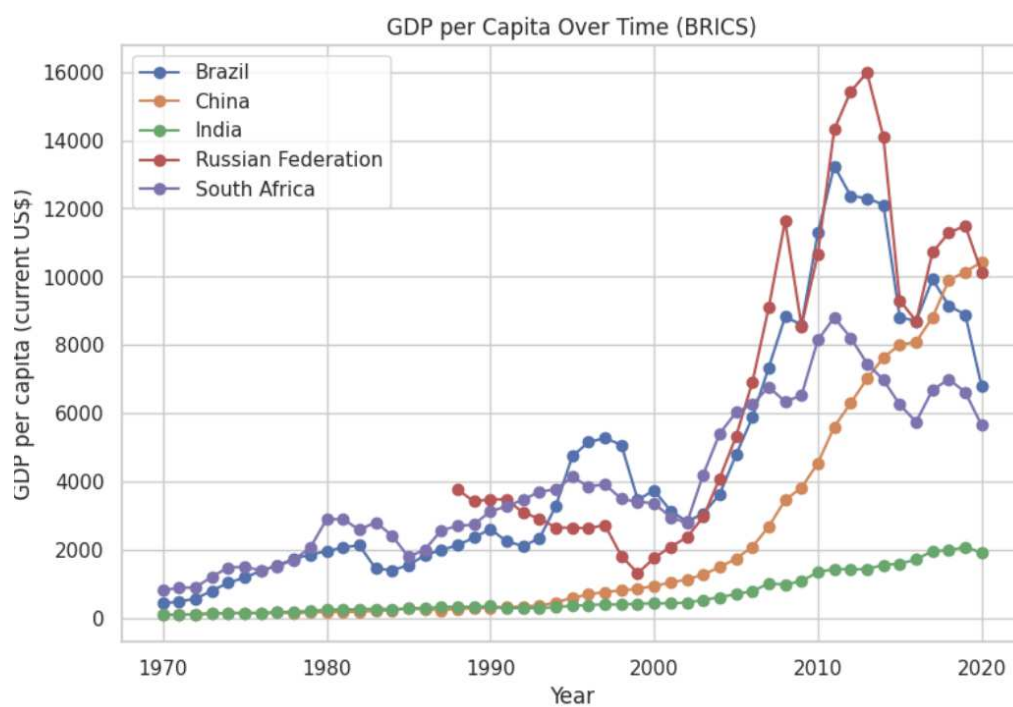


Figure 10 (Boxplot after outlier removal)

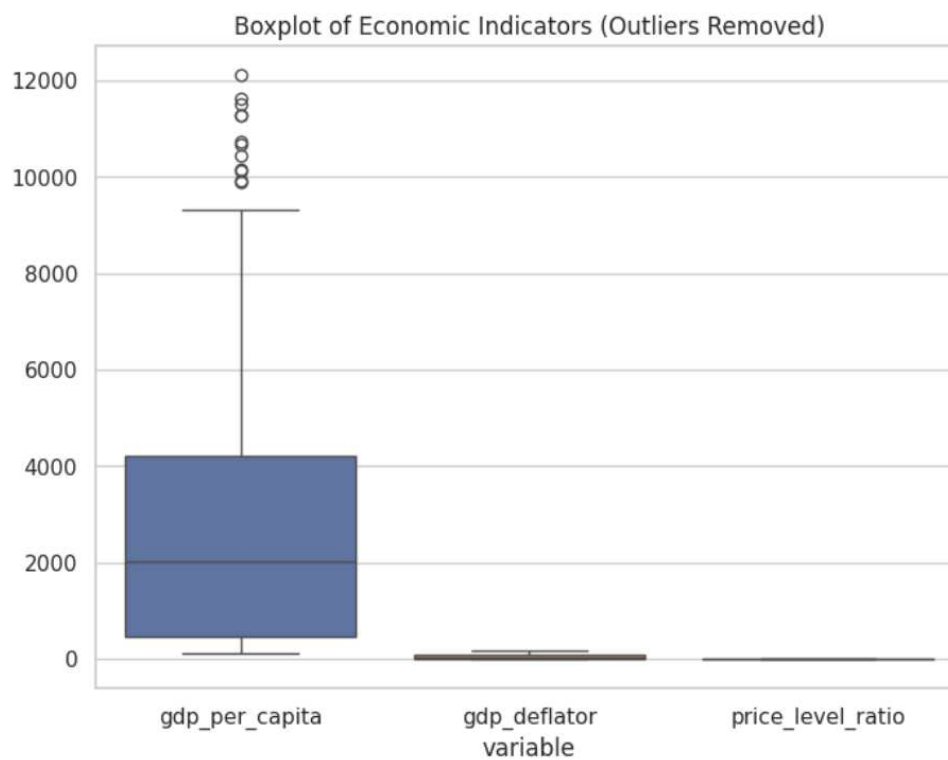


Figure 11 (Correlation Heatmap)

Variable	gdp_per_capita	gdp_deflator	price_level_ratio
gdp_per_capita	1.000000	0.584959	0.798064
gdp_deflator	0.584959	1.000000	0.234157
price_level_ratio	0.798064	0.234157	1.000000

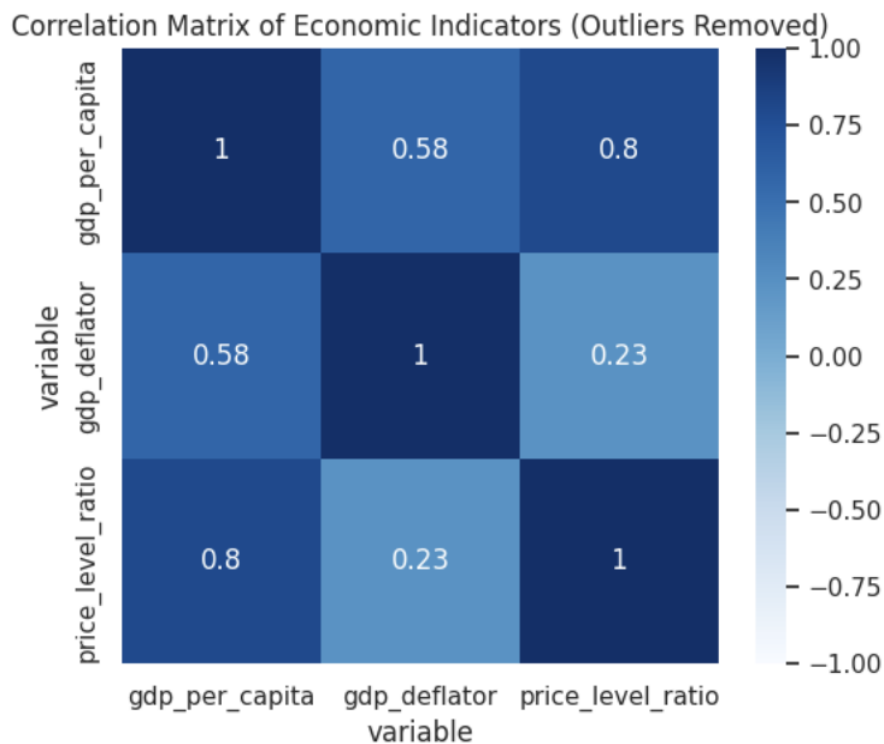


Figure 12: Scatterplot: GDP per capita vs. price level ratio

