THESES FOR PRESENTATION

ASSESSMENT OF CURRENCY RISKS IN THE BRICS LUBRICANTS MARKET: DIGITAL TWIN AS A METHOD OF FORECASTING EXCHANGE RATE VOLATILITY

Relevance

The lubricants market is a key segment of the global oil industry. Geopolitical conflicts (Ukraine, Middle East), unfair competition, and sanctions significantly affect its development. At the same time, digitalization opens new opportunities. The high integration of lubricant products into international trade makes currency risk assessment critically important. BRICS countries are central to these processes.

Hypothesis: currency risks exert a significant influence on the dynamics of the BRICS lubricants markets.

Aim — to identify the relationship between national currency volatility and the market dynamics of lubricants within the BRICS economies.

Objectives:
- To analyze the development trajectories of the BRICS lubricants markets.
- To assess currency risks across the BRICS countries.
- To test causal relationships between exchange rate volatility and lubricants market indicators.
- To construct a digital twin for exchange rate volatility forecasting (using GAM).

Methodology

Period: 2000–2025.

Indicators:
- Exchange rates of BRICS national currencies against USD.
- Value of BRICS export–import operations (HS code 3403 — lubricants).
- Currency risk: coefficient of variation of exchange rates.

Methods:
- Granger causality test
- Correlation–regression analysis
- Generalized Additive Models (GAM) for forecasting
- Data normalization: z-score + sigmoid function

Results: BRICS vs. Global Market Growth

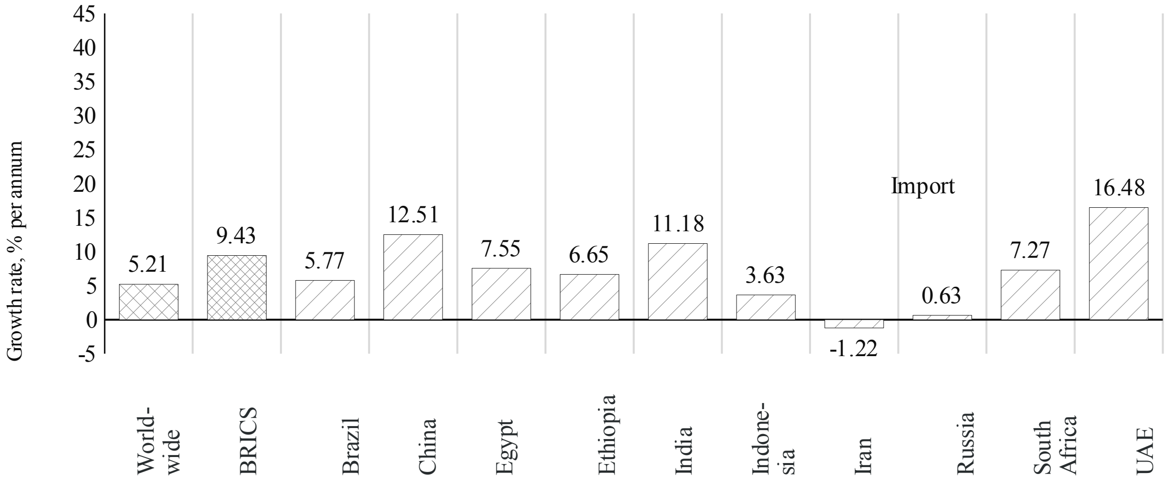


Fig. 1. Average annual growth rate of lubricants imports in the BRICS countries and globally, 2000–2025
Source: compiled by the author based on UN Comtrade data.

Key finding: BRICS lubricants market grows at approximately **twice the global rate** (12.88% vs. 6.30% for exports; 9.43% vs. 5.21% for imports). Growth is driven by UAE, China, and India. Russia is the only country lagging behind global averages.

Results: Currency Volatility by Country

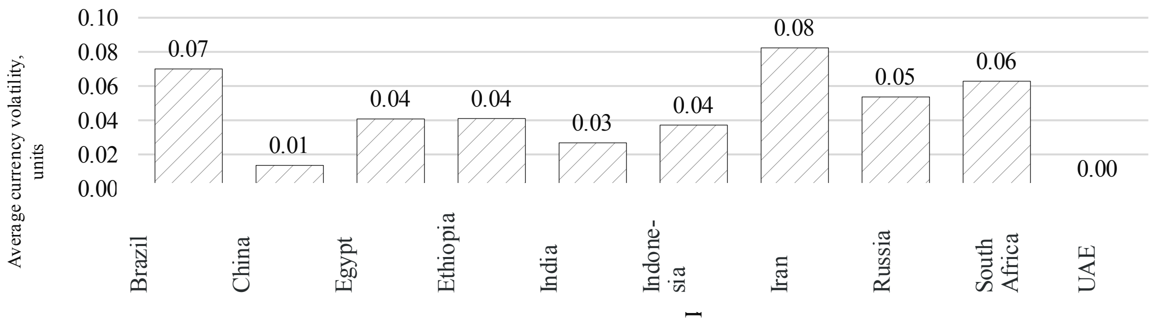


Fig. 2. Average annual volatility of national currencies of the BRICS countries, 2000–2025
Source: compiled by the author based on central banks and IMF data.

Key finding: Brazilian real and Iranian rial show the highest volatility (0.08 and 0.07). UAE dirham is the most stable (fixed peg to USD).

Results: Relationship Analysis

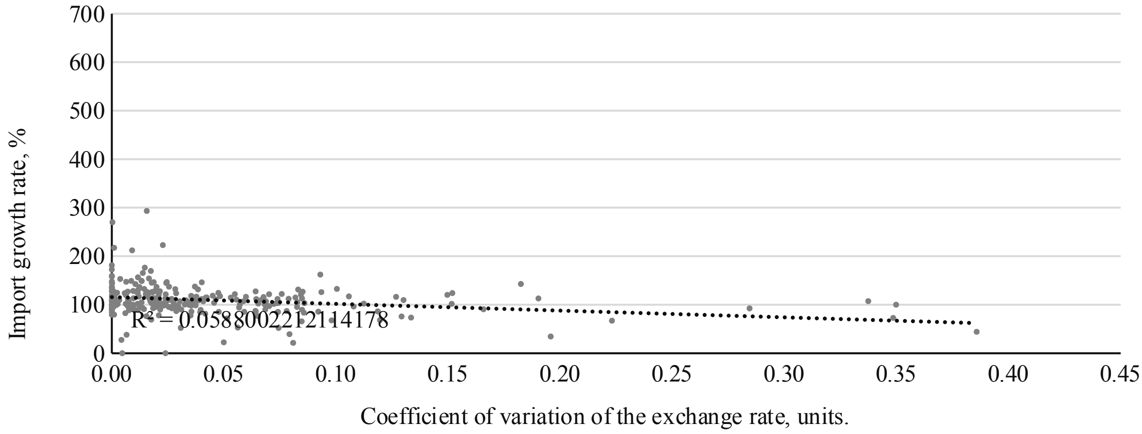


Fig. 3. Relationship between national currency exchange rate volatility and lubricants market indicators in BRICS countries, 2000–2025
Source: author's calculations.

Key finding: Visual analysis suggests **no correlation** between exchange rate volatility and lubricants market indicators for most BRICS countries.

Results: Granger Causality Analysis

Table 1. Results of the Granger causality analysis

Country	Export / Import	p-values of the Granger causality test		
		lag 1	lag 2	lag 3
Ethiopia	Import	0,0382	0,0754	0,5470
India	Import	0,6990	0,0434	0,3413
Ethiopia	Import	0,0738	0,0138	0,0621

Source: author's calculations.

Key finding: Currency volatility affects lubricants imports in Ethiopia (lag 1) and India (lag 2), and exports in Ethiopia (lag 2). For all other BRICS countries, **no causal relationship** was found.

Results: Correlation Analysis

Table 2. Significance estimates (p-values) of correlation coefficients

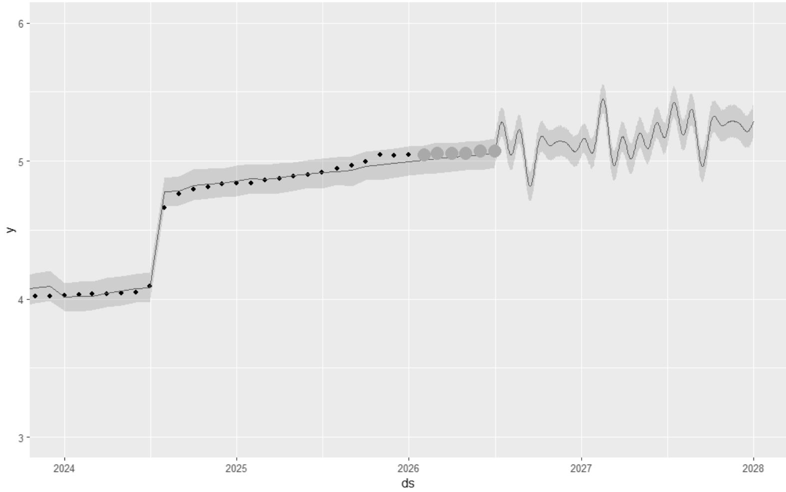
Country	Import (lag 1)	Import (lag 2)	Export (lag 2)
Ethiopia	0,0642	–	–
India	–	0,1322	0,1032

Source: author's calculations.

Key finding: Only one statistically significant relationship exists: Ethiopian birr volatility → lubricants imports (positive correlation, r = 0.3922, at 90% confidence level).
Results: Digital Twin for Ethiopia

Why Ethiopia? It accounts for only 0.08–0.34% of BRICS lubricants imports, but it is the **only country** where a causal relationship was found.

Fig. 4. Comparison of the values estimated using Model 5 (M5) with the test sample
Source: author's calculations.



Three GAM models estimated:

Table 3 – Performance evaluation of the models of the Ethiopian national currency (birr) exchange rate dynamics

Models	MAPE	Coverage
M3	0,0896	0,0000
M4	0,1372	0,0000
M5	0,0134	1,0000

Source: author's calculations based on (Bank of Russia, 2026; Central Bank of Egypt, 2026; Central Bank of the Islamic Republic of Iran, 2026; IMF, 2026a; National Bank of Ethiopia, 2026).

Key finding: Model 5 (with regressors: July 2024 exchange rate reform + BRICS accession) is optimal. All test observations fall within 95% CI.

Results: Forecast

Year	**Coefficient of Variation**
2025 (actual)	0.0741
2026 (forecast)	0.0953
2027 (forecast)	0.1133

Key finding: Ethiopian birr volatility is expected to **increase significantly** in 2026–2027.

Expected lubricants market impact: given positive correlation with 1-year lag, Ethiopia's lubricant imports are expected to grow in 2027, with further acceleration in 2028.

Conclusion

1. BRICS lubricants market grows **twice as fast** as the global market.
2. Currency risks vary: Brazil and Iran = high volatility; UAE = minimal.
3. **No correlation** exists between currency volatility and lubricants market for most BRICS countries.
4. **Only exception: Ethiopia** — positive moderate correlation (r = 0.3922) at 90% confidence level.
5. Digital twin (GAM Model 5) predicts **increased volatility** of Ethiopian birr in 2026–2027.
6. Ethiopia's lubricants market is expected to **accelerate growth** in 2027–2028.
7. **Overall:** currency risks do NOT significantly affect the BRICS lubricants market as a whole — the hypothesis is **rejected** for 9 out of 10 countries.

Thank you for your attention!