СЕКЦІЯ 7. ЕКОНОМІКА ТА ТЕХНОЛОГІЇ

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SECTION 7. ECONOMICS AND TECHNOLOGY

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CRISIS, UNCERTAINTY, AND INVESTMENT DECISIONS IN BRICS: A BAYESIAN NETWORK APPROACH

At the 2024 BRICS Summit, the Kazan Declaration reaffirmed the bloc's commitment to multilateralism, sustainable development, and inclusive global governance. With Indonesia's accession in 2025, BRICS expanded to eleven members (Brazil, China, Egypt, Ethiopia, India, Iran, Russia, Saudi Arabia, South Africa, UAE, and Indonesia) enhancing its geopolitical reach and economic influence as a leading voice for the Global South. This expanded configuration strengthens BRICS' capacity to respond to systemic crises through coordinated policies, cross-regional investment, and deeper South-South cooperation, underscoring the importance of long-term modeling of investment dynamics under uncertainty, particularly in energy and infrastructure across its diverse, interconnected economies.

Even in historical data dating back to 1987 and extending to 2024, the foundational BRICS economies have exhibited persistent structural patterns in investment, institutional dynamics, and trade openness, reflecting their growing role in the global economic landscape. Over this 37-year period, encompassing financial crises, geopolitical shifts, and environmental challenges, these economies have demonstrated evolving yet resilient responses to uncertainty. The expansion of the BRICS framework by 2024 further enhances its capacity to address systemic crises through coordinated policies, cross-regional investment strategies, and strengthened South-South cooperation. This long-term perspective is critical for modeling and forecasting investment behavior under uncertainty, particularly in energy and infrastructure sectors across these diverse but increasingly interconnected economies.

This Bayesian network, constructed in Bayes Server Desktop 11.0, maps the complex probabilistic dependencies among key macroeconomic, institutional, and cultural determinants of investment and openness, particularly in the context of BRICS emerging economies. Central to the model are institutional variables such as power distance (powdist) and uncertainty avoidance index (UAI), which serve as root causes influencing economic behaviors and policy preferences. These institutional factors exert downstream effects on core macro-financial variables including interest rates, inflation (INFL), and capital account openness (KA_OPEN), while also shaping international integration through foreign direct investment (FDI) and trade openness. Structural indicators like gross capital formation (GrossCapForm) and UAI reflect the long-term investment capacity of these economies and are directly influenced by both financial conditions and institutional settings (see Table 1).

Table 1

Variable	Description (Inferred)	Key Role
powdist	Power distance index (culture/institutional factor)	Input to UAI, FDI, EN_use
UAI	Uncertainty Avoidance Index	Affects FDI, Trade openness
WDI I/Y	World Development Indicator	Affects Gross Capital Formation
GrossCapForm	Gross Capital Formation (dependent variable)	Outcome variable
FDI	Foreign Direct Investment	Influenced by UAI, powdist
EN_use	Energy Use	Linked to INFL and possibly FDI
Int_rate	Interest Rate	Influences investment + macro flows
Trade_open	Trade Openness	Influenced by multiple variables
KA_OPEN	Capital Account Openness	Input to FDI?
INFL	Inflation	Influenced by or influencing others

The structure captures the dynamic interplay between cultural rigidity and economic flexibility, illustrating how countries with higher uncertainty avoidance or hierarchical structures may respond differently to external shocks or global uncertainty [1]. By simulating interdependencies within this network, the model enables targeted scenario analysis under varying uncertainty levels, offering insights into how shifts in institutional quality or economic conditions may propagate through the system to affect capital accumulation and global economic engagement. This approach aligns with the broader objective of the research, which is to forecast infrastructure investment behavior under uncertainty in BRICS and other emerging markets.

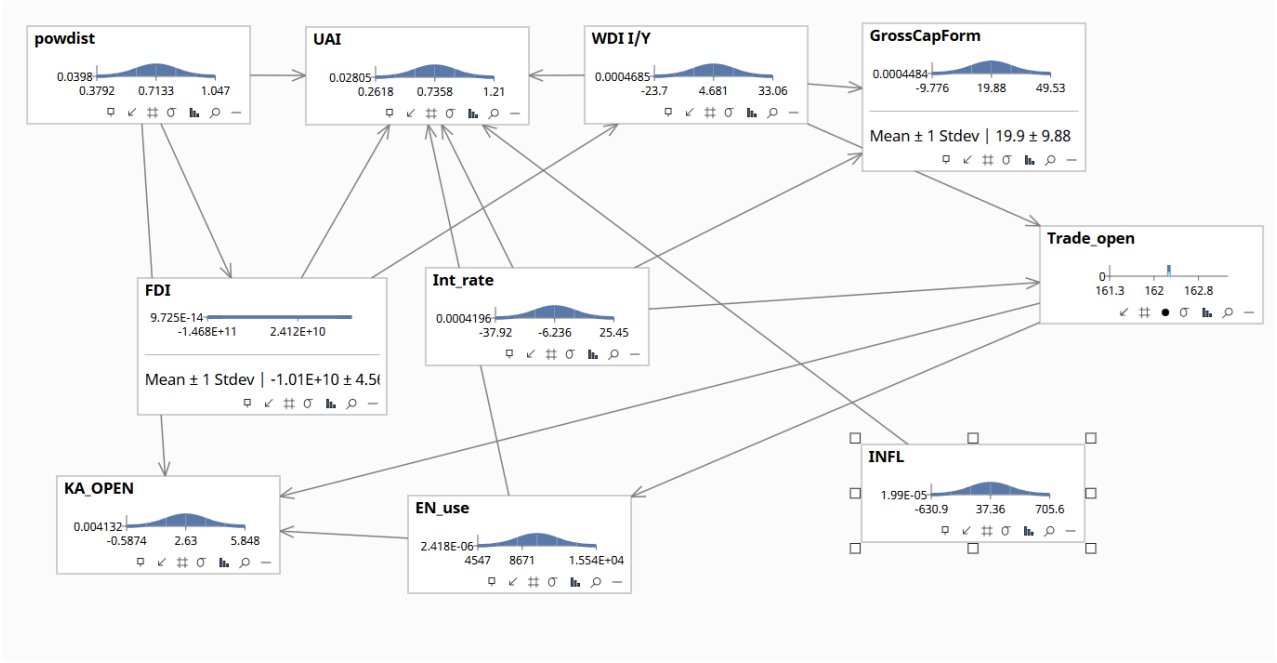

Fig. 1. Probabilistic Relationships Among Key Variables in BRICS Investment Analysis

The Bayesian Network presented in Figure 1 models the probabilistic and causal structure linking key macroeconomic, financial, and institutional variables in the context of investment dynamics within BRICS economies. The model captures conditional dependencies among variables using directed edges, where each node represents a variable with its empirical distribution and summary statistics, and arrows indicate directional influences. Power distance, as a cultural-institutional factor, serves as an exogenous input influencing UAI, and FDI. UAI, in turn, affects FDI and trade openness, reflecting the role of societal attitudes toward risk in shaping investment behavior.

Investment intensity, proxied by WDI I/Y, drives gross capital formation, which feeds into trade openness alongside other macroeconomic forces. FDI emerges as a central node influenced by cultural norms, interest rates, and institutional openness, while also acting as a determinant of capital account openness.

In turn, KA_OPEN is linked to higher energy use, which contributes to inflationary pressures. Inflation is shaped by both monetary policy, via interest rates, and real economic activity through energy consumption, and subsequently influences trade openness. Interest rates play a pivotal mediating role, directly affecting FDI, inflation, and trade integration. Ultimately, trade openness functions as a key outcome variable, embedded within a web of direct and indirect pathways that trace back to institutional, financial, and behavioral drivers.

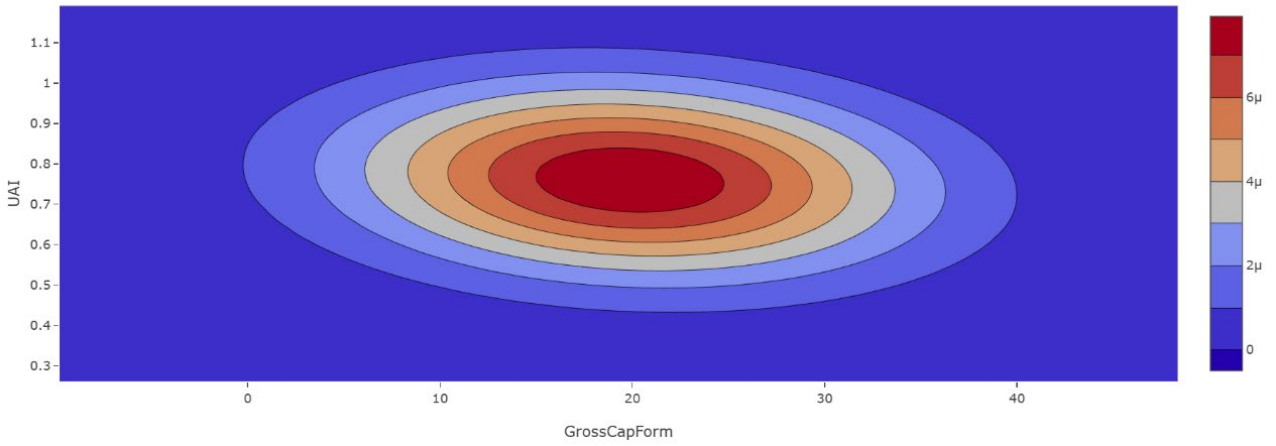

Fig. 2. Mesh query plot generated using Bayes Server Desktop 11.0

This mesh query plot illustrates the joint probability distribution between UAI and GrossCapForm, two critical variables in my research on investment behavior under crisis and uncertainty in BRICS economies (figure 2). The plot reveals a clear relationship where higher levels of uncertainty avoidance are associated with moderate to high gross capital formation. The central region, characterized by darker red hues, indicates the most probable combination of UAI and GrossCapForm, suggesting that societies with moderate-to-high uncertainty avoidance tend to exhibit stable and robust capital formation. The concentric contours and color gradient highlight how the likelihood of different combinations decreases as we move away from this central point, emphasizing the interplay between cultural attitudes toward uncertainty and investment dynamics. This visualization underscores the role of institutional and cultural factors in shaping macroeconomic outcomes, providing valuable insights into how uncertainty avoidance influences investment decisions during periods of crisis and volatility in emerging markets.

This 3D surface plot captures the probabilistic relationship between the UAI and GrossCapForm, offering key insights into how cultural and institutional factors shape investment dynamics in BRICS economies. The peak of the surface, located at moderate-to-high UAI values and positive levels of capital formation, indicates that countries with stronger cultural aversion to uncertainty tend to sustain relatively high levels of investment in physical capital. This suggests that in institutional environments where rules, stability, and long-term planning are emphasized, firms and governments may be more inclined to commit to large-scale capital projects, even under conditions of economic stress. The smooth, concentrated rise in likelihood

around this central region reflects a stable and consistent pattern across the data, reinforcing the idea that cultural dimensions like uncertainty avoidance are not merely background factors but active drivers of macroeconomic behavior. By visualizing this interaction in three dimensions, the plot underscores the non-linear, conditional nature of investment decisions and highlights the value of integrating socio-institutional variables into models of economic performance under uncertainty.

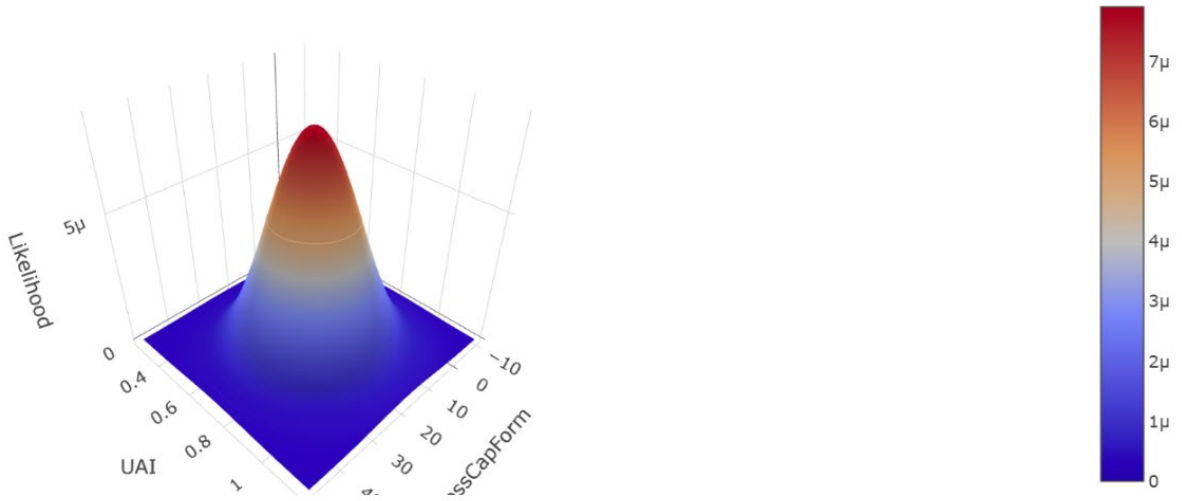

Fig. 3. 3D surface plot generated using Bayes Server Desktop 11.0

This network visualization effectively quantifies and traces causal pathways from institutional and cultural indicators, such as power distance and uncertainty avoidance, to key economic outcomes, including FDI, gross capital formation, inflation, and trade openness. By providing a compact representation of complex interrelations, the model serves as a crucial tool for understanding investment behavior under uncertainty in BRICS and emerging economies. It allows for a nuanced exploration of how structural and policy-related factors interact during periods of crisis and uncertainty, offering a systematic framework for analyzing investment decision-making in these markets.

Список використаних джерел

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