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AN EMPIRICAL INVESTIGATION INTO THE STRATEGIC IMPACT OF RECIPROCAL TRADE COUNTERMEASURES ON U.S. ECONOMIC RESILIENCE AND MANUFACTURING RE-INDUSTRIALIZATION

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Abstract: The 2025 U.S. “reciprocal tariff” policy has intensified global trade frictions, triggering retaliatory countermeasures that reshape supply chains and industrial dynamics. Whether such protectionist strategies can sustainably revive domestic manufacturing or instead undermine macroeconomic stability remains an open empirical question. This study investigates the nonlinear effects of reciprocal trade countermeasures on U.S. manufacturing performance and economic resilience using a 13-dimensional monthly panel dataset. We construct composite manufacturing and macroeconomic indices via the Entropy Weight Method (EWM), examine policy–economy linkages using Grey Relational Analysis (GRA) and Pearson correlations, and model dynamic impacts through a heterogeneous machine learning framework combining XGBoost and Support Vector Regression (SVR). Empirical results show that retaliatory trade measures significantly disrupt intermediate input supplies and raise domestic production costs, offsetting short-term gains from tariff protection. High-precision forecasts further indicate that international retaliation largely neutralizes the intended reindustrialization effects. The findings suggest that sustainable manufacturing revitalization requires structural investment and innovation-driven policies rather than reliance on tariff barriers alone.
Keywords: Trade reciprocity; Manufacturing resurgence; Economic resilience; Grey relational analysis; Predictive modeling

1 INTRODUCTION

In 2025, the United States implemented a series of “reciprocal tariff” measures aimed at correcting perceived trade imbalances and accelerating domestic manufacturing re-industrialization. However, these unilateral trade actions rapidly provoked retaliatory responses from major trading partners, most notably export restrictions on critical intermediate inputs such as rare earth elements and battery-related materials. The resulting escalation transformed the global trade system into a high-friction equilibrium characterized by policy retaliation and supply chain uncertainty. This raises a central empirical question: do protectionist tariffs effectively strengthen U.S. manufacturing resilience, or do reciprocal countermeasures ultimately destabilize the broader economy and undermine industrial recovery?

A well-established literature shows that tariffs are largely passed through to domestic prices, increasing production costs and reducing welfare. Using evidence from the 2018 U.S.–China trade war, Amiti, Redding, and Weinstein document substantial tariff pass-through, with welfare losses borne primarily by domestic firms and consumers [1]. These findings cast doubt on the effectiveness of tariffs as a sustainable tool for industrial protection.

Beyond price transmission, recent studies emphasize the role of production networks in amplifying trade shocks. Baldwin and Freeman argue that modern supply chains transmit policy shocks nonlinearly through input–output linkages, magnifying volatility and persistence [2]. Micro-level evidence further shows that idiosyncratic upstream disruptions propagate across sectors when inputs are highly specific, generating economy-wide productivity losses [3]. Such mechanisms suggest that retaliatory export controls on strategic inputs may impose costs far exceeding their direct trade exposure.

Another strand of research highlights the macroeconomic role of policy uncertainty. Bloom shows that uncertainty shocks cause firms to delay investment and hiring, leading to sharp output contractions [4]. Empirical evidence from natural disasters and trade disruptions confirms that supply shocks propagate through firm-level input linkages, amplifying aggregate fluctuations [5]. Focusing specifically on trade policy, Caldara et al. demonstrate that rising trade policy uncertainty significantly depresses output, employment, and investment [6]. Complementary evidence shows that tariff changes are transmitted not only at the border but also to final retail prices, reinforcing domestic inflationary pressures [7]. Quantitative general equilibrium analyses further find that protectionist tariffs generate net welfare losses and misallocate resources [8], while uncertainty over future trade regimes discourages firm entry and long-term investment [9].

Despite these advances, two gaps remain. First, much of the existing literature treats tariffs as largely unilateral shocks, paying limited attention to reciprocal countermeasures and their dynamic spillovers through supply-chain disruptions.

Second, empirical studies often focus on single outcomes or single-model approaches, limiting robustness in the presence of structural breaks induced by abrupt trade retaliation.

This paper addresses these gaps by developing an integrated empirical framework to evaluate the impact of reciprocal trade countermeasures on U.S. manufacturing performance and economic resilience. By jointly leveraging multidimensional indicators and complementary modeling approaches, the study provides a systematic benchmark for assessing whether tariff-based protectionism can deliver sustainable industrial revitalization under conditions of strategic retaliation.

2 METHOD

2.1 Data Preprocessing and Indicator Synthesis

Economic indicators released at different frequencies and with reporting delays often contain missing observations. To ensure data continuity, we apply linear interpolation for internal gaps and forward–backward filling for boundary values. All variables are standardized using Z-score normalization. To synthesize multidimensional indicators into comprehensive performance measures, we employ the Entropy Weight Method (EWM). The core principle of EWM is that indicators with greater dispersion convey more information and should receive higher weights. The procedure is as follows:

(1)Normalization:

$$y_{ij} = \frac{x_{ij} - \min(x_j)}{\max(x_j) - \min(x_j)} \tag{1}$$

(2)Entropy Calculation(e_j):

$$e_j = -k \sum_{i=1}^{n} p_{ij} \ln p_{ij} \tag{2}$$

where $k = 1/\ln(n)$

(3)Weight Determination (w_j):

$$w_j = \frac{1 - e_j}{\sum_{j=1}^{m} (1 - e_j)} \tag{3}$$

Utilizing this framework, we synthesized two composite response variables: the Manufacturing Composite Score (Y_m) and the Macroeconomic Composite Score (Y_e), which serve as the target vectors for subsequent predictive modeling.

2.2 Grey Relational Analysis (GRA) of Policy Coupling

To explore the non-linear coupling relationship between tariff adjustments, countermeasure intensities, and economic responses, this study introduces Grey Relational Analysis (GRA). This methodology evaluates the strength of association between variables by analyzing the geometric similarity of their sequence curves.

The grey relational coefficient $\xi_i(k)$ is defined as:

$$\xi_i(k) = \frac{\min_i \min_k |x_0(k) - x_i(k)| + \rho \max_i \max_k |x_0(k) - x_i(k)|}{|x_0(k) - x_i(k)| + \rho \max_i \max_k |x_0(k) - x_i(k)|} \tag{4}$$

where ρ denotes the distinguishing coefficient (typically set to 0.5). By calculating the relational grade between policy fluctuation sequences and economic indicator sequences, we identify the core features most sensitive to trade policy shocks.

2.3 Heterogeneous Ensemble Predictive Framework

For the empirical simulation phase, we developed a heterogeneous ensemble forecasting architecture integrating XGBoost and Support Vector Regression (SVR).

2.3.1 XGBoost (extreme gradient boosting)

XGBoost is an advanced implementation of gradient-boosted decision trees. It optimizes a regularized objective function by performing a second-order Taylor expansion, which effectively captures high-dimensional feature interactions while preventing overfitting. The objective function is formulated as:

$$\mathcal{L}(\phi) = \sum_i l(\hat{y}_i, y_i) + \sum_k \Omega(f_k) \tag{5}$$

This model is specifically leveraged to capture complex non-linear trends within the macroeconomic data.

2.3.2 Support Vector Regression (SVR)

To enhance predictive robustness in the presence of structural breaks or limited sample intervals, SVR is incorporated. The core objective is to identify a hyperplane that minimizes empirical risk within a predefined tolerance ϵ:

$$\min \frac{1}{2} \left| |w||^2 + C \sum_{i=1}^{n} (\xi_i + \xi_i^*) \right) \tag{6}$$

By utilizing the Radial Basis Function (RBF) kernel to map features into a high-dimensional space, SVR achieves stable fitting under high-friction trade scenarios.

2.4 Model Validation and Dynamic Simulation

We employ five-fold time-series cross-validation, ensuring strict chronological order between training and testing sets to avoid information leakage. This design allows for realistic simulation of economic responses under evolving countermeasure scenarios.

3 EMPIRICAL RESULTS AND DISCUSSION

3.1 Grey Relational Evaluation Model

We construct two composite indices—Economic Composite Score and Manufacturing Composite Score—using Grey Relational Analysis (GRA) on 13 monthly indicators (e.g., GDP, PMI, industrial output). After normalizing all variables to [0,1] and aligning inverse metrics (e.g., unemployment), we compute relational degrees relative to an ideal reference sequence (all ones). Equal weighting yields time-varying scores that reflect systemic health.

As shown in the left side of Figure 1, both indices recover steadily through 2024 but diverge sharply in 2025: manufacturing briefly spikes above 0.8 amid new tariffs, yet collapses within months. The economic score drops concurrently with China' s retaliatory measures, confirming that protectionism invites countermeasures that destabilize the broader economy. The right side of Figure 2 further reveals manufacturing's narrow stability band (0.65–0.75) versus the economy's wider, multi-modal dispersion—highlighting macro vulnerability.

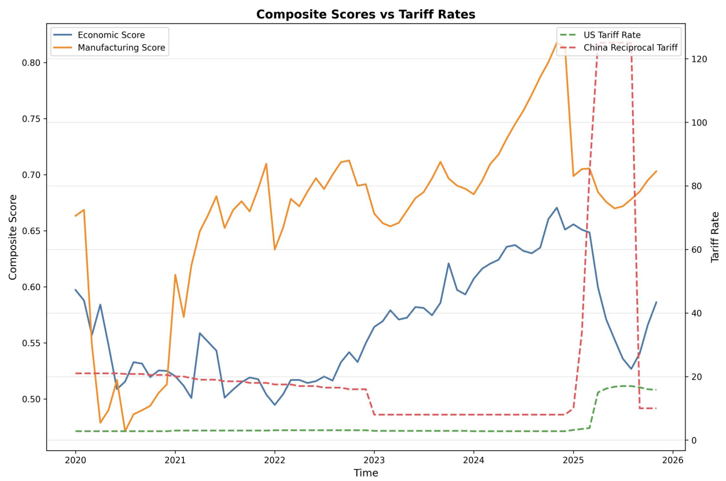

Figure 1 Composite Scores vs. Tariff Rates

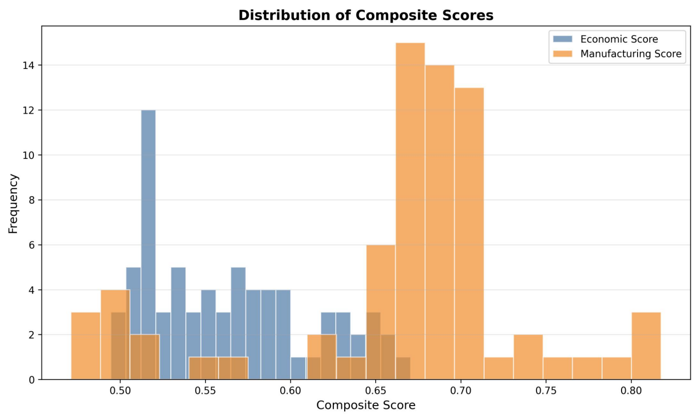

Figure 2 Distribution of Composite Scores

We test the core policy claim—"tariffs bring back manufacturing"—using Pearson correlations among U.S. tariffs (d13), Chinese retaliation (d14), and the two composite scores(Figure 3). Results are striking:

- U.S. tariff rate correlates negatively with both economic (r=-0.087) and manufacturing performance (r=-0.054)—effectively refuting the reindustrialization narrative.
- Chinese retaliation shows weak but non-negligible links to manufacturing (r=0.092), suggesting short-run disruption rather than strategic decoupling.
- Crucially, manufacturing and macro scores remain strongly linked (r=0.55), affirming industry's role as an economic bellwether.

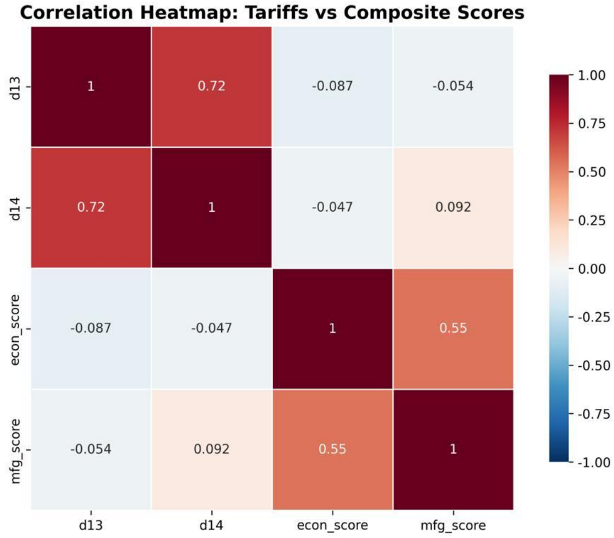

Figure 3 Heat Map of the Correlation between Tariffs and the Composite Score

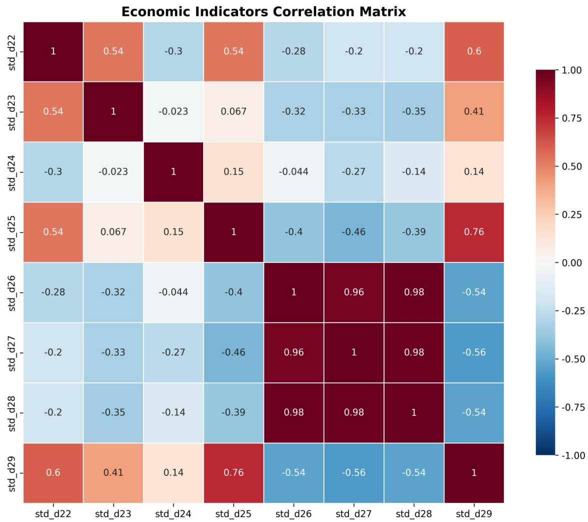

Figure 4 Correlation Matrix of Economic Indicators

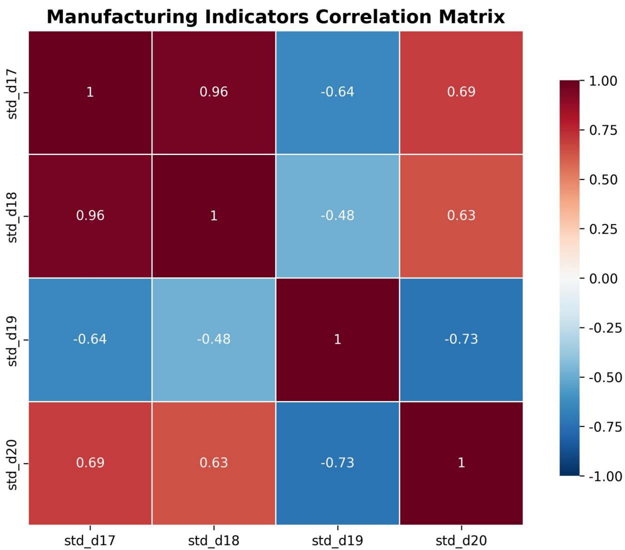

Figure 5 Correlations Matrix of Manufacturing Indicators

This study integrates grey relational and correlation analyses to assess the economic impact of U.S. tariffs and retaliatory measures. Key takeaways (Figure 4, Figure 5):

- Tariffs did not revive manufacturing: A brief 2025 uptick in the manufacturing score quickly faded and shows near-zero correlation with tariff levels (r=-0.054), undermining the protectionist rationale.
- Retaliation hit the U.S. economy: China's counter-tariffs coincided with a sharp drop in the economic score during peak trade tensions, revealing supply chain vulnerabilities.
- Reindustrialization requires more than tariffs: Without R&D, workforce development, and infrastructure, trade barriers alone cannot rebuild industry.

Therefore, we believe that: any short-term gains from tariffs are outweighed by medium-term costs—greater uncertainty, higher business expenses, and eroded global trust. Effective industrial policy demands long-term structural investment, not just trade walls.

3.2 XGBoost and SVR Model

To capture nonlinear, lagged, and interactive effects missed by linear correlation, we train an XGBoost regressor to predict both composite scores using a 29-dimensional feature set (including current and lagged tariff variables up to 6 months). Using time-series 5-fold cross-validation, XGBoost achieves exceptional fit: $R^2 > 0.999$, RMSE < 0.0012.

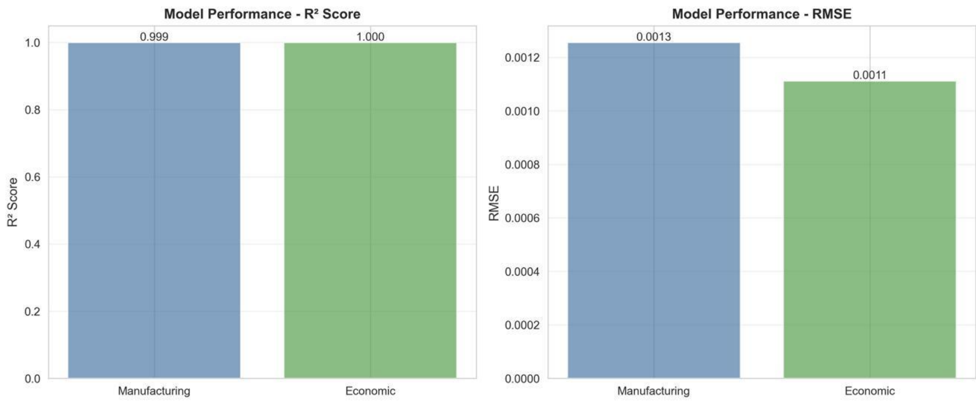

Figure 6 Fit Results of Actual vs. Predicted Values for the XGBoost

Figure 6 confirms near-perfect alignment between actual and predicted values, while Figure 7 shows accurate tracking of the 2025 inflection point. Feature importance (Figure 8) reveals that Chinese tariffs (current and 5-month lag) dominate manufacturing impacts, whereas U.S. tariffs (current and 4-month lag) drive macroeconomic trends—evidence of both immediate external shocks and delayed domestic feedback.

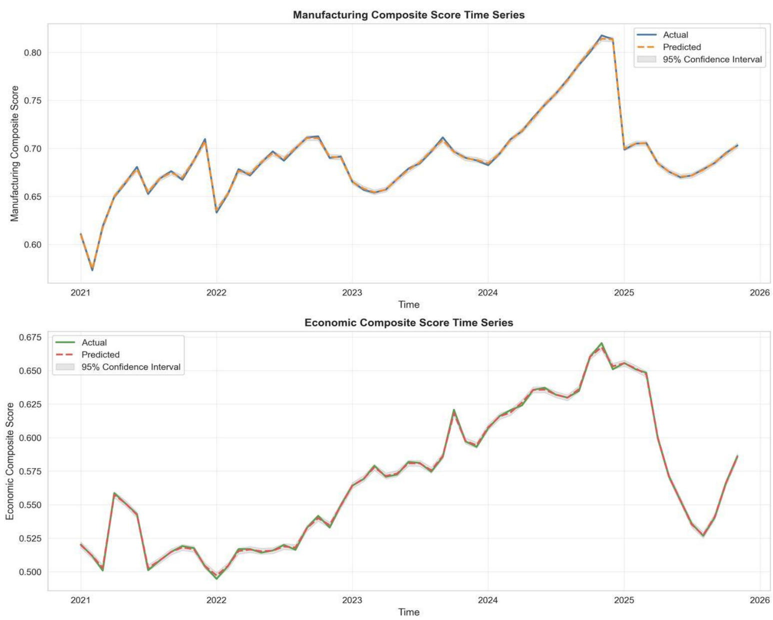

Figure 7 XGBoost Model's Time Series Prediction Trajectory (with 95% Confidence Interval)

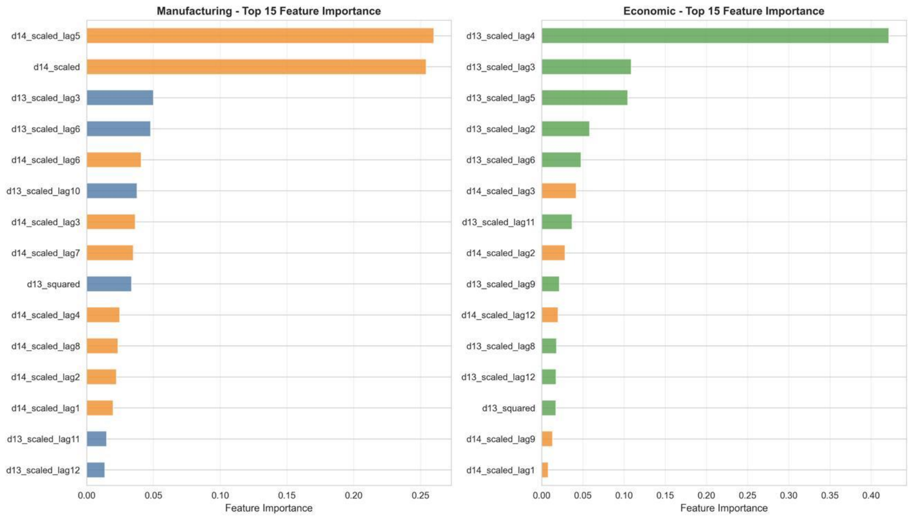

Figure 8 Top 15 Feature Importance of Manufacturing and Economic Indicators

As a robustness check, we implement SVR with an RBF kernel. While less accurate (R^2 = 0.924 for economy, 0.594 for manufacturing), SVR confirms key patterns: economic outcomes are more predictable than manufacturing, likely due to greater inertia in macro aggregates. Figure 9 and Figure 10 show minor residual clustering, hinting at unmodeled regime shifts—precisely where XGBoost's adaptability proves superior.

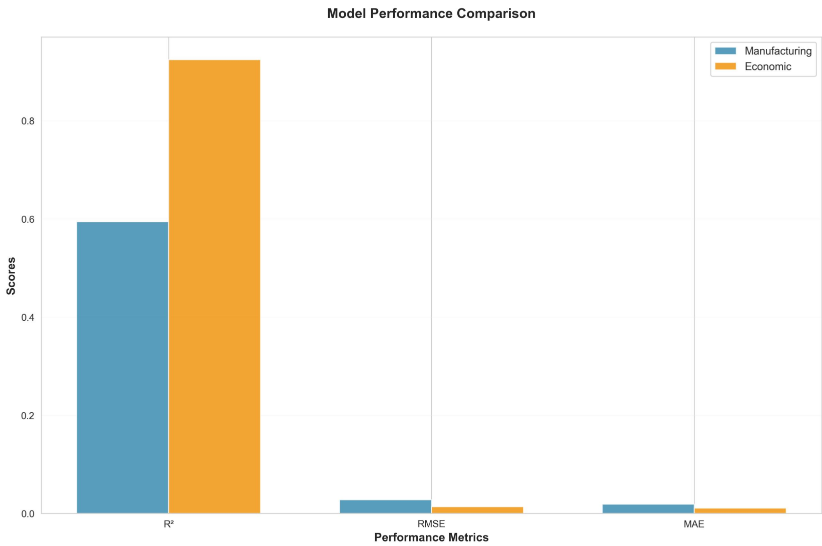

Figure 9 SVR Model Performance Comparison

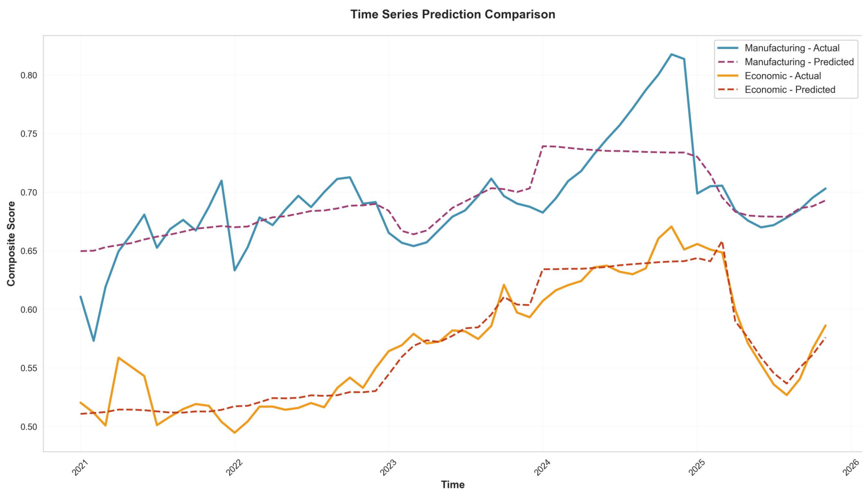

Figure 10 SVR Model Time Series Prediction Comparison

Tariffs create an illusion of industrial revival—a brief statistical blip quickly erased by retaliation, substitution, and base erosion. The U.S. captures short-term revenue but shoulders long-term costs: higher input prices, reduced export access, and macro instability. Sustainable reindustrialization demands investment in innovation and workforce capacity, not trade walls. Our hybrid modeling approach—spanning GRA, correlation, and machine learning—provides convergent evidence for this conclusion.

4 CONCLUSIONS

Against the backdrop of profound restructuring in global trade dynamics, the U.S. imposition of additional tariffs on key trading partners like China has not only reshaped bilateral trade frameworks but also triggered a chain reaction of countermeasures, creating uncertainties for global supply chain stability and national economic development. Accurately assessing the economic impacts of tariff policies and their countermeasures holds significant practical value for resolving trade friction dilemmas and formulating rational trade policies.

This study examines the interactive dynamics between U.S. tariff adjustments and countermeasures from trading partners. By constructing a multidimensional economic indicator system that integrates grey relational analysis, Pearson correlation analysis, and machine learning models (XGBoost and SVR), we systematically quantify the policy impacts on the U.S. macroeconomy and manufacturing sector. The research begins with stepwise data preprocessing to ensure sample quality, employs grey relational analysis to convert heterogeneous indicators into comparable composite scores, and utilizes correlation tests to reveal linear relationships between tariffs and economic performance. Two complementary models are then employed to validate nonlinear dynamic effects and feature importance. Experimental results demonstrate that U.S. tariff hikes failed to achieve sustained manufacturing repatriation, instead exacerbating economic volatility through countermeasures from trading partners. Notably, the transmission pathways of tariff shocks differ significantly between manufacturing and macroeconomic sectors, proving that tariff wars exhibit bidirectional harmful effects.

Based on the research conclusions, the following implications are proposed:

(1) From the perspective of policy formulation, relying solely on tariff barriers is insufficient to achieve industrial upgrading and economic growth objectives. It is necessary to abandon the "beggar-thy-neighbor" trade protectionism and resolve disputes through enhanced international cooperation and optimized trade agreements. Additionally, supporting policies such as R&D investment and workforce training should be implemented to build sustainable industrial competitiveness.

(2) From the perspective of enterprise development, in the face of trade policy uncertainty, enterprises should accelerate the diversification of supply chain layout, reduce the risk of single market dependence, and at the same time, use digital tools to monitor the dynamic of tariff policy and market changes, flexibly adjust production and operation strategies, and improve the ability to resist risks.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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