# The Effects of Economic Sanctions on Inflation Rates in Syria and Russia

## Abstract

This report examines the impact of economic sanctions on inflation rates and related economic metrics in Syria and Russia, utilizing data from 2000 to 2024. Through exploratory data analysis, hypothesis testing, and machine learning, the study assesses how sanctions influence economic stability and livelihoods, drawing insights from datasets on inflation, poverty, unemployment, and exchange rates for both countries.

## Methods

### Data Collection and Preparation

* Inflation rates: Statburreau for Russia, Central Bureau of Statistics for Syria.
* Exchange Rate: International Monetary Fund Data Portal, for both countries.
* Poverty Rate: Russian Federal State Statistics Service for Russia, UNDP for Syria
* Unemployment rate: Russian Federal State Statistics Service for Russia, World Bank and CEIC Syria.

### Exploratory Data Analysis (EDA)

Included Summary Statistics for each attribute

### Hypothesis Testing

A two-sample t-test assessed the null hypothesis that inflation rates pre- and post-sanctions are equal for each country. Normality and equal variance were verified using Shapiro-Wilk and Levene’s tests, respectively.

### Feature Engineering

Features included lagged inflation rates, exchange rate volatility (standard deviation over a 12-month window), and binary sanctions indicators (0 pre-sanctions, 1 post-sanctions).

### Machine Learning

A Linear Regression model predicted inflation rates for each country, incorporating engineered features. Models were trained on 80% of the data, with 20% for testing, using 5-fold cross-validation to optimize the regularization parameter.

## Results

### Hypothesis Test Results

Comprehensive sanctions in Syria affected inflation, the exchange rate, unemployment rate, and poverty rate significantly, while targeted sanctions had a limited effect on the metrics, except for the poverty rate. This might be due to many factors that couldn't have been examined by data science, such as conflicts in the Middle East, and the American War on Terror, which have been ongoing since the mid-90s.

In Russia, Targeted sanctions influenced inflation, the exchange rate, the unemployment rate, and the poverty rate significantly. Comprehensive sanctions influenced the exchange rate, unemployment rate, and poverty rate significantly, whereas they had no significant effect on inflation. The reason might be that targeted sanctions included the energy sector in Russia, which is a very important part of its economy, affecting its indicators even before comprehensive sanctions were applied in 2022.

### Machine Learning Outcomes

Lasso Regression achieved an R² of 0.65 for Syria and 0.58 for Russia on test sets.

### Interpretation

The significant inflation increases post-sanctions in both countries suggest sanctions exacerbate economic instability, with sharper effects in Syria due to prolonged isolation. The Lasso model’s improved R² highlights exchange rate volatility and sanctions timing as critical factors. Negative initial R² and K-S results indicate data challenges (e.g., outliers, shifts), necessitating robust preprocessing and cautious interpretation.

## Limitations and Future Work

Limitations include potential data gaps and lack of causal inference since the fact that sanctions cannot be isolated from an unstable political environment. Future work could compare additional sanctioned countries (e.g., Venezuela, Cuba), incorporate real-time data, or apply time-series models like ARIMA for enhanced trend analysis. Moreover, more domain knowledge of research on compliance and sanctions indicators could add more meaningful attributes to the research, addressing the other part of the effectiveness of sanctions, namely how they influence compliance.

## Conclusion

This project demonstrates the adverse economic impact of sanctions in Syria and Russia, validated through statistical and machine learning approaches. The findings emphasize the need for balanced policy considerations in international relations.