Key Takeaways After Analysis

This section summarizes the most critical insights derived from the analysis of U.S. macroeconomic data from 2018 through mid-2025. The project explored relationships among interest rates, inflation, and money supply, utilizing both traditional statistical techniques and unsupervised machine learning methods. The following takeaways highlight both empirical observations and broader economic implications:

1. Monetary Policy Operates in Distinct Regimes

The analysis revealed that U.S. interest rate policy between 2018 and 2025 could be divided into **three clearly defined regimes**, each representing a different economic context and policy stance:

- **Pre-Pandemic Normalization (2018–2019):** Interest rates were moderately elevated, reflecting a phase of economic recovery and balance following the 2008 financial crisis.
- **Pandemic-Era Stimulus (2020–2021):** The Federal Reserve slashed the Fed Funds Rate to near zero to mitigate the economic fallout from COVID-19. SOFR followed suit, and the Treasury yield dropped, marking an ultra-loose monetary environment.
- **Post-Pandemic Tightening (2022–2023):** As inflation surged, the Fed embarked on its most aggressive rate hike cycle in decades, pushing rates above 5%.

These regimes were quantitatively identified using **KMeans clustering**, confirming that monetary behavior does not evolve linearly but shifts between structurally different phases in response to external shocks and internal policy triggers.

2. Strong Long-Term Relationship Between M2 and CPI

One of the most significant findings is the **strong positive correlation between M2 Money Supply and the Consumer Price Index (CPI)**. The data shows that:

- M2 experienced an unprecedented increase during 2020–2021 as part of pandemic-era stimulus.
- CPI began to rise sharply approximately 6–12 months later, peaking in 2022.

This supports the classical economic theory that **increased money supply, when not matched by productive output, leads to inflation**. Although inflation remained muted immediately after M2 expansion, it eventually accelerated—demonstrating the delayed but potent effect of liquidity injections on the general price level.

3. Inflation Response to Interest Rates Is Delayed and Indirect

Contrary to the assumption that interest rate hikes produce quick deflationary effects, the analysis indicates that:

- **Inflation does not immediately decline following rate increases.**
- Instead, there appears to be a **lag period of 6–12 months**, during which inflation may continue to rise or remain elevated before reacting to tighter monetary policy.

This finding emphasizes the importance of **policy patience** and forward-looking analysis. Over-tightening or reacting too quickly could amplify volatility, while underestimating lags can delay corrective action. Effective inflation control requires strategic timing and communication.

4. Short-Term and Long-Term Interest Rates Move in Lockstep

The Fed Funds Rate, SOFR, and the 10-Year Treasury Yield exhibited **high correlation** throughout the study period. Although driven by different market forces (e.g., Fed Funds Rate via policy, Treasury Yield via market expectations), their movements were tightly synchronized:

- When the Fed began hiking rates in 2022, SOFR and Treasury yields followed almost simultaneously.
- During the zero-rate environment, all three indicators remained suppressed.

This co-movement reinforces the concept of a **coherent monetary environment**, where short-term policy tools effectively anchor long-term borrowing costs. The alignment between instruments also highlights the strength of central bank signaling and market responsiveness.

5. Machine Learning Offers Valuable Regime Detection

The application of **unsupervised machine learning (KMeans clustering)** was instrumental in identifying **non-obvious patterns** and shifts in the macroeconomic landscape. Specifically, clustering helped:

- Segment the dataset into distinct periods (regimes) based on CPI and Fed Funds Rate.
- Visualize transitions in monetary behavior that correlate with real-world economic shifts.

- Provide a data-driven foundation for understanding when and how policy responses differ under varying inflationary pressures.

  This demonstrates the value of **integrating AI/ML tools into economic analysis** to supplement traditional econometric approaches and improve interpretability.

  6. Policy Stability Is the Exception, Not the Norm

  From the lens of regime clustering and time series trends, it becomes evident that **stable, "normal" policy environments are rare and short-lived**. The past seven years were marked by:

- A brief normalization phase
- A prolonged period of emergency stimulus
- A rapid shift to aggressive tightening

  This suggests that **modern monetary policy must be adaptive and resilient**, with frameworks that allow for rapid response but also consider long-term structural changes. Economists, forecasters, and policymakers must prepare for volatility as the new norm, rather than an outlier.