Supply Chain Optimization Report

Introduction

This project focuses on optimizing a global supply chain network to minimize operational costs while meeting production and demand requirements. A mathematical model was developed to account for tariffs, transportation costs, production capacities, and exchange rates.

Objectives

1. Minimize total costs, including fixed, variable, and transportation costs.
2. Ensure sufficient capacity at production plants to meet demand.
3. Evaluate the impact of tariffs and exchange rates on supply chain efficiency.

Methodology

1. **Model Setup:**
    - Decision Variables:
        - Plant operation status (binary).
        - Flow of goods for HighCal and Relax production lines.
    - Constraints:
        - Excess capacity at plants.
        - Demand fulfillment for all regions.
    - Objective Function:
        - Minimize total costs, including fixed costs, production costs, and transportation costs.
2. **Data Considerations:**
    - Demand and capacity data for six regions (e.g., Brazil, Germany, India, Japan, Mexico, U.S.).
    - Transportation costs, tariffs, and duties.
    - Exchange rates based on a 2019 baseline.
3. **Optimization:**
    - Gurobi optimization framework used to solve the model.
    - Sensitivity analysis performed by varying tariffs and exchange rates.

Results

1. **Optimized Flows:**
    - HighCal and Relax flow patterns minimize costs while meeting demand.
    - Flow patterns vary significantly with changes in tariffs and exchange rates.
2. **Plant Strategies:**
    - Operational recommendations for plants (e.g., Brazil, Germany, India).
    - Identified optimal production lines (HighCal, Relax) for each plant.
3. **Cost Minimization:**
    - Minimum cost achieved: $1,163.7 in 2024.
    - Results demonstrate the significant impact of tariffs and duties on total costs.

Discussion

- Tariffs and exchange rate fluctuations have a substantial impact on the supply chain.
- Optimized strategies enable cost-effective distribution and production.
- The model provides actionable insights for decision-making under various economic scenarios.

Recommendations

1. Adopt optimized production and distribution strategies to minimize costs.
2. Monitor tariff changes and exchange rate fluctuations for dynamic adjustments.
3. Conduct regular sensitivity analyses to prepare for economic uncertainties.

Conclusion

This analysis highlights the importance of optimization in managing global supply chains. By leveraging mathematical models, companies can significantly reduce costs while maintaining operational efficiency and meeting customer demand.

References

- Data: Production capacities, demands, costs, and tariffs.
- Optimization Tool: Gurobi Solver.