

Energy Trade and Security: Scenario Simulation Comparison of Natural Gas Trade Using Computable General Equilibrium Models and Social Network Analysis

John Schoeneman¹
john.schoeneman@okstate.edu

Lixia Lambert¹
lixia.lambert@okstate.edu

Dayton Lambert¹
dayton.lambert@okstate.edu

29th Annual Conference on Global Economic Analysis
Kyoto, Japan

June 18th 2026

¹Oklahoma State University

Motivation

- Build an ensemble model that captures structural interdependencies and economic relationships in the energy trade networks to simulate disruption within energy supply chains.

Models

- Additive and Multiplicative Effects Network (AMEN) Model
- Computable General Equilibrium (CGE) Model

Data

- UNCTAD trade data at the HS-4 digit level
- 2017 and 2023

Design

- Monopartite network for HS Code 2711
- Estimate Effect Matrix (EM) → Simulate disruption → Iteratively add flows back post-disruption with EM
- Disruptions: Post Invasion of Ukraine (50%) and Strait of Hormuz Blockade (100%)

Data

- GTAP 12
- 2017 and 2023

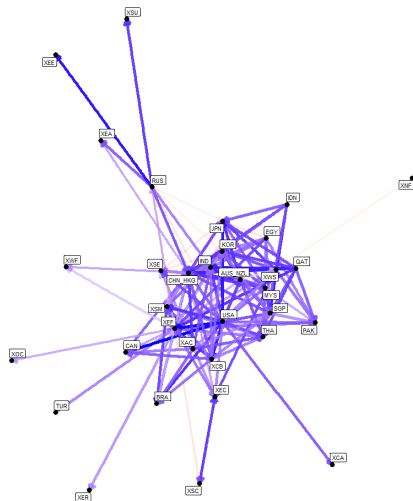
Design

- 12 Commodity Groups (Natural Gas is separated) and 45 regions
- Shock Natural gas flows via Import Taxes. 50% import tax for Invasion of Ukraine and 100% transport margins for Strait of Hormuz.
- Standard GTAP model in GAMS with comparative-static simulations and Constant-Difference-in-Elasticity (CDE) utility function
- Changes are measured by regional bilateral import demand

2022 Disruption Change 1

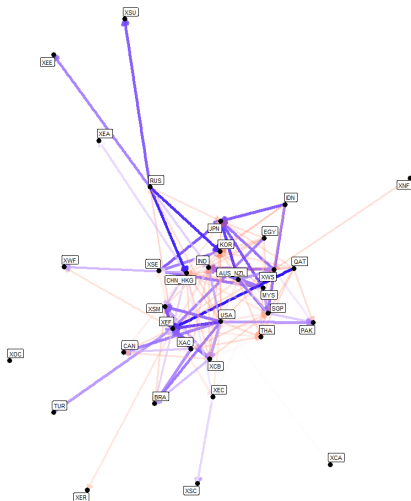
AMEN

Average Difference = 4.2



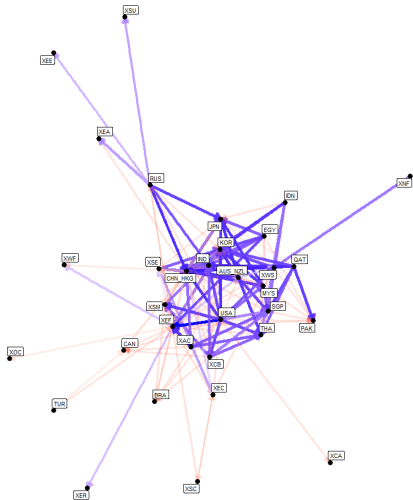
GTAP

Average Difference = 9.1



2022 Disruption Change 2

(c) Combined
Average Difference = 0.68



(d) 2023
Average Difference = 0

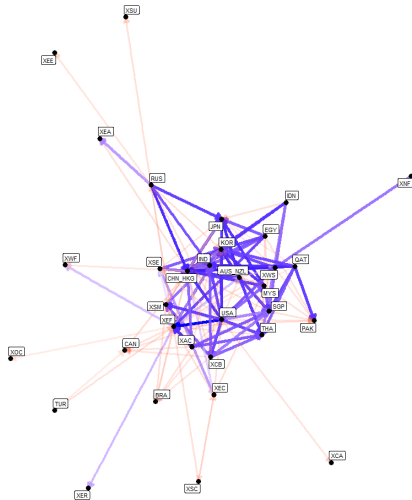


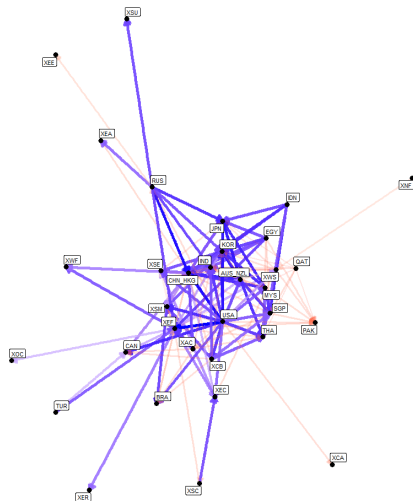
Table: Partner Changes for AMEN Model

Exporter	Rank	Importer	Base	Shock	2023
RUS	1st	XEF	7.15%	1.89%	4.27%
	2nd	JPN	1.98%	0.52%	2.02%
	3rd	CHN_HKG	0.73%	0.80%	2.51%
	4th	KOR	0.70%	0.19%	0.51%
USA	1st	XEF	8.47%	9.62%	18.14%
	2nd	KOR	1.40%	1.58%	2.00%
	3rd	JPN	1.16%	1.28%	1.63%
	4th	XSM	0.80%	0.85%	1.06%

2026 Disruption Change

AMEN

Average Difference = 4.2



GTAP

Average Difference = 9.1

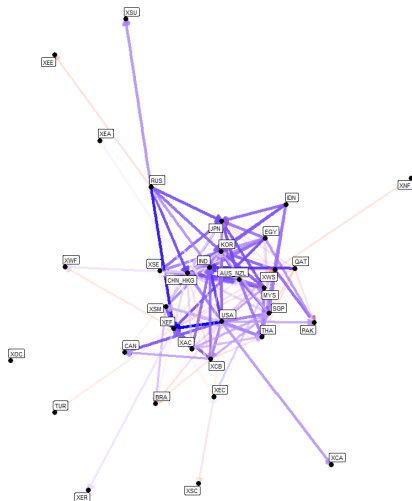


Table: Partner Changes for AMEN Model

Exporter	Rank	Importer	Base	Shock
RUS	1st	XEF	7.00%	5.43%
	2nd	JPN	1.49%	2.19%
	3rd	CHN_HKG	4.20%	6.29%
	4th	KOR	0.38%	0.59%
USA	1st	XEF	15.02%	15.40%
	2nd	KOR	3.09%	5.00%
	3rd	JPN	2.63%	4.10%
	4th	XSM	1.29%	1.54%

Conclusion and Next Steps

Conclusion

- Structural dependence in the network captures underlying political alliances and can assist in more accurate scenario simulation, but fails to account of price signals
- Results indicate the two models are complimentary

Next Steps

- Integrate modeling approaches via price signals as a network model variables or adding network variables to CGE framework instead of combining changes after simulations (May require different CGE model such as KITE)
- Account for volume changes through dynamic time trends
- Add contract restrictions to data