Calculating Economic Security Dependencies

A Comprehensive Methodology for Trade Vulnerability Analysis

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USITC ITPD-E Database

- Source: U.S. International Trade Commission (USITC)
- Content: International and domestic trade flows, reconciled for accuracy
- Coverage: 264 countries, 170 industries (agriculture, mining, energy, manufacturing, services)
- Timeline: 1986-2022 (Release 3, June 2025)
- Reliability: Administrative data only, no statistical estimates

Introduction: What is Economic Dependency?

- The indicator measures a country's reliance on another as a supplier for specific goods
- Crucial for understanding vulnerabilities and risks in global supply chains
- The analysis covers both direct and indirect trade relationships:
  - Direct: Country A imports goods directly from Country B
  - Indirect: Country A imports from C, which sources from B
- Essential for economic security policy design and strategic autonomy assessment

Foundation: Clean and Significant Trade Data

The analysis is built upon a solid data foundation:

1. We begin with ITPD-E bilateral trade data for hundreds of industrial sectors

2. Minor or insignificant trade flows are filtered out to ensure accuracy
   - Trade links included only if they represent meaningful share of imports
   - Threshold-based filtering to reduce statistical noise

3. This process focuses analysis on economically relevant dependencies

Step 1: Calculating Direct Dependency

This measures the share of a country's total imports that comes directly from a single supplier.

Formula:

$$D_{ij} = \frac{X_{ji}}{\sum_k X_{ki}} \tag{1}$$

Where:

- D_{ij} is the direct dependency of country i on country j
- X_{ji} is the value of goods imported by i from j
- $\sum_k X_{ki}$ is the total value of goods imported by i from all countries k

Interpretation: Values range from 0 (no dependency) to 1 (complete dependency)

Step 2: Indirect Dependency & Path Analysis

We reveal hidden relationships by tracing goods through intermediary countries.

Path Dependency Formula:

$$\text{Dependence}(p) = \frac{f_{p_1,p_2}}{d_{p_n}} \times \prod_{i=2}^{n-1} \frac{f_{p_i,p_{i+1}}}{d_{p_i}} \tag{2}$$

Where:

- p represents a supply chain path from origin to destination
- $f_{a,b}$ is the trade flow from country a to country b
- d_i is the total demand of country i
- The product captures "dilution" effects through intermediaries

Key insight: Captures vulnerability transmission through complex supply networks

Step 3: The Role of Intermediaries

We identify critical roles each country plays within global supply chains.

Two key metrics for every intermediary country:

Frequency	How often the country acts as a "bridge" in global supply paths
Strength	Total economic value of trade flowing through the country as intermediary

This allows identification of:

- Critical hubs in the global trade network
- Potential bottlenecks and single points of failure
- Systemically important intermediary countries

The Final Indicator: Total Dependency

The total dependency score combines all layers of analysis.

$$\text{Total Dependency}_{ij} = D_{ij}^{\text{direct}} + \sum_{\text{paths } p} \text{Dependence}(p) \tag{3}$$

This provides:

- Holistic view of economic vulnerability to specific suppliers
- Ranking of most critical supply paths
- Policy-relevant insights for strategic autonomy
- Scenario analysis capabilities for different disruption patterns

Applications: Economic security assessment, diversification strategy design, resilience policy planning

Policy Applications for Economic Security

The methodology supports evidence-based policy design:

Strategic Applications:

- Vulnerability Assessment: Identify critical dependencies before crises
- Diversification Strategy: Distinguish between superficial and deep diversification
- Resilience Planning: Prioritize sectors and relationships for intervention
- Scenario Analysis: Evaluate impact of geopolitical fragmentation

Particularly relevant for:

- EU "Open Strategic Autonomy" initiatives
- Critical materials and technologies assessment
- Supply chain resilience in strategic sectors

Future Research Directions

Extensions to enhance the methodology:

Value Chain Integration:

- Explicit inclusion of global value chains in dependency calculations
- Analysis beyond directly traded products to critical input requirements
- Mapping dependencies of products that require other critical goods for production
- Integration of input-output relationships within supply chain analysis

Additional Enhancements:

- Time-varying dependency patterns and trend analysis
- Integration of geopolitical risk factors
- Sectoral vulnerability indices incorporating technological complexity
- Dynamic simulation of disruption scenarios