

Semiconductor Supply Chain Mapping

ASML → TSMC → Nvidia → CSP Analysis

Executive Summary

The global semiconductor supply chain is highly concentrated and interdependent. ASML holds a monopoly on EUV lithography systems, which are essential for manufacturing advanced chips below 7nm. TSMC dominates the foundry market with 60% market share, manufacturing chips for Nvidia, AMD, and Apple. This concentration creates significant supply chain risks.

Critical Dependencies

1. ASML → TSMC Dependency:

TSMC's 3nm and below processes are 100% dependent on ASML's EUV systems. Each EUV machine costs \$150-200M and has 18-month lead times. ASML can produce approximately 60 systems per year, creating a bottleneck for capacity expansion.

2. TSMC → Nvidia Dependency:

Nvidia manufactures 100% of its H100/H200 GPUs at TSMC using CoWoS advanced packaging. This dependency level is critical, as no alternative foundry can currently produce equivalent performance chips. AMD faces similar dependency with its MI300 series.

3. SK Hynix → Nvidia HBM Supply:

SK Hynix supplies approximately 50% of Nvidia's HBM3E requirements. The company's HBM production capacity is fully allocated through 2025, creating supply constraints for AI accelerators.

Geopolitical Concentration Risk

Taiwan Concentration:

TSMC's primary manufacturing facilities are located in Taiwan, producing over 90% of the world's most advanced chips. Taiwan Strait tensions create systemic risk for the entire AI and semiconductor industry. Alternative fabs in Arizona and Japan won't reach significant capacity until 2026-2027.

Netherlands Export Controls:

ASML, based in the Netherlands, is subject to export restrictions on EUV systems to China. This creates geopolitical leverage points and potential supply disruptions if relations deteriorate.

Supply Chain Resilience Efforts

CHIPS Act (USA):

\$52B in subsidies to build domestic semiconductor manufacturing. TSMC is constructing two fabs in Arizona (5nm and 3nm), Intel is expanding in Ohio and Arizona, and Samsung is building a fab in Texas.

Dual Sourcing Strategies:

Nvidia is diversifying HBM suppliers by qualifying Samsung and Micron alongside SK Hynix. However, process qualification takes 12-18 months, limiting short-term flexibility.

Alternative Architectures:

Cloud providers (AWS, Google) are developing custom chips (Trainium, TPU) to reduce dependency on Nvidia. However, software ecosystem lock-in (CUDA) maintains Nvidia's competitive moat.

Supply Chain Vulnerability Assessment

Critical Single Points of Failure:

1. ASML EUV systems (no alternative supplier)
2. TSMC advanced packaging (CoWoS, InFO)
3. Taiwan-based manufacturing (geopolitical risk)
4. HBM production capacity (12-month lead times)
5. Rare earth materials (China controls 80% of supply)

Risk Mitigation Timeline:

- Short-term (2024-2025): Limited options, inventory buffer only
- Medium-term (2026-2027): New fabs coming online (Arizona, Japan)
- Long-term (2028+): Geographic diversification achievable