Analysis of the AI–Semiconductor Bubble

Valuation Diagnostics and Evidence of Structural Fragility

Using normalised price-to-earnings (P/E), normalised price-to-sales (P/S), market concentration, and price–fundamentals decomposition, no evidence of sustained mispricing in leading semiconductor firms was found; however, market leadership was found to be highly concentrated and structurally fragile.

Objectives

Rapid appreciation in semiconductor and AI-linked equities has prompted a widespread narrative that the sector is experiencing a speculative bubble, frequently compared to historical episodes such as the dot-com boom. This analysis examines whether recent price gains reflect the sustained mispricing characteristic of a bubble, or whether valuations remain fundamentally justified by realised earnings growth.

Methodology

Data

- Publicly traded semiconductor firms: NVIDIA, AMD, TSMC, ASML, Broadcom
- Monthly price, earnings, revenue, and market capitalisation data
- Data sourced via Yahoo Finance using the `yfinance` API

Diagnostics Applied

- Normalised price-to-earnings (P/E) ratios relative to firm-specific historical medians
- Normalised price-to-sales (P/S) ratios to assess revenue-level valuation pressure
- Market capitalisation concentration within the semiconductor sector and the S&P 500
- Price–fundamentals decomposition using:

$$\Delta \ln P = \Delta \ln E + \Delta \ln(P/E)$$

Key Findings

- Normalised P/E ratios show no sustained or synchronised multiple expansion across firms, with valuation spikes being firm-specific and typically followed by mean reversion as earnings materialise.

- Normalised P/S ratios remain within approximately 0.5–1.5× their historical medians, far below the extreme deviations observed during historical speculative bubbles.
- Price–fundamentals decomposition indicates that recent price appreciation in market leaders has been predominantly earnings-driven rather than valuation-driven.
- Market capitalisation has become increasingly concentrated within both the semiconductor sector and the broader S&P 500, indicating narrow market leadership and elevated structural fragility.
- Across all diagnostics, there is no evidence of persistent decoupling between prices and underlying fundamentals.

Interpretation

The findings indicate that the current AI–semiconductor regime does not exhibit the characteristics of a speculative bubble, instead demonstrating elevated structural fragility rather than mispricing. While speculative bubbles are defined by sustained valuation expansion and price–fundamentals decoupling, fragility arises from narrow market leadership and capital concentration, increasing sensitivity to shocks even when valuations are justified. As a result, the market may be vulnerable to sharp drawdowns without implying that prices were previously irrational or unsustainable.

Limitations

- This analysis does not assess private AI company or early-stage venture valuations, where speculative dynamics may differ materially from public markets.
- The absence of bubble diagnostics does not preclude drawdowns driven by narrative shifts, geopolitical risk, or policy shocks.
- Findings apply to large, publicly traded semiconductor firms and do not generalise to the broader AI startup ecosystem.

Importance of Findings

Distinguishing between speculative mispricing and structural fragility is critical for interpreting market risk. In a fragile but fundamentally supported regime, volatility and drawdowns may arise from concentration, narrative shifts, or exogenous shocks without implying prior unsustainable valuations. Mischaracterising such corrections as a "bubble bursting" risks flawed investment or policy conclusions by conflating structural risk with valuation error.

Full paper, figures, and methodology available via the accompanying GitHub repository.