

# Principal Components as a Measure of Systemic Risk

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The U.S. government's failure to provide adequate oversight and prudent regulation of the financial markets, together with excessive risk taking by some financial institutions, pushed the world financial system to the brink of systemic failure in 2008. As a consequence of this near catastrophe, both regulators and investors have become keenly interested in developing tools for monitoring systemic risk. But this is easier said than done. Securitization, private transacting, complexity, and "flexible" accounting<sup>1</sup> prevent us from directly observing the many explicit linkages of financial institutions. As an alternative, we introduce a measure of implied systemic risk called the absorption ratio, which equals the fraction of the total variance of a set of asset returns explained or "absorbed" by a fixed number of eigenvectors.<sup>2</sup>

The absorption ratio captures the extent to which markets are unified or tightly coupled. When markets are tightly coupled, they are more fragile in the sense that negative shocks propagate more quickly and broadly than when markets are loosely linked.

We offer persuasive evidence that the absorption ratio effectively captures market fragility. We show that

1. Most significant U.S. stock market drawdowns were preceded by spikes in the absorption ratio.

2. Stock prices, on average, depreciated significantly following spikes in the absorption ratio and, on average, appreciated significantly in the wake of sharp declines in the absorption ratio.
3. The absorption ratio provided early signs of the consolidation of the U.S. housing market.
4. The absorption ratio systematically rose in advance of market turbulence.
5. Most global financial crises coincided with positive shifts in the absorption ratio.
6. The absorption ratio captures a large fraction of the information of more complex and computationally intensive structural models of financial contagion.

We proceed as follows. We begin with a literature review of systemic risk and related topics. Then we provide a formal description of the absorption ratio. We next present historical estimates of the absorption ratio for a variety of asset markets, and we show how it relates to asset prices, financial turbulence, the global financial crisis, and financial contagion. We conclude with a summary and suggestions about how regulators and investors might use the absorption ratio as an early warning signal of market stress.