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Citation

Singapore Management University. Predictions for protection: A system to measure and detect asset bubbles. (2011).

Available at: <https://ink.library.smu.edu.sg/pers/324>

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PREDICTIONS FOR PROTECTION: A SYSTEM TO MEASURE AND DETECT ASSET BUBBLES

Published:
8 Oct 2011



The damage wrecked by the bursting of asset bubbles can have a devastating impact on investors' fortunes. In the Internet bubble, some US\$8 trillion of shareholder wealth was destroyed. What is even more pertinent, however, is how the popping of a bubble can create a financial crisis, impacting nations and their economies. As a result, understanding how to identify bubbles is an important first step in combating these speculative bubbles, with interested parties ranging from the academic and investment community to central bankers and policy makers.

[Yu Jun](#), a professor of economics and finance, the director of [Sim Kee Boon Institute for Financial Economics](#), and co-director at the [Centre for Financial Econometrics](#), Singapore Management University (SMU), has researched on the detection of bubbles and the dating of its origination and termination. Speaking at a [talk](#) organised by the CFA Institute, Yu noted that while some economists will say that it is not possible to know if a bubble exists before it pops, the identification of bubbles is an area of study that is of great importance to policymakers, given its broad impact on the economy.

In fact, Donald Kohn, former vice chairman of the US Federal Reserve Board once said, "Federal Reserve policy makers should deepen their understanding about how to combat speculative bubbles to reduce the chances of another financial crisis."

Believers in the efficient market hypothesis, the bedrock of the study of financial analysis, should deny that bubbles even exist since, in theory, they believe that the markets have priced in all information, including future expectations, into asset prices, and hence, the price is "right".

Nonetheless, Yu defined a bubble as the deviation of price from its fundamentals. This price based on fundamentals is derived using the present value theory, specifically the dividend discount method, which sums all future dividends from the asset, discounting each of these cash flows to the present using the risk free interest rate. Any difference between the actual price and this price derived from these fundamentals then becomes the bubble component.

Setting up the bubble test

Analysing a time series of price data using statistical methods and hypothesis testing can reveal if the behaviour of the data is stationary, a random walk (unit root), or if it exhibits explosive behaviour. "Stationarity" means that the statistical properties of the data (i.e. the mean and variance) do not change over time while the trajectory of bubbles would exhibit non-stationary behaviour.

In a paper published in 1988, two economics professors, Behzad Diba and Herschel Grossman, applied standard unit root tests to real US Standard and Poor's Composite stock price index data from 1871 to 1986, testing stock price levels and differences for non-stationarity. They found support in the data for non-stationarity in levels but found stationarity in differences. Since differences of an explosive process still manifest explosive characteristics, these findings appear to reject the presence of a market bubble in the data.

Further tests provided confirmation of co-integration between stock prices and dividends over the same period, supporting the conclusion that prices did not diverge from long-run fundamentals and thereby provides additional evidence against bubble behaviour. This approach was, however, criticised by another economist, G.W. Evans, in 1991. He argued that the time series that produces periodically collapsing bubbles manifests more complex bubble characteristics that cannot be shown by the standard unit root and co-integration tests.

Evans argued further that standard unit root and co-integration tests are inappropriate tools for detecting bubble behaviour because they cannot effectively distinguish between a stationary process and a periodically collapsing bubble model. Patterns of periodically collapsing bubbles in the data look more like data generated from a unit root or stationary auto-regression than a potentially explosive process.

Building on these works, Yu, with his colleagues, Peter Phillips and Wu Yangru, proposed a recursive right-tailed unit root test, or sup augmented Dicky-Fuller test (SADF), that would seek to identify the origination and termination dates of bubbles.

"The system can detect exuberance in an asset price series during its inflationary phase and can serve as an early warning system," said Yu. To test out the method, he has applied it to the real estate, mortgage backed securities, commodity, bond and foreign exchange markets, analysing the transmission mechanism of the bubbles.

By implementing the right-tailed unit root test repeatedly on a sequence of forward expanding samples of data, it becomes possible to identify the origination and termination date of the bubble. These timestamps are when the Dicky-Fuller t-statistic exceeds a critical value, or significance level.

Understanding bubbles

In examining the internet bubble for the Nasdaq price index, using a five per cent critical value, this method shows the origination date of the bubble to be as early as June 1995, with the termination in July 2001, where the prices had by then already collapsed. The data used by Yu had stripped out the effects of inflation by converting the nominal series to a real series using the consumer price index, and covered the period from February 1973 to June 2005, comprising 389 monthly observations.

Both price and dividend grew steadily from the beginning of the sample until the early 1990s. The price series then began to surge and the steep upward movement in the series continued until the late 1990s as investment in dot-com stocks grew in popularity. Early 2000 saw the price abruptly drop and it continued to fall to the mid-1990s level. The dividend series, on the other hand, had remained steady throughout the sample period.

The t-statistic for the dividend series also shows no such explosive behaviour as the price series, which indicates a departure of the price from the fundamentals. Curiously, Alan Greenspan, then chairman of the US Federal Reserve had made his famous remark in December 1996, coining the term “irrational exuberance”. He had asked, “How do we know when irrational exuberance has unduly escalated asset values?” The timestamp of the origination of the internet bubble predates Greenspan’s remark, hence providing empirical content to his remark.

It is noteworthy that the bubble had continued strongly for another three years even after his cryptic warning, showing that just because a bubble has been identified does not mean that it is also due to pop any time soon.

Bubbling up policy measures

Extending this method to the subprime crisis, there appears to be a transmission of the growth of bubbles, starting with the Nasdaq price index during the internet bubble, then the home price index (from January 2001 to August 2007) followed by commodity prices such as crude oil (March 2008 to August 2008), bond price bubble (October 2008 to December 2008) and the GBP-USD exchange rate (from October 2008, and was still continuing when the study ended in 2009). These classes all underwent bubble inflation and collapse, with Yu noting that “an economic story can be told of the bubble migration.”

“This method will provide dates of origination and collapse but it uses historical data, and hence it does not have a predictive element,” Yu explained. From an investor who wishes to time the market, in a bid to buy low and sell high, the method might not be directly relevant. However, if regulators had a method to identify potential bubbles, such as the one proposed by Yu, they could then be able to introduce policy measures in a timely manner for maximum effect.

Turning his attention to the Singapore real estate market, the method identified two periods of bubble price behaviour in the last five years. The first ran from May 2007 to late 2008, while the second began in October 2009, and is still continuing. With recent policy measures intended to cool the property market, these initiatives may appear timely to create a soft landing as opposed to a bubble implosion, which may have a destabilising effect on the economy.

Given the implications of his work, these techniques have received a great deal of interest from several central banks and policymaking bodies, including the Monetary Authority of Singapore, the Urban Redevelopment Authority of Singapore, and the central banks of Hong Kong, China, Korea and Canada. If indeed an early warning system can be designed to accurately demarcate bubble territory for financial assets, policy measures can be executed before damage is wrought on the economy.