DEMYSTIFYING BUBBLES IN ASSET PRICES

Christine L. Storrie
SUNY Oneonta

ABSTRACT

This paper provides a survey of asset price bubbles. I focus on the theoretical model for pricing assets from both a classical rational expectations model as well as some of the theories from newer behavioral models. A review of empirical methods used to estimate bubbles is presented along with an examination of the difficulties of empirically identifying bubbles in asset prices. I provide a discussion of the role of central banks and whether a response to asset-price bubbles is appropriate on their part and conclude with a summary of some of the more famous bubbles throughout history.

INTRODUCTION

There is much debate in the literature on the existence of asset price bubbles. Examples of bubbles in asset prices go as far back as Holland in 1636 when the first documented bubble occurred in the Dutch tulip market, known as Tulip mania. Since that time, dozens of other examples of asset bubbles can be traced throughout history. Some economists, weary of violating the foundations of the rational expectations model, prefer to classify these periods of extreme run-ups in prices and subsequent crashes as manias. A mania can be defined as a run up in prices that triggers additional price increases. The upward movement in prices is based on the exaggerated beliefs about potential future earnings. The rise in price is followed by a collapse.

Efficient market theory has been commonly been used to justify what seems to be elevated market valuations. A fundamental concept underlying the efficient market models is the assumption that prices are always correct and reflect market fundamentals. In financial markets, stock prices are calculated as the discounted present value of all future cash flows. The price of each stock adjusts to reflect all available information. No arbitrage opportunities are possible because the markets will adjust to any mispricing. If the price of an asset is high only due to investor expectations of future cash flows and not based on any fundamentals, this is because of the belief that the price of the asset will be high in the future. Another major point of the efficient market hypothesis is that one cannot earn above average returns without taking on above average risk.

According to the efficient market hypothesis, any asset price bubbles are a result of self-fulfilling expectations of rising prices. Prices change with new information making stock prices unpredictable over time. Simply stated, rational bubbles represent a mispricing of the asset relative to pricing consistent in efficient markets (Malkiel, 2010). A rational bubble's equilibrium price is higher than the price justified by the value of the discounted dividend stream.

Rational expectation models imply that bubbles in asset pricing cannot exist. Even in models where the assumption of no arbitrage is relaxed, there are still no opportunities to exploit any mispricing. Agents would choose to hold an asset they believe the price is above the fundamental value but there is no way to predict the end of the mis-pricing and therefore no opportunities to exploit the mispricing. Alternatively, behavioral models explain the existence of bubbles by describing heterogeneous agents and expectations.

Whereas efficient market theory incorporates rational expectations into the model, irrational or behavioral models take another approach to explaining the behavior of buyers and sellers. One of the assumptions of the rational expectations model is that all agents have the same information set at time t. This information is reflected immediately in the price of the asset. But what if this assumption is relaxed and not all agents have the same information? Behavioral models allow for heterogeneous agents and asymmetric information and ultimately describe the existence of a bubble in asset prices.

The purpose of this paper is to provide an overview of asset price bubbles. It is not intended to be exhaustive in scope. Instead the intent is to provide a concise survey of asset bubbles in terms of identifying, testing for and responding to bubbles as well as summarizing some of the more famous bubbles throughout history. This survey is organized as follows. In Section 2, I present a model for determining the existence of a bubble by deriving the relationship between the price of an asset and its future flow of dividend stream. Next, I consider the existence of a bubble in asset prices from both the traditional efficient market theory of rational investors as well as alternative explanations. Section 3 provides examples of econometric methods used in the literature to test for asset price bubbles as well as the difficulty in identifying bubbles with certainty. The role of the central bank and whether a central bank should respond to bubbles in asset prices is discussed in Section 4. Whether or not we can truly classify an asset price anomaly as a bubble, there are some famous examples of bubbles throughout history. I present an overview of some of these historical bubbles in Section 5. This overview is also not intended to encompass every historical bubble and be exhaustive, merely to summarize and highlight the conditions surrounding the run up of the asset prices and subsequent collapses. Emphasis is placed on the housing bubble in the United States as there were several contributing factors that fueled the rapid inflation in the housing market during that time. Section 6 offers some concluding remarks.

RATIONAL OR IRRATIONAL INVESTORS?

Shiller (2000) argues that according to the efficient market hypothesis, when prices appear to be too high or too low at times the apparent price distortion must be an illusion. Price changes are unpredictable since they occur only in response to new information. The fact that the information is genuinely new information, it is unpredictable. This approximately describes random walks through time. The efficient market hypothesis implies difficulty in predicting day-to-day price changes therefore one cannot predict *any* changes in price.

To derive the basic relationship between the price of an asset and its future flow of dividend stream we define the asset's growth rate. The growth rate of an asset can be expressed as

$$(1 + r_{t+1}) = \frac{P_{t+1}+d_{t+1}}{P_t} \tag{1}$$

where P_t is the price of the asset at time *t,* and d_t is the dividend received on the asset. Assuming a constant rate of return on an infinitely-lived asset, then the expected future rate of return, $E_t(r_{t+1}) = r$ and equation (1) becomes

$$P_t = \left(\frac{1}{1+r}\right) E_t(P_{t+1} + d_{t+1}) \tag{2}$$

Iterating forward *I* periods we can solve for the price of an asset for a finitely-lived asset such that,

$$P_t = \left(\frac{1}{1+r}\right) E_t[\sum_{i=t+1}^{I} P_{t+i}]^I + \left(\frac{1}{1+r}\right) E_t[\sum_{i=t+1}^{I} d_{t+i}]^I \tag{3}$$

Rational expectations assumes an infinitely-lived agent so in the limit,

$$P_t = \sum_{i=t+1}^{\infty} \left(\frac{1}{1+r}\right)^i E_t d_{t+i} + \lim_{i\to\infty} \left(\frac{1}{1+r}\right)^i P_{t+i} \tag{4}$$

Equation (4) is known as the dividend discount model. The transversality condition in infinite horizon models affirms that the expected future price converges to zero

$$\lim_{i\to\infty} \sum_{i=1}^{\infty} \left(\frac{1}{1+r}\right)^i P_{t+i} = 0 \tag{5}$$

Using the dividend discount model, the price of an asset can be determined by the present value of discounted future dividends can be expressed as

$$P_t = \sum_{i=t+1}^{\infty} \left(\frac{1}{1+r}\right)^i E_t d_{t+i} \tag{6}$$

Tests for rational bubbles in the model violate the assumption of equation (5) such that equation (6) can be rewritten as

$$P_t = \sum_{i=t+1}^{\infty} \left(\frac{1}{1+r}\right)^i E_t d_{t+i} + B_t \tag{7}$$

where B_t represents any price beyond the fundamental value of the discounted value of future cash flows. B_t can be any stochastic process satisfying

$$B_t = \left(\frac{1}{1+r}\right) E_t(B_{t+1}) \tag{8}$$

Equation (7) rules out any arbitrage opportunities in the model. Scherbina & Schlusche (2014) describe the conditions in which a bubble can exist in context of the

classical definition of a rational expectations model. The assumption is that all agents are perfectly rational and have the same information set at time t. A bubble can only exist if the rate of growth of the asset is equal to the discount rate and the asset is infinitely lived. Additionally, rational bubbles require an assumption of no upper limit to the size of the bubble. A rational bubble's equilibrium price is higher than the price justified by the value of the discounted dividend stream.

If the rate of growth of the asset was lower than the discount rate, the present value of the bubble is zero. If the asset's growth rate was higher than the discount rate, the present value of the asset is infinite. In both cases, the bubble cannot exist. A bubble can exist only if the rate of growth of the bubble is exactly equal to the asset's required rate of return. This condition implies that bubbles cannot exist when there is an upper bound to the price of the asset. If dividends grow slower than the rate of return on the bubble, the fundamental component of the asset price will converge but the bubble component will become infinite making the present value of the asset infinite. If the rate of return on the bubble is less than the rate of return on the dividends, the present value will be zero and the bubble cannot exist.

Gurkaynak (2008) presents an alternative method to obtain equation (6) using a consumer's optimization problem. The present value model assumes the value of $B_t = 0$ in all periods. Other assumptions in addition to the constant rate of return include no asymmetrical information and the representative consumer is risk-neutral agent.

A major implication of these models is that bubbles cannot exist in finitely-lived assets. Rational agents will anticipate the bursting of the bubble at the end of the asset's life in time T (Scherbina & Schlusche, 2014) . No one would be willing to buy the asset at time T-1 since it has an inflated price. The agents will also recognize this for each preceding period prior to T-1. Backward induction would iterate back to the present value of the asset.

In some looser versions of rational expectations models, the assumption does not require all agents to be rational (Driscoll & Holden, 2014) . If the possibility of arbitrage were to exist, some agents will profit by selling the asset if the price is above the fundamental price. The rational investors would choose to continue to hold the asset even if they believe the price is above the asset's fundamental value (Canterbery, 1999) . Rational investors believe that naive investors will buy the asset at a higher price in the future allowing for them to profit from their investment. There is no way to predict the timing of the end of upward movement in the price of the asset, however. Therefore, there are no opportunities to exploit the mispricing.

A limitation of EMH is that even given the knowledge of any mispricing, investors do not know how long the mispricing will last or when it will end. Additionally, unless one can prove this knowledge to a large audience, there is no way to profit from such knowledge. Proponents of EMH argue that even if irrational or behavioral traders exist in the market, rational arbitrageurs will still force the asset price back to its fundamental values.

Behavioral models describe heterogeneous agents and expectations (Driscoll & Holden, 2014) . Not all agents have the same information set. Some agents are more informed than others. The better-informed agents choose to hold the asset even though the price is inflated above the fundamental price because they expect to eventually sell it to less informed agents.

Shiller (2003) describes speculative bubbles. These are bubbles in which investors are attracted irrationally to an investment due to the expectation of future price increases of the asset. As more and more people are attracted to the investment, the price increases

creating a feedback loop. The bubble ends once the expectation that prices will continue to rise ends. Subsequently, demand falls bursting the bubble.

Mishkin (2009a) describes two types of asset price bubbles. Bubbles driven by credit and bubbles formed by overly optimistic expectations. Credit-driven bubbles pose a higher risk to economic fundamentals since easy lending policies increase demand for lending and subsequently further increase the demand for the asset. This creates both a credit boom, which in turn drives up the asset price generating the bubble in the asset price. When the bubble inevitably bursts, asset prices decline, lenders cut back on loans, demand for the asset drops even further causing prices to plummet. This can cause a decline in household spending impacting the entire economy.

Bubbles, driven solely by "irrational exuberance" as described by Mishkin (2009a) and referring to Alan Greenspan's description of the overly optimistic markets during the tech-stock bubble, do not pose a great a threat to the economy. These bubbles are not associated with any credit boom, such as the technology stock bubble in the late 1990's. The burst of this bubble did not impact the economy as severely as the housing bubble and the recession following the technology stock bubble was fairly mild in comparison. As opposed to speculative bubbles as are the type often seen in the financial markets, Miskin argues that credit-driven bubbles are in fact possible to identify and pose a greater threat to economic fundamentals than speculative bubbles.

ESTIMATING BUBBLES IN ASSET PRICES

There is conflicting literature on the existence of bubbles. Often when a bubble is determined in one study, another study fits the data without using bubbles. Alternative explanations include studies of habit formation that make risk aversion a function of consumption, allowing for the discount factor to vary with the business cycle (Campbell & Cochrane, 1999) .

Models based on optimizing behavior have difficulty accounting for key real-world observations. Behavioral economic assumptions are used in attempt to make model predictions better fit the data (Driscoll & Holden, 2014) . Behavioral models allow for irrational pricing and are associated with irrational bubbles (Gurkaynak, 2008).

Testing for the presence of an asset price bubble include the standard utility maximization problem and the present value of dividends model. The present value of dividends model is used in equity pricing and tests the validity of a standard present value model. Assumptions of the present value model include no arbitrage conditions, a risk neutral consumer, a constant discount rate and an assumption of no asymmetrical information.

Econometric tests for the existence of bubbles using the standard present discounted value of the dividends model can show that data is inconsistent with the presence of a bubble. Econometric methods used for detecting bubbles include the variance bounds test, West's test of bubbles, integration/cointegration based tests as well as tests for collapsing bubbles. There are no tests however, that can eliminate other plausible explanations and conclude that the data is only consistent with the presence of a bubble.

Validating the empirical evidence of excess volatility has been much debated in the literature. Variance bounds tests for detecting bubbles in stock prices test whether stock prices are more volatile than traditional models imply. These econometric methods for testing the validity of the present value model were first proposed by Shiller (1981) and LeRoy and Porter (1981). This method derives a relationship between the variance of equity

prices and the ex post realized discounted sum of present and future dividends. Shiller finds large variability in stock prices that cannot be justified by movements in nominal interest rates during the same sample period. He concludes that volatility in stock prices can be explained fundamentally by unobservables but cannot be evaluated statistically. A major criticism of this method is that the variance bound is only valid when dividends follow a stationary process (Engel, 2005; Kleidon, 1986; Marsh & Merton, 1986) .

In contrast to the variance bounds tests that test for volatility in stock prices, West (1987) formally tests for the existence of speculative bubbles. West's test for speculative bubbles allows for a wider class of bubbles than in previous tests. This method can be applied even in the presence of non-stationarity. Two parameters are estimated separately. The first component regresses stock prices on a set of lagged dividends. The null hypothesis of the test is that the price of the stock is determined by the dividend discount model. If a bubble exists, the stock price is determined by two components, the price under the efficient market model and a bubble component. The second set of parameters is obtained indirectly using equations using an arbitrage equation for the discount rate as well as an ARIMA equation for the dividend process. Critics contend that it is an overly restrictive form of the present value model.

Campbell and Shiller (1987) test the validity of the present value model using a cointegrated vector-autoregressive VAR model. This method was first introduced by Engle and Granger (1987) and Phillips and Durlauf (1986). The cointegrated technique effectively addresses the issue of nonstationarity and incomplete data on the information set of the market participants, which are two of the problems found in the present value model. One of the major criticisms of the integration/cointegration based tests for detecting bubbles is the difficulty in estimating cointegrating relationships and the econometric challenge of detecting non-stationarity (Gurkaynak, 2008).

Gurkaynak (2008) finds that all empirical tests for bubbles fail to distinguish between the existence of asset bubbles and misspecification of the fundamentals in the model. He therefore concludes that bubbles cannot be detected using econometric testing with any degree of certainty.

SHOULD CENTRAL BANKS RESPOND TO ASSET PRICE BUBBLES?

A major obstacle in popping asset price bubbles is the problem of identification. To identify an asset price bubble, one must accurately estimate unobservable fundamentals (Bernanke, 2002). Most economists agree on the implications of central banks responding to asset price bubbles. Monetary authorities should not to attempt to prick or slow the growth of asset bubbles. Any attempts to control asset price bubbles may cause more harm than good since monetary policy targets the entire economy not just asset markets.

Even a small response by monetary authorities can be problematic. A small change in short term interest rates will not dissuade investors since they are expecting exceptionally high returns on the asset. The small change will, however, weaken macroeconomic fundamentals. Bernanke (2002) maintains that a speculative bubble can only be slowed by a rate increase sharp enough to slow the whole economy.

Targeting an asset bubble with a policy instrument that is intended to target the entire economy will also have macroeconomic consequences. The effect of raising interest rates for example, may not be able to slow down the growth of the bubble since investors are expecting a higher than average return on their investment. Another possible consequence of

raising interest rates is the rate hike could cause the bubble to burst more severely causing a greater impact on the entire economy (Mishkin, 2009a). Raising interest rates affects the whole economy by slowing the down economy causing job loss and price levels to fall below the desired level.

Bernanke notes that a stock market boom might signal higher spending indicating inflationary pressures. Policy actions are to contain inflation not address any stock market boom. If Central Bankers do in fact respond to asset price bubbles, the response should be in terms of how the central bank forecasts inflation (Bernanke & Gertler, 2009) . Using an inflation-targeting approach, Bernanke and Gertler find "aggressive inflation targeting rule" substantially stabilizes not only inflation but also output in scenarios with a stock market boom-bust cycle. Assuming an aggressive response to inflation by a central bank, they find no additional benefit to responding to asset prices.

Monetary policy actions are intended to address changes macroeconomic conditions. Only when an asset bubble affects inflation or GDP, should they intervene (Taylor, 2007). According to Shiller (2000):

> A small, but symbolic, increase in interest rates by monetary authorities at a time when markets are perceived by them to be overpriced may be a useful step, if the increase is accompanied by a public statement that it is intended to restrain speculation. But authorities should not generally try to burst a bubble through aggressive tightening of monetary policy.

Intervention on the part of the central bank is still not recommended, even if the bubble appears to be credit driven as opposed to a speculative bubble. Mishkin does believe a policy response is appropriate, but it should be in the form of financial regulation and supervision on the part of policy makers or central bankers by ensuring credit standards are sufficiently high and not by altering monetary targets (2009b).

HISTORICAL BUBBLES

There are many recorded examples of bubbles throughout history. This section highlights some of the more famous examples. For the remainder of this paper, I refer to the periods of extreme price inflation of an asset followed by the subsequent collapse of its price as bubbles but make no assertation as to whether these extreme run-ups in prices can be proven empirically to be asset price bubbles or not.

Discussion of historical bubbles typically begins with Holland's Tulip Mania. Tulip Mania is considered to be the first historical asset price bubble and occurred in the Netherlands during the 1600's. During this time, tulips were considered to be a rare and beautiful flower and were coveted among the wealthy. Tulip bulbs that produced unique patterns commanded higher prices than common bulbs(Garber, 1989). The price of certain tulip bulbs rose sharply as demand for bulbs affected by the mosaic virus increased. This virus produced "breaking" in the bulbs that resulted in uniquely patterned flowers but also reduced the bulb's rates of production. The bulbs that were affected by the mosaic virus were considered rarer and commanded a higher market price.

Much of the tulip market was for the outgrowths of these rarer bulbs. The outgrowths needed to become an adequate size prior to delivery. This in essence, created a futures market for the bulbs. Written contacts were drawn outlining details for future

payment and delivery. The increase in demand was caused not only by professional growers and flower enthusiasts but due to the sharp rise in prices, the tulip market attracted speculators.

Eventually, the price for tulip bulbs collapsed. Whether or not the bursting of the tulip mania bubble caused a subsequent severe economic distress in the Netherlands is difficult to conclude since data is difficult to obtain.

The run up in prices in the tulips in Holland is generally considered the first historical bubble. Not all economists agree, however, on the classification of Tulip Mania as a true asset bubble. In fact, Garber (1990) argues that the sharp rise and decline in price of tulips is no different than other bulbs introduced into the market in following years. He finds only one month during which common bulb prices increased and rapidly crashed remains plausible as a potential bubble. He also finds no serious evidence of economic distress following tulip mania.

The next major historical bubble is known as The South Sea Bubble. The name South Sea refers The South Sea Company. This English firm aimed at managing the country's national debt and increasing faith in the credit-worthiness of the British government (Malkiel, 2010). The South Sea Company was granted monopoly rights for trading in the Spanish colonies of South America in trade for purchasing £9.5 million of short-term government debt (Dale, 2004). The interest paid to the South Sea Company on the government debt was around 6% and provided earnings to shareholders.

A speculative craze began when investors learned that great profits could be earned from trade with South America after the war ended between Britain and Spain (Malkiel, 2010). In 1720, the stock price of the South Sea Company soared. The price of The South Sea Company's stock rose by of over 700 percent only to come crashing down by year end to only 50 percent above the stock price at the beginning of the year (Scherbina, 2013).

Much like the South Sea Bubble, the Mississippi Bubble was linked to expansive monetary policy and investor speculation (Kindleberger & Aliber, 2011) . A Scottish financier by the name of John Law, founded a company called Compagnie d"Occident. It was later re-named Compagnie des Indes, but referred to as the Mississippi Company (Scherbina, 2013). Along with its other endeavors including the right to mint new coins in France and to collect all French indirect taxes, the Mississippi Company was granted a monopoly on trade in the Mississippi Territory as well as China and the East Indies. Investors were lured by the prospect of gold and silver potentially in the Mississippi territory causing the share price for the Mississippi Company to rise sharply.

The Banque Royal, the Royal bank of France, increased the money supply by increasing its note issue to facilitate stock sales of the Mississippi Company. Shareholders began to convert shares into gold coins and share prices began to fall. Since the supply of gold coins was drying up, the company attempted to exchange shares for paper money (Garber, 1990). This caused inflation in France to explode to 23 percent by January 1720. In a series of stages, Law devalued shares of the Mississippi Company and by September 1721, stock prices plummeted back down to their price prior to the bubble (Scherbina, 2013).

The first modern passenger British railway was introduced in 1830. Success of initial railway companies sparked a frenzy of applications for new railway companies in the early 1840's. Over one thousand new railway companies were created between 1844-1846. In 1850, the Bank of England raised interest rates. Investment began to flow to government bonds and away from the railways. Soon after, railway stock prices peaked and began to plummet.

Often, the assumption is that naïve investors fuel asset price bubbles. Campbell and Turner (2012) examine the British Railway Mania of 1845-1846 and find that these so called inexperienced investors did not contribute a disproportionate portion of the investments. They find that naïve investors fared no worse than those that could be considered more experienced investors.

The roaring twenties was a period of economic boom that ended with the crash of the stock market in October 1929. For the United States, this decade was marked by greater investor enthusiasm and vaster public attention in the stock market than previous eras(Shiller, 2000). During this time, economic growth was rapid and many technological advances were made available to the general population. This overall enthusiasm caused a run-up in the stock market.

The eventual decline in stock prices triggered an even bigger crash in the market. Investors, who bought stock on margin, were forced to sell their shares when they were either unwilling or simply unable to meet the call (Malkiel, 2010). Falling prices led to more and more margin calls creating a downward spiral. The stock market crash was followed by one of the most severe depression in U.S. history.

The start of the Internet bubble began around 1995 and burst in March 2000 (Malkiel, 2010; Scherbina, 2013). During this time, the stock market saw an increase in overall prices of over 200%. The market value of U.S. stocks grew from 60 percent of GDP in 1982 to 300 percent of GDP in 1999 (Kindleberger & Aliber, 2011) . Although the United States saw the largest gains in stock prices, countries worldwide were enjoying huge gains in their stock markets as well (Shiller, 2000). The sharp rise in stock prices during this time is somewhat comparable to the stock market crash of 1929 if corrected for the latter's smaller scale. Since the bubble was not associated with credit increases, there was no effect on banks and the subsequent recession was fairly mild (Kindleberger & Aliber, 2011) .

Much like the new trade opportunities of the South Sea Bubble, the Internet, or dot-com bubble was brought on by new technology as well as new business opportunities sparked by the Internet. As with many other bubbles throughout history, one explanation for the rapid rise and crash of stock prices is speculation and enthusiasm for the new technology.

The housing bubble that originated in the United States and eventually spread across the globe began in 1997. According to the Case/Shiller House Price Index, house prices rose by 132% from the first quarter of 1997 through the peak in the second quarter of 2006. Unlike many of the previous historical bubbles, the housing bubble cannot be attributed to one factor and causes of the bubble are still up for debate. Holt (2009) attributes the cause of the housing bubble to four factors: low mortgage interest rates, low short-term interest rates, relaxed standards for mortgage loans and irrational exuberance.

Two new classifications of mortgages were popularized during this time. A subprime mortgage was now available for borrowers with less than perfect credit scores, and Alt-A mortgages for those that had higher credit scores than those qualifying for sub-prime mortgages but still deemed as having a higher probability of defaulting on the loan than those receiving the prime rate. The number of sub-prime mortgage originations rose 292% from 2003-2007.

The Federal Housing Enterprises Financial Safety and Soundness Act of 1992 created the Office of Federal Housing Enterprise Oversight (OFHEO) as an independent regulator within HUD. This Act amended Fannie Mae and Freddie Mac's charters and required them to meet "affirmative obligation to facilitate the financing of affordable housing for low-income and moderate-income families."[1] Then in 1995, HUD began to require

Fannie Mae and Freddie Mac to meet certain mortgage purchase goals each year.

The government service enterprises were mandated to purchase loans made to low to moderate income families, loans for mortgages on properties in underserved areas and mortgages made to families in very-low income brackets and low-income families in low-income areas. From 2002-2006 the combined purchases of Fannie Mae and Freddie Mac's mortgage-backed securities rose from $38 billion to $90 billion per year.

Other government policies enacted during this time include the Tax Payer Relief Act of 1997, which eliminated capital gains taxes on the sale of residential homes up to a two-hundred and fifty thousand dollars per individual providing that they occupied the home for at least two of the past five years, and HUD's "National Homeownership Strategy" signed into law by Bill Clinton in 1996. This legislation further relaxed credit standards by eliminating the requirement that homebuyers make significant down payments as well as enabled the GSE's to reduce required loan documentation and to enter the 0% down payment mortgage market.

In an attempt to combat the recession in 2001 coupled with fears of a financial market collapse in the wake of 9/11, the Federal Reserve lowered interest rates eleven times from 6.5 percent to a low of 1.00 percent in June of 2003 (Greenspan, 2007) .

Low short-term interest rates encouraged the use of adjustable rate mortgages (ARMs). These low rate mortgages allowed borrowers to invest in higher priced homes that they would not have been able to afford with a fixed rate mortgage. The assumption was if the rate were to increase beyond what the homeowner could reasonably afford, they could simply sell the home to pay off the loan. From 2004-2006, it is estimated that over 90% of subprime loan originations were adjustable rate mortgages.

Another effect of the low short-term interest rates was that low short-term rates encourage leveraging (Holt, 2009) . Investors could increase their returns by borrowing at low short-term rates and investing in higher yield long-term investments like mortgage-backed securities. Leveraging also was a factor that increased the amount of financing available in the market and in turn helped fuel rising house prices.

By 2005, the national rate of homeownership was at sixty-nine percent. As with all bubbles, house prices rose too far above their fundamental value and by the second quarter of 2006 the housing bubble burst. The decline in house prices led many homeowners with loan amounts greater than the market value of the property and an inflated mortgage payment when their interest payments adjusted upward, to default on their loans. Defaults on mortgages skyrocketed, eventually leading to over 1 million homes in foreclosure. (Mishkin, 2010) Borrowers risk was limited due to small down payments. The risk was transferred to the financial markets in the form of the bundled mortgage-backed securities. In 2006, 93% of the foreclosures from loans made and bundled in subprime mortgage backed securities are attributed to adjustable rate mortgages.

The collapse of the housing market had a profound effect on the U.S. financial markets as well as banking systems across the globe. The financial crisis that followed was the worst since the Great Depression. Between 2007 and 2009 the U.S. saw a series of banking failures and fell into a prolonged recession lasting over 19 months and is now known as the Great Recession.

CONCLUSION

This paper provided a survey of asset bubbles. An asset is considered to be overvalued if its price is higher than its fundamental value. Efficient market theory assumes that all investors are rational. According to EMH, no bubbles can exist in asset prices because no investor would choose to hold an asset that is priced above its intrinsic value. Examples of alternative explanations for the existence of bubbles were provided. These include relaxing some of the assumptions of the rational expectations model as well as some of the more recent behavioral models.

Whether or not asset price bubbles can be properly identified is still up for debate among economists. Testing for bubbles in asset prices with any degree of certainty is problematic. More work is needed in this area in order to identify proper methods to test for the existence of bubbles.

Innovation, technology and new business or trade opportunities are often the driving forces of investor enthusiasm and subsequent run ups in asset prices. In some cases, the price of the asset is driven up solely by one contributing factor like during Holland's Tulip Mania. During that time, the price of certain tulips rose steeply when the demand for the bulbs affected by the mosaic virus increased. During other times, however, there can be many mitigating factors that drive prices upward. This was the case during the housing bubble that occurred in the United States. Low short-term and mortgage interest rates, relaxed mortgage standards, as well as government initiatives and policies all contributed to the rapid rise in prices in the US market in the early 2000's.

These periods of rapid increases and subsequent collapses of the asset price can and often do have major impacts on an economy. The question then arises whether a central bank response is appropriate to attempt to prick or pop the asset price bubble. Monetary policy tools are intended to target the macroeconomy. Any policy action on the part of the central bank to address the overvalued asset price will affect the entire economy, not just the bubble. A small response may not be enough to slow down the rising price of the asset. A large response could burst the bubble causing a greater impact on the economy. Additionally, a large response on the part of the central bank could slow down the entire economy impacting jobs and overall price levels.

ENDNOTES

[1] U.S. code title 12, ch 46, sec 4501. section 1302(7) of housing and community development act.

REFERENCES

Bernanke, B. S. (2002). Asset-Price "Bubbles" and Monetary Policy. *Remarks by Governor Ben S. Bernake* before the New York Chapter of the National Association for Business Economics, New York, NY.

Bernanke, B. S., & Gertler, M. (2009). Should Central Banks Respond to Movements in Asset Prices? In A. Chrystal, & P. Mizen (Eds.), (pp. 3-7) Elgar Reference Collection. International Library of Critical Writings in Economics, vol. 235. Cheltenham, U.K. and Northampton, Mass.: Elgar.

Campbell, G., & Turner, J. D. (2012). Dispelling the Myth of the Naive Investor During the British Railway Mania, 1845—1846. *The Business History Review, 86*(1), 3-41.

Campbell, J. Y., & Cochrane, J. H. (1999). By Force of Habit: A consumption-based explanation of aggregate stock market behavior. *Journal of Political Economy, 107*(2), 205-251.

Campbell, J. Y., & Shiller, R. J. (1987). Cointegration and Tests of Present Value Models. *Journal of Political Economy, 95*(5), 1062-1088.

Canterbery, E. R. (1999). Irrational Exuberance And Rational Speculative Bubbles. *The International Trade Journal, 13*(1), 1-33.

Dale, R. (2004). *The First Crash: Lessons from the South Sea Bubble*. Princeton, NJ: Princeton University Press.

Driscoll, J. C., & Holden, S. (2014). Behavioral Economics and Macroeconomic Models. *Journal of Macroeconomics, 41*, 133-147.

Engel, C. (2005). Some New Variance Bounds for Ssset Prices. *Journal of Money, Credit, and Banking, 37*(5), 949-955.

Engle, R. F., & Granger, C. W. J. (1987). Co-integration and Error Correction: Representation, estimation, and testing. *Econometrica, 55*(2), 251-276.

Garber, P. M. (1990). Famous First Bubbles. *The Journal of Economic Perspective, 4*(2), 35-54.

Garber, P. M. (1989). Tulipmania. *Journal of Political Economy, 97*(3), 535-560.

Greenspan, A. (2007). *The Age of Turbulence: Adventures in a new world*. New York, NY: The Penguin Press.

Gurkaynak, R. S. (2008). Econometric Tests of Asset Price Bubbles: Taking stock. *Journal of Economic Surveys, 22*(1), 166-186.

Holt, J. (2009). A Summary of the Primary Causes of the Housing Bubble and the Resulting Credit Crisis: A non-technical paper. *The Journal of Business Inquiry, 8*(1), 120-129.

Kindleberger, C. P., & Aliber, R. Z. (2011). *Manias, Panics, and Crashes A history of financial crises* (6th ed.). New York, NY: Palgrave Macmillan.

Kleidon, A. W. (1986). Variance Bounds Tests and Stock Price Valuation Models. *Journal of Political Economy, 94*(5), 953-1001.

LeRoy, S. F., & Porter, R. D. (1981). The Present-Value Relation: Tests based on implied variance bounds. *Econometrica, 49*(3), 555-574.

Malkiel, B. (2010). Bubbles in Asset Prices. *Princeton University, Department of Economics, Center for Economic Policy Studies, Working Paper Series*(1204)

Marsh, T. A., & Merton, R. C. (1986). Dividend Variability and Variance Bounds Tests for the Rationality of Stock Market Prices. *The American Economic Review, 76*(3), 483-498.

Mishkin, F. S. (2009a). Central Banking and the Conduct of Monetary Policy. In D. Battista (Ed.), *The economics of money, banking, & financial markets* (9th ed., pp. 415-419) Addison-Wesley.

Mishkin, F. S. (2010). Financial Crises and the Subprime Meltdown. *Money, banking & financial markets* (9th Edition ed., pp. 207-209) Addison-Wesley.

Mishkin, F. S. (2009b). Is monetary Policy Effective During Financial Crises? *The American Economic Review, 99*(2, Papers and Proceedings of the One Hundred Twenty-First Meeting of the American Economic Association), 573-577.

Phillips, P. C. B., & Durlauf, S. N. (1986). Multiple Time Series Regression with Integrated Processes. *The Review of Economic Studies, 53*(4, Econometrics Special Issue), 473-495.

Scherbina, A. (2013). Asset Price Bubbles: A selective survey. *International Monetary Fund Working Paper, 13*(45), 2-36.

Scherbina, A., & Schlusche, B. (2014). Asset Price Bubbles: A survey. *Quantitative Finance, 14*(4), 589-604.

Shiller, R. J. (1981). Do Stock Prices Move Too Much to be Justified by Subsequent Changes in Dividends? *American Economic Review, 71*(3), 421-436.

Shiller, R. J. (2000). *Irrational Exuberance*. Princeton, New Jersey: Princeton University Press.

Shiller, R. J. (2003). From Efficient Markets Theory to Behavioral Finance. *Journal of Economic Perspectives, 17*(1), 83-104.

Taylor, J. B. (2007). Housing and Monetary Policy. *NBER Working Paper Series,* (13682)

West, K. D. (1987). A specification test for speculative bubbles. *Quarterly Journal of Economics, 102*(3), 553-580.