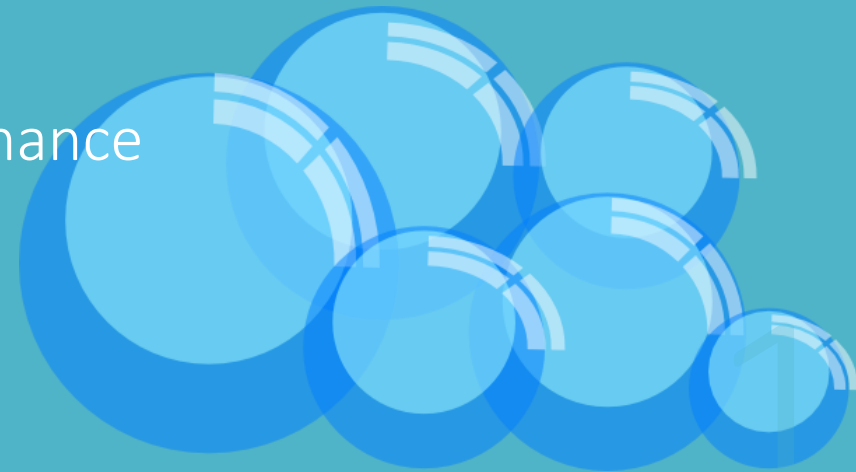


Asset Price Bubbles: Should We Invest in Bubbles?

Jungsuk Han

Stockholm School of Economics and Swedish House of Finance

February 2018



Academic Literature on Bubbles?

- Common misunderstanding: academics believe in efficient markets, thus, there is little academic interest in bubbles
- It is far from the truth
 - Academics in general do not argue that markets are efficient
 - Even proponents of efficient markets think market prices can be dislocated temporarily
- In fact, there is a large academic literature on bubbles. The problem is that there are too many
- In this seminar, I will selectively review academic literature on bubbles by choosing those practically useful (hopefully!)

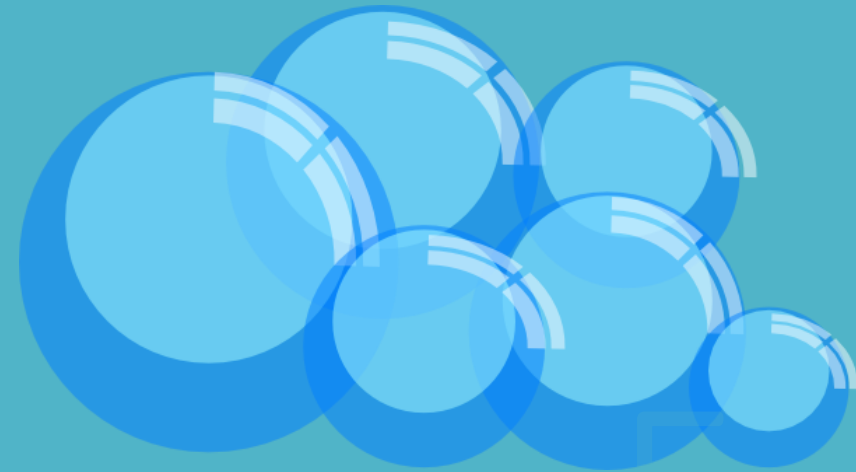
Practical Lessons from Academic Literature

- Theoretical side:
 - Depending on the nature of bubbles, it gives different prescriptions for investors about what to do as an individual investor (or institution) in the economy
 - For example, theories suggest we should invest in certain kinds of bubbles rather than avoid them (but what kind? And is that harmful for the society?)
- Empirical side:
 - There are plenty of methods on testing and detecting bubbles, but the results are not conclusive
 - Some methods may be handy in some cases, but in most cases we won't get much practical guidance (in particular about whether to invest or not)

Main Agenda

- The ultimate question today: **“Should we invest in bubbles?”**
 1. Not all bubbles are equal
 - Various kinds of theoretical bubbles
 2. We are not talking about the same bubble
 - Elusive definitions of bubble
 3. Bubbles are too slippery to catch
 - Challenges in testing or detecting bubbles
 4. Who are the winners?
 - Can we time the market with bubbles?
 5. Bonus tracks: Bitcoin bubbles, and Reference

Not All Bubbles Are Equal



Theory of Bubbles

- Irrational bubbles
 - Bubbles are caused by irrationality (or behavioral bias) of people
 - Investors don't even realize that there is a bubble
 - Example: irrational exuberance (price increase to optimistic belief, more optimistic belief to further increasing price, and so on)
- (Rational) bubbles*
 - Bubbles arise even when investors realize that there is a bubble because it is individually optimal to invest (it may or may not be socially suboptimal)
 - Example: money (price is non-zero and fundamental is zero)

* I put a parenthesis on the word rational because the term “rational bubbles” is often used in a narrower sense in academic literature. But, here I mean any bubble not driven by pure irrationality

Impossibility of Bubbles

- If all (or at least some) investors are rational, bubbles are often theoretically impossible. Why?
 - Arbitrage can eliminate any mispricing for an asset with immediate payoff
 - A chain of arbitrage can eliminate any possibility of mispricing at any point of time*
- Generating bubbles in a theoretical model with all rational investors with perfect (frictionless) markets often requires very special conditions which may be practically uninteresting
- But, it is not all impossible when we make the models a little more realistic

* This is called “backward induction” in economics jargon.

Possibility of Bubbles

- Market imperfection*
 - Bubbles exist for good reasons. They actually offer investors better investment opportunities
- Limits to arbitrage
 - Bubbles do not help anything. But there is no way to eliminate bubbles because arbitrage is difficult (chain of arbitrage is broken somewhere in the middle)
- Financial intermediation
 - There are misaligned incentives between ultimate owners and delegated investors
- Bounded rationality, heterogeneous beliefs, etc
 - Bubbles don't require too much irrationality in the context of markets

* A correct academic jargon would be “incomplete market” which means investors cannot trade against all possible contingencies including the time dimension

Should Bubbles Burst?

- Irrational bubbles
 - Yes, it will burst as soon as enough people realize it is a bubble (however, lack of coordination may delay bursting a bit further)
- (Rational) bubbles
 - It depends on the nature of the bubble
 - Some bubbles may stay forever without bursting if market imperfection or limits to arbitrage persist
 - Bubbles may eventually burst either because of reduction in driving forces or because of outside shocks (such as regulations or weakened confidence)

Prescriptions for Investors

- Irrational bubbles
 - What to do: should avoid it as soon as you realize it is a bubble unless you are sure that you are the smartest who can time the market
- (Rational) bubbles
 - What to do: it is rational to invest in it
 - Investors receive what they deserve (high returns for bubbles are often compensation for bearing risk of bubble assets)
- (Boundedly rational) bubbles
 - What to do: this is in-between case, investors should approach it case by case

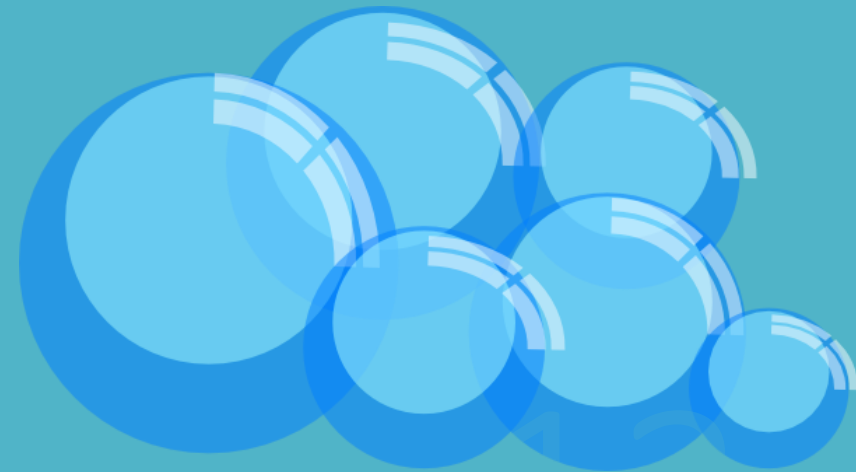
Theories on Welfare

- Bubbles are not always bad. However, it is usually bad
 - Bubbles misallocate resources
 - Bubbles create illiquidity and fire sales in the aftermath of their bursts
- If bubbles exist because of market imperfection, it can be beneficial
 - Bubbles help economic activities by providing better investment opportunities (e.g., store of values)
 - Bubbles can promote innovations (e.g., knowledge spillover)
- Private optimality does not equal social optimality
 - Individual investors may optimally invest in bubbles even when it is socially undesirable (individuals do not internalize social cost)

Theories on Policies and Regulations

- If bubbles exist for good reasons, one should be careful
 - The theory of second best: reducing bubbles may be possible, but at what cost?
- High interest rates (leaning against bubbles) will reduce bubbles?
 - It is theoretically unclear; it may actually boost a bubble even larger by raising its growth rate

We Are Not Talking About the Same Bubble



Definition of Bubbles

- Most of confusions often arise from the fact that there is a lack of consensus on the definition of bubbles
- So, what are the usual definitions of bubble?
 - “price > fundamental value” (overvaluation)
 - Ponzi game (bigger fool theory)
 - Sharp rise and fall in price
 - And more ...
- In fact, there is a deeper problem lying in this disagreement than just terminology
 - Even though we agree on terminology, we may not agree on the actual fundamental value

The Usual Definition: “Price > Fundamental”

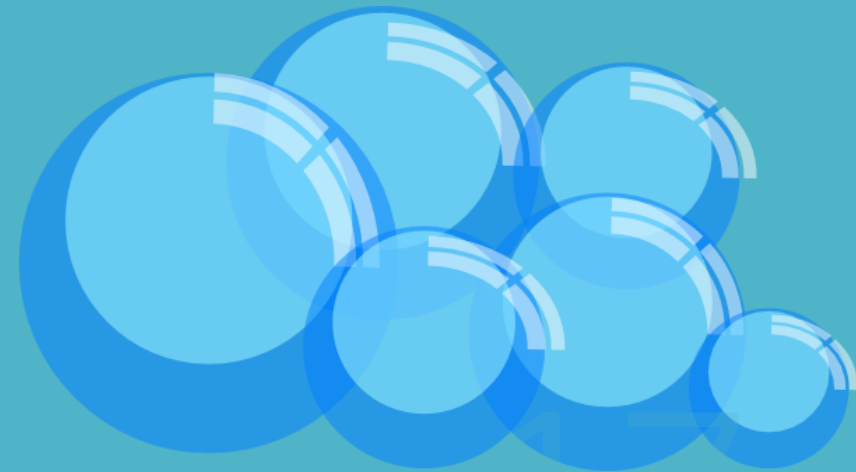
- Defining bubble as overvaluation is reasonable, and it is by far the most popular definition. But, using it is not that easy as it sounds. Why?
- The issue is that we do not agree on the term “fundamental value”, and furthermore we do not know it even if we do agree
- In fact, it is not just a matter of terminology. It is more complicated than that. It is a matter of market imperfection
- So, what is the fundamental value?
 - Present value of cash flow?

$P > PV(\text{cash flow})$ means a bubble?

Issues with “Fundamental Value”

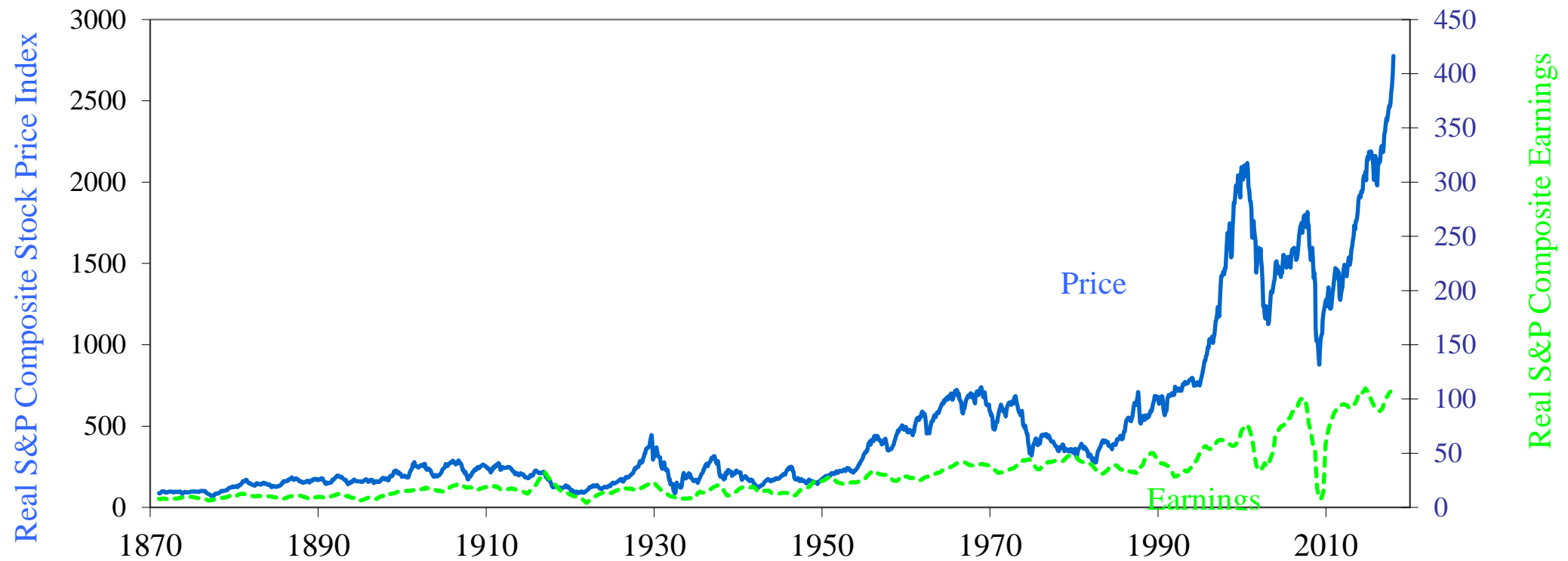
- Disagreement on cash flows
 - Private information
 - Optimistic or pessimistic beliefs, higher-order beliefs
- Fundamental value may not just lie in cash flows
 - Liquidity, credit, control rights, etc
- Disagreement on discount rates
 - Risk attitude
 - Wealth
- If market is imperfect, we simply cannot agree on both the payoff and the discount rates even though we are using the same terminology*

Bubbles Are Too Slippery to Catch



Can We Say There are Bubbles?

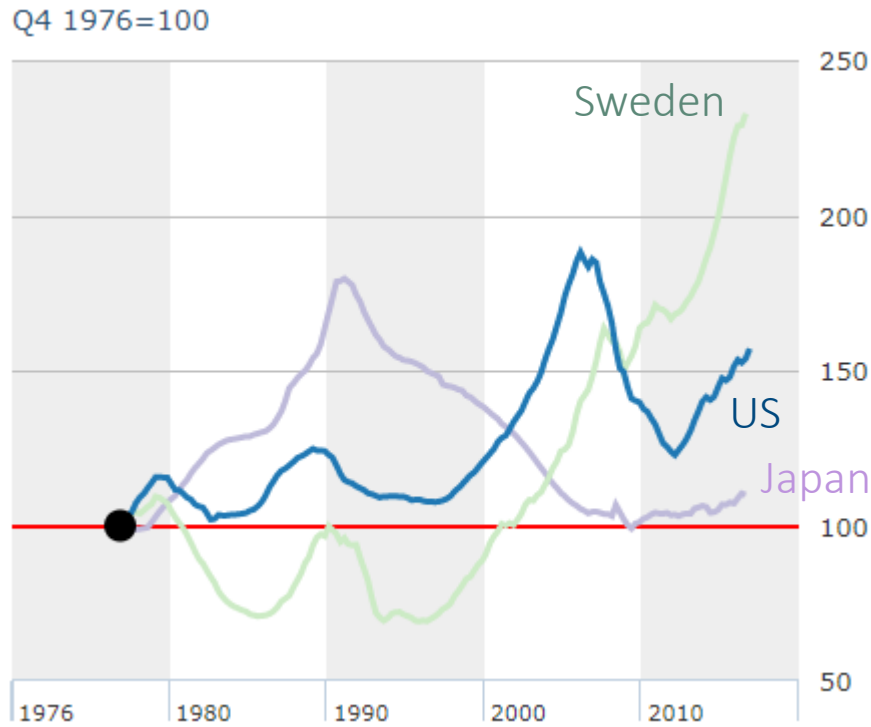
- No, unless we have good ideas about expectations and discount rates



(Source: online data from Robert Shiller's website)

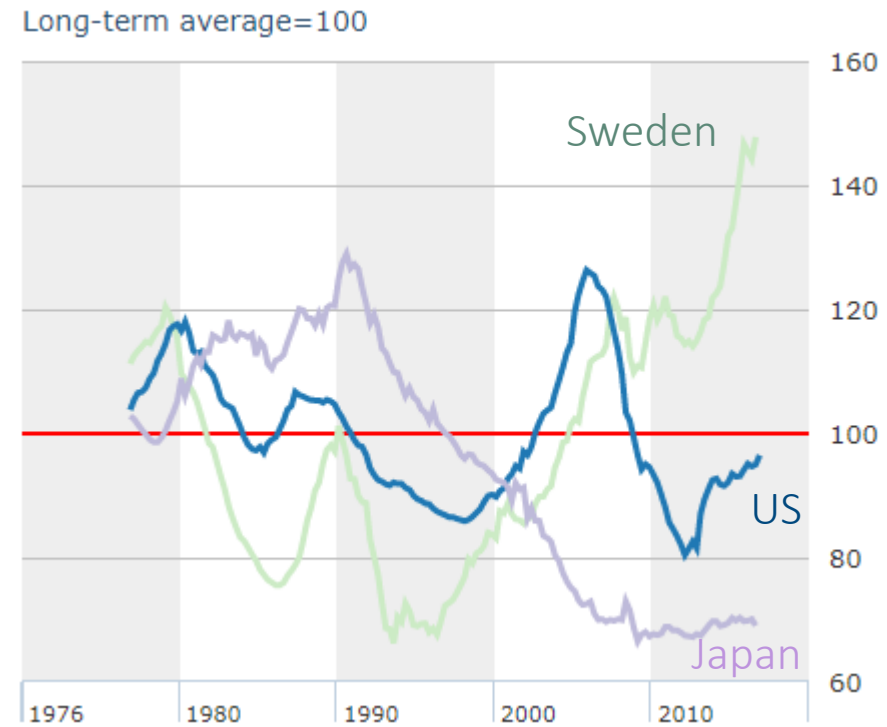
Again the Same Story...

Prices in Real Terms



The Economist house-price index

Prices against Average Income



The Economist house-price index

Violations of the Law of One Price

- There are some special cases, we can tell price is not equal to fundamental value
 - Siamese twin companies (e.g., Royal Dutch Shell): two stocks with identical cash flow have different prices
 - Closed-end funds: price is different from NAV
 - Negative stub: spinoff is more expensive than mother firm
 - Chinese warrants bubbles 2005-2008: deep-out-of-the-money options trading at inflated prices
- The direct test of bubbles is to see whether price is greater than fundamental value
- Unfortunately, it is difficult in general

Detection Method 1: Fundamental

- A direct test is not feasible because we do not know and cannot even agree on the exact fundamental value
- Indirect way of testing bubbles typically assumes a few statistical properties of fundamental values (essentially assuming that things are not becoming totally different in the future), then attempts to find bubbles based on those assumptions*
- Many studies report that it is not easy to detect bubbles even with those assumptions
- Two concerns: (i) economic situations may actually become different (e.g., innovations), (ii) no information about the nature of bubbles (so, should invest or not?)

* In economics jargons, it is called “stationary process” under which time series do not change their behaviors when shifted in time. For example, cointegration test, which is often used to test bubbles, is based on the assumption.

Detection Method 2: Price behavior

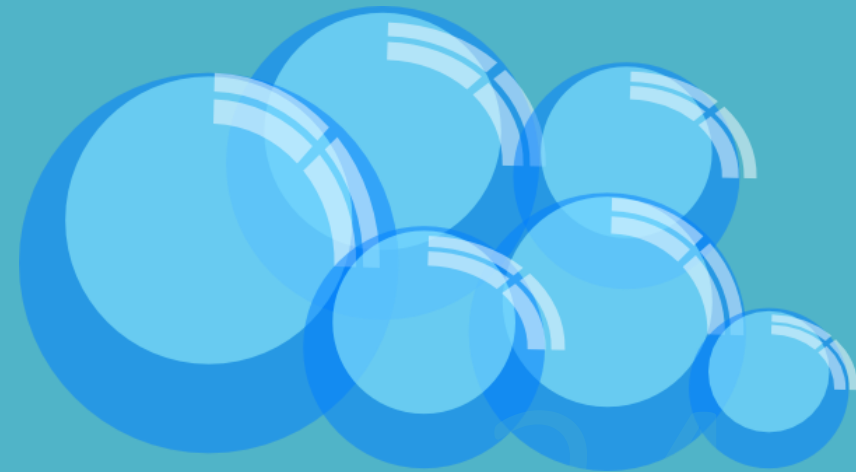
- Still another way is using an alternative definition of bubble: finding “explosive price movements” or “sharp rise and fall of prices”
- There are various ways of doing this
 - Detecting unusual rise in price levels or volatility
 - Detecting deviations from certain mathematical patterns found in the past
- These methods are easier to use, but there are still lots of disagreements about historic bubbles (like the IT bubble)
- Issues: (i) no connection to the fundamental, (ii) the same issues as the first method still apply

Further Remark on Detecting Methods

- Detection methods can be helpful, but sometimes we do not need a sophisticated detection method if it is rather too “unusual”



Who Are the Winners?



Rationality or Irrationality?

- Different levels of rationality among people.
 - For example, experimental evidence on guessing games show that there are different depths of reasoning among players
 - *All players choose a number out from 0 to 100 , and the player who chooses 2/3 of the average wins*
 - *The only rational outcome is everyone choosing zero, but actual average is actually strictly greater than zero*
- Behavioral biases including overconfidence
 - People are often overconfident about their ability or information*
 - Empirical evidence on retail traders: “Trading is hazardous to your wealth”

* Svenson (1981) found that 93 percent of American drivers and 69 percent of Swedish drivers believed themselves better than the median

Need to Time the Market with Bubbles?

- (Rational) bubbles are fair games in which everyone knows they are bubbles
 - Some bubbles never burst (like cash)
 - Some may burst but offer proper risk premium
 - No need for timing the market
- Some bubbles like irrational bubbles are not fair games
 - We should either avoid them or need to time the market
 - But everyone thinks they are better than others!

Can Some Investors Market-time the Bubbles?

- Evidence in academic literature is generally mixed
 - Some hedge fund managers seem to have timed the bubble successfully during the IT bubble in the late 1990s
 - Young and unexperienced investors (mutual fund managers) made bigger losses by overinvesting in the IT bubble
 - Personal home transactions of Wall street securitization managers (midlevel) show that on average they failed timing the market during the 2004-2006 U.S. housing bubbles

Bitcoin Bubble?



Bitcoin

- Money is a bubble according to the definition “price > fundamental” because fundamental value is zero, but it is a sustainable bubble
- The difference between Bitcoin (or any other virtual currency) and existing currencies (such as dollar, euro, krona) is that Bitcoin is not a legal tender
- The sustainability of Bitcoin purely depends on investors’ confidence (but even legal tenders can collapse in the absence of confidence)
- Blockchain technology per se does not guarantee anything, but it does help boosting confidence if it is useful, safe, etc



Nature of Bitcoin Bubble

- Bitcoin as a rational bubble
 - It exists because market is imperfect, so there is a possibility that it is sustainable
 - Bitcoin bubble will burst once confidence becomes weaker (due to regulations, etc)
 - Feedback effect between Bitcoin prices and its sustainability
- Irrationality
 - Too much enthusiasm and self-reinforcing optimism
- Large disagreement on the future prospect of Bitcoin
- Limits to arbitrage
 - Short sale is not possible
 - Transactions take a long time at least so far

* Svenson (1981) found that 93 percent of American drivers and 69 percent of Swedish drivers believed themselves better than the median

Verdict on Bitcoin?

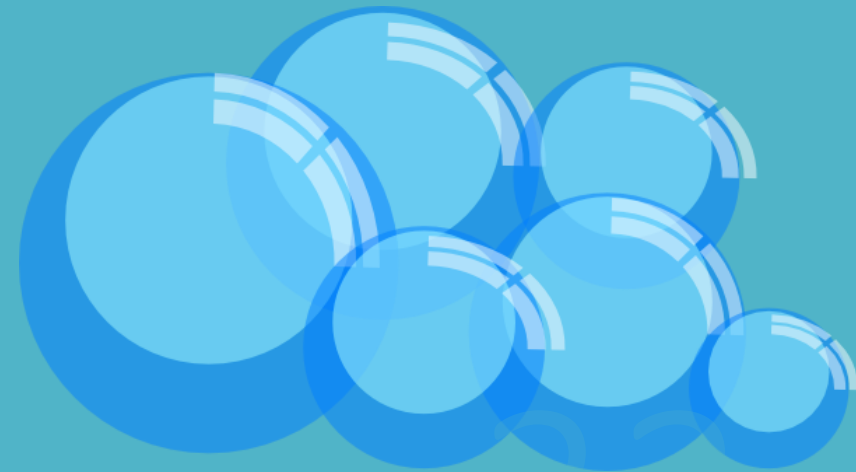
- Bitcoin is a bubble, but this does not mean that we should not invest in it
- As the theory suggests, investing in a bubble (Bitcoin) may be still rational even if there is a possibility of collapse
 - High expected returns from the bubble (Bitcoin) reflects the risk of potential collapse
- But, there may be also an irrationality element in the Bitcoin bubble
 - Even though Bitcoin may become eventually sustainable, the irrational bubble component may not be sustainable in the long run
- A cryptocurrency (it may or may not exist yet) can be eventually accepted as one of the global currency, but it does not have to be Bitcoin
 - If so, Bitcoin may go bust as market imperfection will be resolved by other means

Theoretical Price of Bitcoin?

- There is no theoretical guidance from bubble theory about the price of any cryptocurrency
 - Theoretically any money-like rational bubble can take any value
 - Total Bitcoin value should be less than the total value of wealth in the world economy (but this is not very helpful)
- Some food for thought
 - Total values (in terms of M2) of both dollars and euros are about \$14 trillion*
 - Total value of Bitcoin is about \$150 billion as of Feb. 3rd, 2018 (\$327 billion in Dec. 2017)
- So, perhaps still more room for growth if it is ever going to be accepted as a major currency in the future?

* Other definitions can be used here (M0: monetary base, M1: M0+demand deposit, M2: M1+savings deposit), M1 of USD is roughly about \$4 tril.

Concluding Remark



Conclusion and Further Discussions

- Contrary to the common perception, bubbles are not all bad – so **we should invest in some bubbles (but not all)!**
- High returns from investing in a bubble can be just risk premium associated with its collapse
- Timing the market with a bubble is perhaps a bad idea (unless you think you have clear advantage like fast trading or private information, etc), and be careful about overconfidence
- Bubbles are usually bad for economic welfare, but they may be actually desirable in some cases

Reference



Recommended Reading

- Theory of Bubbles (p.6)
 - Shiller, R. J. (2000). *Irrational Exuberance*. Princeton University Press, Princeton, New Jersey
 - Brunnermeier, M. K. (2008). Bubbles. In *New Palgrave Dictionary of Economics* (pp. 1–17).
- Impossibility of Bubbles (p.7)
 - Tirole, J. (1982). On the possibility of speculation under rational expectations. *Econometrica*, 50(5), 1163–1181.

- Possibility of Bubbles (p.8) – Market imperfection
 - Tirole, J. (1985). Asset bubbles and overlapping generations. *Econometrica*, 53(6), 1499–1528.
 - Santos, M. S., & Woodford, M. (1997). Rational asset pricing bubbles. *Econometrica*, 65(1), 19–57.
- Possibility of Bubbles (p.8) – Limits to arbitrage
 - Dow, J., & Gorton, G. B. (1994). Arbitrage Chains. *Journal of Finance*, 49(3).
 - Shleifer, A., & Vishny, R. W. (1997). The limits of arbitrage. *Journal of Finance*, 52(1), 35–55.
- Possibility of Bubbles (p.8) – Financial intermediation
 - Allen, F., & Gale, D. (2000). Bubbles and crises. *The Economic Journal*, 110(July 1997), 236–255.
 - Dow, J., & Han, J. (2015). Contractual incompleteness, limited liability and asset price bubbles. *Journal of Financial Economics*, 116(2), 383–409.

- Possibility of Bubbles (p.8) – Bounded rationality, heterogeneous beliefs, etc
 - Harrison, J. M., & Kreps, D. M. (1978). Speculative Investor Behavior in a Stock Market with Heterogeneous Expectations. *The Quarterly Journal of Economics*, 92(2), 323–336.
 - Scheinkman, J. A., & Xiong, W. (2004). Heterogeneous Beliefs, Speculation and Trading in Financial Markets. In *Paris-Princeton Lectures on Mathematical Finance 2003* (pp. 217–250).
 - Bénabou, R. (2013). Groupthink: Collective delusions in organizations and markets. *Review of Economic Studies*, 80(2), 429–462.
 - Han, J. & Kyle A. S. (forthcoming) Speculative Equilibrium with Differences in Higher-Order Beliefs. *Management Science*.
- Should Bubbles Burst? (p.9)
 - Weil, P. (1987). Confidence and the real value of money in an overlapping generations economy. *The Quarterly Journal of Economics*.
 - Abreu, D., & Brunnermeier, M. K. (2003). Bubbles and crashes. *Econometrica*, 71(1), 173–204.
 - Martin, A., & Ventura, J. (2012). Economic Growth with Bubbles. *American Economic Review*, 102(6), 3033–3058.

- Theories on Welfare (p.11)
 - Olivier, J. P. (2000). Growth-Enhancing Bubbles. *International Economic Review*, 41(1), 133–151.
 - Caballero, R. J., & Krishnamurthy, A. (2006). Bubbles and capital flow volatility: Causes and risk management. *Journal of Monetary Economics*, 53(1), 35–53.
 - Farhi, E., & Tirole, J. (2012). Bubbly Liquidity. *The Review of Economic Studies*, 79(2), 678–706.
 - Hirano, T., & Yanagawa, N. (2017). Asset bubbles, endogenous growth, and financial frictions. *Review of Economic Studies*, 84(1), 406–443.
- Theories on Policies and Regulations (p.12)
 - Barlevy, G. (2007). Economic theory and asset bubbles. *Economic Perspectives*, 31(3Q), 44–59.
 - Galí, J. (2014). Monetary Policy and Rational Asset Price Bubbles. *American Economic Review*, 104(3), 721–752.

- Definition of Bubbles (p.14)
 - Kindleberger, C. P. (1978). *Manias, Panics, and Crashes: A History of Financial Crises*, Basic Books, New York.
 - O'Hara, M. (2008). Bubbles: Some perspectives (and loose talk) from history. *Review of Financial Studies*, 21(1), 11–17.
 - Pastor, L., Veronesi, P. (2009). Technological revolutions and stock prices. *American Economic Review*, 99, 1451–1483.
 - Scherbina, A., & Schlusche, B. (2014). Asset price bubbles: A survey. *Quantitative Finance*, 14(4), 589–604.

- Violations of the Law of One Price (p.20)
 - Lee, C. M. C., Shleifer, A., & Thaler, R. H. (1991). Investor sentiment and the closed-end fund puzzle. *The Journal of Finance*, 46(1), 75–109.
 - Froot, K. A., & Dabora, E. M. (1999). How are stock prices affected by the location of trade? *Journal of Financial Economics*, 53(2), 189–216.
 - Lamont, O., Thaler, R., (2003). Can the market add and subtract? mispricing in tech-stock carve-outs. *Journal of Political Economy*, 111, 227-268.
 - Xiong, W., & Yu, J. (2011). The Chinese warrants bubble. *American Economic Review*, 101(6), 2723–2753.
- Detection Method 1 (p.21)
 - West, K. D. (1988). A specification test for speculative bubbles. *The Quarterly Journal of Economics*.
 - Diba, B. T., & Grossman, H. I. (1988). Explosive rational bubbles in stock prices? *The American Economic Review*, 78(3), 520–530.

- Detection Method 2 (p.22)
 - Zhou, W. X., & Sornette, D. (2003). 2000-2003 real estate bubble in the UK but not in the USA. *Physica A: Statistical Mechanics and Its Applications*, 329(1–2), 249–263.
 - Pastor, L., & Veronesi, P. (2006). Was there a Nasdaq bubble in the late 1990s? *Journal of Financial Economics*, 81(1), 61–100.
 - Phillips, P. C. B., Wu, Y., & Yu, J. (2011). Explosive Behavior in the 1990s NASDAQ: When Did Exuberance Escalate Asset Values? *International Economic Review*, 52(1), 201–226.
 - Frehen, R. G. P., Goetzmann, W. N., & Geert Rouwenhorst, K. (2013). New evidence on the first financial bubble. *Journal of Financial Economics*, 108(3), 585–607.
 - Phillips, P. C. B., Shi, S., & Yu, J. (2015). Testing for multiple bubbles: Limit theory of real-time detectors. *International Economic Review*, 56(4), 1079–1134.

- Rationality or irrationality? (p. 25)
 - Nagel, R. (1995). “Unraveling in Guessing Games: An Experimental Study.” *The American Economic Review* 85(5), 1313–26.
 - Svenson, O. (1981). “Are We All Less Risky and More Skillful than Our Fellow Drivers?” *Acta Psychologica* 47(2), 143–48.
 - Barber, Brad M., & Odean, T. (2000). “Trading Is Hazardous to Your Wealth: The Common Stock Investment Performance of Individual Investors.” *Journal of Finance* 55(2), 773–806.
- Who are the winners? (p. 27)
 - Brunnermeier, M. K., & Nagel, S. (2004). “Hedge Funds and the Technology Bubble.” *The Journal of Finance* 59(5), 2013–2040
 - Greenwood, R., & Nagel, S. (2009). Inexperienced investors and bubbles. *Journal of Financial Economics*, 93(2), 239–258.
 - Cheng, I. H., Raina, S., & Xiong, W. (2014). Wall street and the housing bubble. *American Economic Review*, 104(9), 2797–2829.