Which stock market fluctuations are bubbles?

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Abstract

In the following essay, I would like to analyze theoretical empirical problems of "bubbles", give a short review of definitions and results of mathematical, literary and laboratory experiment economics. By the results of experimental economics and the intuitions of my Ph.D. research, I try to draw a new framework for characterizing and distinguishing stock market bubbles from regular turbulence of stock markets[1].

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1. Introduction

"Bubble" is one frequently used phrase for stock market phenomena. There are two different approaches as starting points: mathematical economics describes asset price bubbles, literary economics analyze stock market bubbles. None of definitions are appropriate, useful because of problem of fundamental value (equilibrium price), and misinterpretation of "speculation". In the next section, I would like to summarize and recompose the main theoretical, and empirical results of related literature.

How can we distinguish bubbles from regular fluctuations of stock markets? Stock price is a market term, which is determined by market players' behavior as Keynes (1936) intuitively said with his famous beauty-contest comparison. Crashes occur not because of the overvaluation of stocks or because too many speculators trade in the market, but because players dramatically change their attitudes towards stocks. In hypothetical stock market, laboratory experiments give some intuitions what elements affect investors' behavior. I will summarize the results of this fast-growing branch of economics. I argue that noise trading concept can incorporate mathematical, historical and laboratory experience. Noise is irrelevant information investors trade on (Black 1986). They would be better of not trading on it, however. If noise increases in the market, the probability of a would-be stock market crash also increases. There are signals that may indicate when noise trading becomes dominant. These signals are the following: leverage, unexplained comovement of stock prices. There are more elements, such as scandals and continually more active monetary policy, which are indirect signals for a possible market crash, as drivers of investors' attentions. The section 3 explains the relationship between investors' behavior and stock market bubbles, and shows the intuitive role of noise trading. I am going to summarize the phenomena that may be signals for the dominance of noise trading.

The main purpose of my work is to shed light on contradictions in literature and to put theoretical problems into a new framework, and finally to give a more appropriate explanation for stock market bubbles. The main statement of my essay is to give typical features of stock market bubbles, and I also express the effects of stock market bubbles on real economy. Using historical approach I enumerate the features of famous stock market bubbles. Finally I give two examples, when for different reasons, large price swings should not be called bubbles: Dutch Tulip Mania and Budapest Stock Exchange between 1996 and 2003.

2. Definitions, results and contradictions in related literature

Mathematical economics defines asset price bubble as a positive difference between actual and fair (fundamental) prices of the asset (Gilles & LeRoy 1992). Actual price is given as follows:

$$p_t = \sum_{j=1}^{\infty} \frac{E_t\left(d_{t+j}\right)}{\left(1+r\right)^j} + b_t \qquad (1)$$

where d_t indicates dividends, p_t is price at time t, $E_t(\cdot)$ is the expected value of the expression incorporated all available information at time t. If the rate (r) is fixed for the whole period, the first complex term gives the equilibrium price (fundamental value), b_t is the stochastic „bubble" term satisfying this condition: $b_t = E_t(b_{t+1}) /(1 + r)$, therefore in this literature there are no negative bubbles.

The strong and irrational deviation of a stock or stocks from fundamental value (overvaluation) cannot be proven, however. In the last two decades a new branch of finance analyzing anomalies in asset pricing, the behavioral finance collected psychological phenomena, which always drive price away from fair or equilibrium price. See *Table 1*.

Table 1

Behavioral patterns in investors' decisions

Behavioral pattern	*Effects*
Optimism – overconfidence in abilities/information	Investors are more active, volume increases
	Overreaction to news
Representativeness	Overreaction to rare events
	Wrong and overreaction because similarity
Conservatism – Anchoring	Underreaction because investors do not update their beliefs
Framing	Risk attitude, direction of decision depend on the interpretation of the news, situation
Cognitive dissonance	Investors tend to follow trends: "herding".

Summary of sources: Odean (1999), Shleifer (2000), Shiller (2000)

The most important statement of behavioral finance is that there is no perfect arbitrage, therefore the actual price deviate from the fair value of the asset, and we always have asset price bubbles. Brunnermeier (2001) summarize how mathematical economics try to avoid the case, when bubble becomes an useless and empty phrase. Equilibrium price is an anchor in those models, around which price is fluctuating. If the actual price does not deviate irrationally (strongly), we face with rational (expected) bubble. Separating condition to have irrational (strong) bubble is if there are not such dividends in the future that may justify the current price (Blanchard 1979).

Problems arise from this condition. Investors essentially buy a stock to obtain its future returns (dividends, profits from selling at higher prices). Apart from frauds and swindles, any future dividends can be expected that may justify the actual stock price. Even naive expectations are not irrational because investors do not have specific knowledge about the future prospects of the business, they just take bets on future success of the certain companies. In the case of stocks we rarely face with Ponzi-financing, on the contrary when we have loans, for instance, when paying interests can only be financed by other new loans. In account systems there is a standard from 1847, that dividends can be only paid from the actual or reserved profit of the firm, and capital rise cannot finance dividends to shareholders.

It is difficult to give the fundamental value of a financial asset and its change in practice. There are some important examples when fundamental value can be defined, but prices do not react on the changes of fundamentals. Roll (1984) found that future price of orange juice does not depend on the accuracy of weather forecasts, Rau (2001) showed that “cheap talk” usually affects the price of ball tickets, and Ariely *et al* (2004) gave convincing examples when subjects esteem values of different goods in strong correlation with the last two digits of their own security number. There are psychological anchors for prices, and sometime fundamental value plays little role in determining stock prices. One conclusion that can be drawn from the papers of behavioral finance is that psychology does matter more than fundamentals. There are cases in stock markets when it is no doubt that stock prices irrationally differ from its fundamental value: closed-end funds, twin-stocks. Shleifer (2000) analyzed in detail why the values of underlying assets of closed-end funds usually differ from the actual stock price of the same funds, and why the stock prices of Royal Dutch and Shell are different in spite of their same fundamental values. (Profits are divided in 40/60 ratio, in practice they from one firm.) One explanation is that there is no force to push prices to the "right" level. There is no costless and riskless arbitrage, therefore current prices may differ from fair values significantly for long periods without being in equilibrium. We cannot give a certain level of difference, separating rational and irrational deviations of prices, because spreads between fundamental and actual values can be unlimited depending on investors' behavior. It creates a special risk, namely noise trader risk (De Long *et al* 1990) other investors cannot avoid. Noise traders are not irrational investors from every aspect, they follow special trading rules, chase trends when miming others (Banerjee 1992), and behave along with their personal information or constraints. This is one reason why the separating condition between rational and irrational bubbles is useless for practical analyses.

Let us examine bubbles from other point of view. Bubble in literacy economics usually covers a more general, broader economic phenomenon. Kindleberger (1991:20) gives the following description: "A bubble may be defined loosely as a sharp rise in price of an asset or a range of assets in a continuous process, with the initial rise generating expectations of further rises and attracting new buyers – generally speculators interested in profits from trading in the asset rather than its use of earning capacity. The rise is usually followed by reversal expectations and a sharp decline in price often resulting in financial crisis."

The two (mathematical, literary) definitions seem to be different, however, they basically mean the same: stock prices definitely deviate from economic fundamentals. We can find some errors in Kindleberger's definition, why it is not appropriate to differentiate regular fluctuations of stock prices from economic, scientific aspect. The weakness of his argument comes from not giving the standard level of speculation. On the other hand, there is no sense in defining such a level, we cannot separate two motives of trading with stocks: completing market towards Pareto-optimum (Brunnermeier 2001) and speculation. Speculation also contains two motives: taking bets on the future success of firms, and on the possibility of selling stocks to other investors who take bets on the future success of firms, an so on. These two motives cannot be separated either. Kindleberger (1978, 1991) also mentions when giving description that bubbles may be accompanied by macroeconomic effects. I think this open consequence of bubbles should be essential part of distinguishing bubbles from regular turbulence of stock markets. I will come back to this point in the next section.

An other fast developing direction of research is, experimental economics. In the laboratory experimental simulations (line of Vernon Smith's research), we can directly observe how bubbles occur most of the time, because future dividends are previously given, and no news but subjects' selling/buying decisions determine stock prices. When changing the conditions in experiments, we can conclude that the extent of price bubbles depends on the liquidity and the information subjects have. See the summary of main findings of experimental literature in *Table 2*.

Table 2

Factors to determine the extent of price bubbles in laboratory experiments

	Great price bubble	*Small price bubble*
1.	Subjects have less experience	Subject have more experience
2.	Number of rounds are not known in advance	Number of rounds are known in advance
3.	High cash	Low cash
4.	Dividends are paid immediately	Dividends are paid with a delay
5.	No information about the transactions	Information about the transactions

Summary of sources: Smith *et al* (1988), Stanley (1997), Caginalp *et al* (2001).

Results of laboratory experiments confirm that extension of bubbles depends on information and cash. The points 1, 2, 5 are related to information subjects have, the points 3, 4 are connected to the liquidity in the market. On the other hand, in these experiments we cannot filter out the distorting effects of laboratory environment. During theses experiments subjects are paid, but they do not have other things to do but trade. There is an other contradictory result is that negative bubbles occurred in most of the experiments. I will apply the main results from laboratory experiments in the next part, when giving a new description of bubbles.

3. How to distinguish stock market bubbles?

I argue that a stock market bubble should be defined as a consequence of investors' behavior. I disregard other possible economic reasons, their roles are not mentioned in my definition, because in stock markets, prices primarily reflects investors' expectations about future prospects of listed firms. Expansions and bursts of bubbles can be traced back to change in investors' behavior, especially overconfidence (see *Table 1*). Investors are usually overconfident in their abilities. They overestimate the precision of their decisions. If investors have more information, they think that they can make better decision. This phenomenon is usually called illusion of knowledge. When investors suffer from illusion of knowledge, they would be better off not trading, but nevertheless they trade. Most of the time it is accompanied by increase of irrelevant information (noise). To put it other way, when a stock market bubble usually occurs, the intensity of noise trading increases too. We can distinguish four phenomena, when the intensity of noise trading increases.

(i) If economic policy makers become more active, it refers to the increase of noise trading. Different policy actions are signals for the investors, and drive investors' attention, and investors take these signals into account in their expectations but inaccurately and with a delay. Friedman *et al* (1963) gave the same argument when analyzing stock market crash of 1929.

(ii) Same effect can be found when number of news about scandals, frauds, and corruption increases, and these signals may indicate sales of stocks of not related firms too.

(iii) Leveraged trading is noise trading in one respect, because of finite duration of the particular asset involves short sale constraint for the investor who does not trade anymore on public but private information and in consequence of private constraint (deadline of repayment of private loan). Leverage also increases liquidity of investors involved, which blows the bubbles greater. The leverage as a reason for market crash is coincide with opinion of Galbraith (1961).

(iv) If stock prices move together, and no fundamental factors justify this synchronicity, it may also indicate noise trading (De Long *et al* 1990; Barberis *et al* 2003). There is no standard level of price comovement, but if it rises significantly without change of any economic or market factors, it may show that investors' decision making progress is becoming more simple and unsophisticated. To measure price synchronicity we can take average R-squared between stocks and market index, if the stocks belong to one industry or one well defined market. In these cases, investors regard the stocks as one bunch, and the increase of comovement stresses the dominance of noise trading.

The cases (i)-(ii) are the indirect factors with the framing effect (see *Table 1*), the feature (iii) are direct factor causing constraints at individual level, and the element (iv) may indicate "herding" among investors. These phenomena show that stock prices are not driven by relevant information about their fundamental values, but depend on investors' rapidly changing behavior. In these cases the probability of a possible market crash increases.

As the conclusion of the results and arguments above, we distinguish bubbles from other fluctuations of stock market with the following feature:

(a) A stock market bubble starts with a strong and continuously rise in stock prices, mostly due to a macroeconomic shock.
(b) This initial displacement positively affect investors' expectations on the future. The volume of stock market also rises significantly, and the intensity of noise trading increases. We regard booms as bubbles if the probability of large price drop – market crash – is considerable.
(c) The final and probably the most important feature of stock market bubbles is the real effect at macroeconomic or regulating level. We differentiate bubbles from regular fluctuations caused by instability of stock markets with the features, consequently these characteristics give the economic importance to the term "bubble".

Trading in stock exchanges is basically a zero-sum game, its role is only to distribute wealth, but indirectly has effects on macro- and microeconomic levels. That is why it should be a compulsory feature of bubbles. There are some negative effects, when stock prices are rising, and firms make over- and malinvestments financed by public offerings. These decisions have repercussions on firms' revenues and cash flows, also increase investors' risk. Other well-known effect of stock market booms is the wealth-effect. If value of household-owned stocks increases, their consumption also rises, and it may follow from the foregoing that inflation may accelerate. At micro level, firms may easily obtain quasi-venture capital when market is soaring. In these periods investors make decisions on less information or noise. It may give an impulse to the industry and the economy as well. An other positive output is when market crash force important changes in regulatory environment, and the efficiency of market may improve finally.

I summarize the most famous cases of stock market bubbles in economic history in *Table 3*, getting some details from Galbraith (1961) Kindleberger (1978), Shiller (2000) and Shleifer (2000).

Table 3 (I.)

Features of stock market bubbles in economic history

Period	1710-1720	1717-1720
Country	England	France
Speculation on	Stocks of South Sea Company	Stocks of Mississippi Company
Initial displacement	New markets, trade with South America Undertaking and conversion of Government debts	New market, trade with Louisiana Conversion and securitization of Government debts
Fueling investors' positive attitude	Easier public offerings in succession Support of Government (Bubble-Act)	Easier public offerings in succession Law's full powers in financing decisions, and absolute support of Government
Signals for the danger of crash	Insider trading involving MPs, Leverage	Leverage, Critiques on unsophisticated investors (insider information) Administrative steps
Crash	August 1720	May – December 1720
Macroeconomic / regulatory effects	Bubble-Act made it difficult to found new joint-stock companies	Reform of finance of State started and came to a sudden standsill after the crash.

Period	1845-1847	1873
Country	England	USA
Speculation on	Stocks of railway companies	Stocks of railway companies
Initial displacement	New, fast and cost efficient way of transport	Expansion after American civil war
Fueling investors' positive attitude	Development of infrastructure by Government	Large financial government support for railways
Signals for the danger of crash	Insider trading (connection between London Society and George Hudson) Leverage (dividends are financed by public offerings)	Leverage (short term loans from Europe)
Crash	October 1847	September 1873
Macroeconomic / regulatory effects	Suspension of Banking Act in 1844 Reform in Accounting (dividends can be paid from profits)	Because of development of infrastructure, economic activity increases in western states and trade with eastern states

Table 3 (II.)

Period	End of 1880s	1920s
Country	England	USA
Speculation on	Stocks of companies interested in agricultural lands in Argentina	Stocks after IPOs
Initial displacement	Increase in demand of Argentine agricultural products	End of deflation fears after WWI. Increase in mass production
Fueling investors' positive attitude	Increase of number of public companies Political incentive of Argentine state president	Development of financial services (investment fund) Easier public offerings in succession
Signals for the danger of crash	Biased analyses (Barings), insider trading	Leverage, buying shares on margin Actions of politics and economic policy
Crash	November 1890	October 1929
Macroeconomic / regulatory effects	Coup d'etat in Argentina Restriction of foreign investments	Glass-Steagall Act, "Chinese" wall between (separating) banking and investment services (SEC) Splitting big companies Deepening economic crisis

Period	1982-1987	1990s
Country	USA	South-East Asian Countries*
Speculation on	Stocks of reorganized companies	Stocks, Government bonds
Initial displacement	Waves of merger & acquisition because of cost efficiency	Increase of speed of economic growth, cost efficiency of reorganizations Deregulation, liberalization
Fueling investors' positive attitude	Government incentives for economic development, Development of financial services, tax-cuts	Fix exchange rate system Government incentives for economic development (tax benefits)
Signals for the danger of crash	Junk-bonds Insider trading (management) Program-trading	Manipulating financial reports State budget deficit and expansive economic policy
Crash	October 1987	December 1997, January 1998
Macroeconomic / regulatory effects	Changes in trading rules. Brady-Commission Making buying outs more difficult, less tax benefits	Domino-effects in emerging security market Restrictions of capital flows

Table 3 (III.)

Period	1990s	1990s
Country	Russia*	Brazil*
Speculation on	Stocks and government bonds	Stocks and government bonds
Initial displacement	Positive signs of economic recovery after collapse of USSR Deregulation, liberalization	Positive consequences of stabilization pack of 1993-94 Deregulation, liberalization
Fueling investors' positive attitude	Fix exchange rate system Government incentives for economic development	Fix exchange rate system Government incentives for economic development
Signals for the danger of crash	Large state budget deficit Corruption and scandals in business and state sectors (e.g. privatization)	State budget deficit and expansive economic policy Frauds in financial reporting
Crash	August 1998	January 1999
Macroeconomic / regulatory effects	Domino-effect to Eastern and Central European countries	Domino-effect to Latin America.

Period	1995-2001
Country	USA and developed countries
Speculation on	Dotcom companies
Initial displacement	Computerization (PC) in a wide range: households, firms Development of Internet
Fueling investors' positive attitude	New channels of communication Cost-efficient and fast trading, marketing etc.
Signals for the danger of crash	Activity of monetary policy Frauds and scandals in big firms
Crash	March-April 2000
Macroeconomic / regulatory effects	After economic recession, robust economic growth, Debates of corporate governance in a wide range Regulation on more transparent investment decisions

* *Note*: Stock market bubbles in Eastern and South Asia, Russia and Brazil were accompanying events of currency crises. In these countries stock markets do not play a great rule like in Anglo-Saxon countries, but the prices of certain shares and market indexes drive investors' attention, there were domino effect in related regions and contagion in other securities. These effects had negative impacts on the FDI to the regions, and worsened investors' appreciation.

4. Conclusion and further research

Stock markets are inherently unstable. In this essay, I have argued that there are some reasons we should distinguish some of regular fluctuations, because they have specific features: displacement (macroeconomic shock), increase in noise trading, macroeconomic and/or regulatory consequences. I have tried to prove that my definition of stock market bubbles is more accurately than in the literature, and using these features it is worth differentiating bubbles from other regular fluctuations. Apart from examples in *Table 3* there are two more cases to look at.

Economic tradition considers Dutch tulip-speculation in 1630s as a classic example of bubble. If we follow the bubble-description, we cannot classify the as a typical bubble. Although we can find some sources about the increase in leverage, comovement of tulip prices, but there are no reliable data as Garber (2000) argued. Most of the analyses are based on a moral pamphlet written against the “vicious” speculative attitude. It is also widely considered that the tulip-speculation as the main factor to retard the economic performance in Netherlands in the mid of 1600s. Along with Garber (2000), I reject this hypothesis, because of the possible small extent of this speculation, it could not cause any real effects on the economy or the regulatory environment. The economic depression observed in Netherlands afterwards should be considered as consequences of the 30 year war and the plague that killed almost 1/3 of the population in that regions.

No fluctuations in the Hungarian stock market (Budapest Stock Exchange, BSE) at the turn of the millenium are bubbles (Komáromi 2004). Although some bubble-phenomena (comovement of prices, leverage) can be observed between 1997 and 2000, but the BSE plays an insignificant role for financing firms or accumulate savings in Hungary. During this period Hungarian firms were not active in raising their capital through public offerings. Other signal that supports the hypothesis above, is that stock exchange had not been prerequisite for foreign capital inflow to Hungary. Some formerly state-owned companies (e.g. MATÁV - telecom, MOL - oil, OTP - banking) became privatized, stakes were sold directly to foreign investors, but insignificant activity of domestic investors did not mean risk-sharing opportunities for them. Therefore the stock market fluctuations in BSE were direct consequences of the international trends and of the development of an emerging stock market, and even today the BSE was still in its infancy.

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