International Journal of Economics and Finance; Vol. 16, No. 9; 2024
ISSN 1916-971X E-ISSN 1916-9728
Published by Canadian Center of Science and Education

Do Bubbles Have Real Effects? Balance Sheet Analysis and Review of Literature

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Received: May 4, 2024 Accepted: June 23, 2024 Online Published: August 31, 2024

doi:10.5539/ijef.v16n9p41 URL: https://doi.org/10.5539/ijef.v16n9p41

Abstract

This paper studies the nature and the existence of bubbles in financial markets. Do bubbles have real effects? How do they behave? From balance sheet, we learn that the impacts of bubbles depend on who owns the bubbles assets. The effects of speculative bubbles are intensified when it is banks that hold financial assets. Banks' balance sheets are improving following the expansion of a bubble that sharply increases asset prices, earnings and equity. The increase in equity rises the capacity of banks to grant credit to the economy, to stimulate economic growth, investments and production. Balance sheet crises, in which asset prices collapse, pose particular economic challenges. Banks' equity fall abruptly, Banks may not be able to grant as much credit to the economy as in the past. Economic activity is contracted, there will be a reduction in investment and production. A financial crisis can then cause an economic crisis. The total assets of banks can change greatly, depending on whether we are in periods of spectacular increases in asset prices or in periods of drastic fall in assets prices. We use econometric methods to determine the specific effects to each bank, and we note that in presence of speculative bubbles, the total assets held by the largest banks increases on average by about US $360.5 billion. In contrast, during periods of drastic declines in asset prices, the total assets held by the world's largest banks decreases by about US $291.3 billion. Thus, over time, after a business cycle (recovery, recession, recovery), the total assets of the world's largest banks increase by an average of US $90 billion.

Keywords: rationality and bubble, balance sheet, financial institutions, reel effect of bubbles

Jel codes: B23, B26, D53, E44, F65, G01, G17, G21, G33, N20.

1. Introduction

On December 1996, Alan Greenspan, chairman of the Federal Reserve Board in Washington, used the term "irrational exuberance" (Note 1) to describe the behavior of stock market investors. The words irrational exuberance quickly became Greenspan's most famous quote and a catch phrase for everyone who follows the market (Shiller, 2000).

Financial history can be read in many respects, as a history of boom and burst bubbles. The infamous Dutch Tulip Mania (1634-1637), the French Mississippi Bubble (1719-1720), the South Sea Bubble in the United Kingdom (1720s), the first Latin American debt boom (1820s), and railway manias in the United Kingdom (1840s) and United States (1870s) are all notable examples (Garber, 1990). In the past century, no busts have been more devastating than the Great Depression ushered in by the collapse of US stock markets in 1929. Over the past few decades, the Japanese Heisei bubble in the late 1980s, the various emerging market booms and busts in the 1980s and 1990s, and the equity mania in the late 1990s, offer others examples of speculative frenzies gone awry.

Despite such evidence, many debates persist on the existence of speculative bubbles. The existence of speculative bubbles in financial markets has been a long-standing issue under debate. Financial economists and market participants often hold quite different views about the price of an asset (Bertus & Stanhouse, 2001). The "pro-bubble" side is largely supported by some hedge fund managers and some policy-makers. While on the other side, a number of academic economists are skeptical of bubbles' theory. Financial economists and market participants often hold quite different views about the price of an asset. On the one hand, financial economists usually believe that given the assumption of rational behavior and rational expectations, the price of an asset must simply reflect market fundamentals, that is to say, the price of an asset, can only depend on information about current and future returns from this asset. Deviations from this market fundamental value are taken as prima facie signs of irrationality. On the other hand, market participants argue that strange events and self-fulfilling rumors may well influence the price, if believed by other participants to do so; "crowd psychology" becomes an important determinant of price. Rationality of behavior often does not imply that the price of an asset be equal to its fundamental value. In other words, there can be rational deviations of the price from fundamental value - rational bubbles. The word "bubble" recalls to some famous episodes in finance history in which asset price rose far higher than it could be easily explained by fundamentals, and with investors appeared to betting that other investors would drive price even higher in the future. History has too often witnessed the rise and collapse of assets price. The first recorded bubble is the "Tulip mania", in February 1637 - a period in Dutch history where prices for tulip bulbs reached extraordinarily high levels and then suddenly collapsed. Almost surely, the financial crisis caused by the burst of the U.S. housing bubble (Note 2) is not last one (Note 3). Many debates rose to know whether price "bubbles" ever existed. The "pro-bubble" side is largely supported by some hedge fund managers and some policy-makers. On the other side, a number of academic economists are skeptical of the bubble theory, citing a lack of empirical evidence (e.g., Krugman, 2008).

This paper examines the nature and the existence of bubbles in financial markets. What are bubbles? Are bubbles consistent with rationality? Do they have real effects? How do they behave? These are questions we answer in the following sections. The paper is organized as follows: Section 2 focus on rationality and bubbles and discusses the existence of bubble. Section 3 presents real effects of bubbles.

2. Rationality and Bubble: Do Bubbles Exists?

2.1 Description

Rationality of behavior and expectations, together with market clearing, imply that assets are voluntary held and that no agent can, given his private information and information revealed by price, increase his expected utility by reallocating his portfolio (Blanchard, 1979). With many other assumptions, this lead to a standard "efficient market" or "no arbitrage condition". Let us define the net simple return,

$$R_{t+t} = \frac{P_{t+1}+D_{t+1}-P_t}{P_t} \qquad (1.a)$$

this definition is straightforward, but it uses two notations conventions that deserve emphasis. First P_{t+1} denotes the price of an asset measured at the beginning of the period t+1, or equivalently an ex-dividend price: purchase of a stock at a price P_t today, gives one a claim to the next period dividend per share D_{t+1}; but not the period's dividend D_t. D_{t+1} is the direct return, one can see D_{t+1} as the dividend, although it may take depending on the asset, pecuniary or non-pecuniary forms. Second, R_{t+t} denotes the return on the asset held from t to $t+1$. R_{t+t} is the return of the holding asset, which is the sum of the dividend price ratio and the capital gain. *t* indicates the time. The subscript $t+1$ is used because the return is known at the time $t+1$. Let us assume that, the expected return of the asset is constant, that is:

$$E(R_{t+1}|\, F_t) = R \qquad (1.b)$$

Taking the expectations (Note 4) of the identity (1.a), imposing (1.b) and rearranging, we obtain an equation relating the current stock price to the next period expected stock price and dividend (Campbell & Mackinlav, 2000):

$$P_t = \frac{1}{1+R} E_t(P_{t+1} + D_{t+1}) \qquad (1.c)$$

F_t is the information set available at time *t*, E_t is a short for $E(\,|\,F_t)$. The condition (1.b) states that the expected return on the asset is equal to the interest rate *R*; assumed constant. Among the assumptions needed to obtain equation (1.c), some are inessential and could be relaxed at a cost of increase complexity of notations.

Given assumption of rational expectations and the fact that agent do not forget, so that $F_t \subseteq F_{t+1}$, the equation (1.c) is solved recursively, by repeatedly substituting out future prices and using the law of iterated expectation:

$$E_t\left(E_{t+j}(P_{t+T})\right) = E_t(P_{t+T}), \ \ \forall j \geq 0, \qquad \forall T \geq 0$$

to eliminate future-dated expectations. After solving *T* periods, we obtain:

$$P_t = \left[\sum_{i=1}^{T} \left(\frac{1}{1+R}\right)^i E_t(D_{t+i})\right] + E_t\left[\left(\frac{1}{1+R}\right)^T P_{t+T}\right] \qquad (2.a)$$

When the horizon T increases to infinity, we have:

$$P_t = \left[\sum_{i=1}^{+\infty}\left(\frac{1}{1+R}\right)^i E_t(D_{t+i})\right] + \lim_{T\to+\infty} E_t\left[\left(\frac{1}{1+R}\right)^T P_{t+T}\right] \qquad (2.b)$$

The first term of the equation (2.b) is the present value of the expected dividends and thus it's called the "market fundamental" value of the asset. This term is standard in financial markets. It was introduced in economics by Flood and Garber (1980).

The relation (2.b) is well elucidated in Campbell and Mackinlav (2000), chapter 7. The basic framework for their analysis is the discounted-cash-flow or present value model. Their model relates the price of a stock to its expected future cash flows-its dividends-discounted to the present using a constant or time-varying discount rate. Since dividends in all future periods enter the present-value formula, the dividend in any one period is only a small component of the price.

$$\mathrm{P}_t^* = \sum_{i=1}^{+\infty}\left[\left(\frac{1}{1+\mathrm{R}}\right)^i \mathrm{E}_t(\mathrm{D}_{t+i})\right] \qquad (3.a)$$

P_t^* is a solution of the equation (1.c), but it is not the only solution of (1.c). Any P_t of the following form (Note 5).

$$P_t = \mathrm{P}_t^* + B_t \qquad (3.b)$$

where:

$$B_t = \frac{1}{1+R}\mathrm{E}_t(\mathrm{B}_{t+1}) \qquad (3.c)$$

is a solution as well. Thus the market price can deviate from its market fundamental value without violating the arbitrage condition (1.c). As $R > 0$, this violation B_t must however be expected to grow over time. The deviation B_t embodies the popular notion of "bubble", namely the movements in the price, apparently unjustified by information available at the time. When the additional term B_t in (3.b) satisfies (3.c), it is called a "rational bubble". The adjective "rational" is used because the term B_t is consistent with rational expectations and constant return.

The second term in the right-hand size of the equation (2.b) is the present expected discounted value of the stock price as the horizon grows to infinity. When we impose:

$$\lim_{T\to+\infty} E_t\left[\left(\frac{1}{1+R}\right)^T P_{t+T}\right] = 0 \qquad (TC)$$

then, P_t^* becomes the unique solution of (1.c). *(TC)* is called the transversality condition. The condition *(TC)* rules out the presence of bubbles. If the transversality condition *(TC)* does not hold, the general solution to (1.c) has the form (3.a-c).

2.2 Do Bubbles Exist?

2.2.1 Theoretical Argument

In the section 2.1, we have only shown that arbitrage condition does not prevent bubbles by itselft. Are there some conditions under which bubbles can be ruled out? Blanchard and Watson (1982) made a discussion on transversality conditions. In Blanchard and Watson's model, bubbles should have the following property:

$$\lim_{\mathrm{T}\to+\infty} \mathrm{E}_t(\mathrm{B}_{t+\mathrm{T}}) = \begin{cases} +\infty & \text{if } \mathrm{B}_t > 0 \\ -\infty & \text{if } \mathrm{B}_t < 0 \end{cases} \qquad (4)$$

The condition (4) implies that, there cannot be negative bubbles in Blanchard and Watson's model. A negative value of B_t today implies that there is a positive probability, possibly very small, that at some date $t + T$, $\mathrm{B}_{t+\mathrm{T}}$ becomes large and negative enough to make the price becomes negative. If the asset cannot be disposed at no cost, its price cannot become negative. Then rationality implies that bubble cannot be negative today for an exchangeable asset. Although the stochastic bubbles have attracted considerable attention, there are both theoretical and empirical arguments that can be used to rule out bubble solution to (1.c). Theoretical arguments may be divided into partial-equilibrium and general-equilibrium arguments.

In partial equilibrium, the first point to note is that there can never be a negative bubble on an asset. If negative bubbles existed, it would imply a negative expected asset price at some date in the future, and this would be inconsistent with the limited liability (Diba & Grossman, 1988b). A second important point follow from this: A bubble on a limited liability cannot start within an asset pricing model. If bubble exist today, it must has exist since asset trading began. Diba and Grossman (1988b) argue that any rational bubble that starts after the first date of trading has an expected initial value of zero. The reason is that, if bubble ever has a zero value, its expected future value is zero by the condition (3.c). Third, a bubble cannot exist if there is any upper limit to the price of an asset. Finally, bubble cannot exist on asset such as bonds which has fix value on a terminal date.

General-equilibrium considerations also limit the possibilities for rational bubbles (Tirole, 1982). Tirole (1982) has shown that bubbles cannot exist in a model with finite number of infinite-lived rational agents. His argument is easy to understand when short sales are allowed. If positive bubbles exist in an asset, infinite-live agent could sell the asset short, invest some of proceeds to pay the dividends streams, and have positive wealth left over. This arbitrage opportunity rules out bubbles. Tirole (1985) has studied the possibility of bubbles within the Diamond overlapping-generations model. In his model, there is an infinite number of finite-lived agents. Tirole shows that even here, bubble cannot rise when interest rate exceeds the growth rate of the economy, because bubble would eventually become very large relative to the wealth of the economy. This would violate some agent's budget constraint. Thus, the bubbles can exist only in dynamically inefficient overlapping-generations economy that have over accumulated private capital, driving the interest rate down below the growth rate of the economy. Fantcho, JE. (2007, 2021) uses affine structure model, to split up asset price between fundamental and bubbles.

2.2.2 Technical Argument on Transversality Condition

Transversality conditions together with Euler equation are sometime used to characterize the optimal solution of dynamic models. Stockey and Lucas (1989, p. 102) provide the sufficiency of the transversality condition. Michel (1990), for a concave optimal control problem, studies more general transversality conditions that an optimal path has to satisfy. Montrucchio and Privileggi (2001) study the existence of bubbles for pricing equilibriums in a pure exchange economy "à la Lucas", with infinitely lived homogeneous agents. They prove that the pricing equilibrium is unique as long as the agents exhibit uniformly bounded relative risk aversion. They also give generic uniqueness result regardless of agent's preferences. Kamihigashi (2002) give a simple proof of the necessity of the transversality conditions. Kamihigashi (1998), Montrucchio and Privileggi (2001) construct a few "pathological" examples of economies exhibiting pricing equilibriums with bubble components. We give here the Kamihigashi's necessary of transversality condition.

Kamihigashi consider the following maximization problem:

$$\begin{cases} \max_{\{x_t\}_{t=0}^{\infty}} \sum_{t=0}^{+\infty} v_t(x_t, x_{t+1}) \\ s.t. x_0 = \bar{x}_0, \forall t \geq 0, (x_t, x_{t+1}) \in X_t \end{cases} \quad (5.a)$$

Kamihigashi's result: Under the some assumptions, any optimal interior path $\{x_t^*\}_{t=0}^{\infty}$ satisfies:

$$\lim_{T\to+\infty} -v_{T,2}(x_T^*, x_{T+1}^*) \cdot x_{T+1}^* = 0 \quad (5.b)$$

Since an interior path satis.es the Euler equation:

$$v_{t,2}(x_t^*, x_{t+1}^*) + v_{t,1}(x_t^*, x_{t+1}^*) = 0 \quad (5.c)$$

(12.b) is equivalently expressed as:

$$\lim_{T\to+\infty} v_{T,1}(x_T^*, x_{T+1}^*) \cdot x_T^* = 0 \quad (5.d)$$

When we read this result, we do not directly see how transversality conditions rule out asset price bubbles. To be more explicit, one can consider a deterministic version of Lucas (1978) asset pricing model. There are many homogeneous agents, a single good, and a single asset that pays a dividend of D_t of good in each period *t*. The population and the supply of asset are normalized to one. Each agent solves the following problem:

$$\begin{cases} \max_{\{c_t, x_{t+1}\}_{t=0}^{\infty}} \sum_{t=0}^{+\infty} \beta^t \cdot u(c_t) \\ s.t. x_0 = 1, \forall t \geq 0, x_{t+1} \geq 0, c_t + P_t x_{t+1} = (P_t + D_t) x_t \end{cases} \quad (P)$$

where c_t is consumption, P_t is the price of the asset, D_t is the dividend, and x_t is the shares in the asset at the beginning of the period t. u is the instantaneous utility function at the date *t*, u is a strictly increasing and strictly concave. In equilibrium:

$$c_t^* = D_t, x_{t+1}^* = 1, \forall t \geq 0.$$

The Euler equation and the transversality condition for an interior equilibrium are:

$$u'(c_t^*) \cdot P_t = \beta \cdot u'(c_{t+1}^*) \cdot (D_{t+1} + P_{t+1}) \quad (6.a)$$

$$\lim_{T\to+\infty} \beta^T \cdot u'(c_{t+T}^*) \cdot P_{t+T} = 0 \quad (6.b)$$

The sequence of price $\{P_t^*\}_{t=0}^{\infty}$ given by:

$$P_t^* = \sum_{i=0}^{+\infty} \beta^i \cdot \frac{u'(c_{t+i}^*)}{u'(c_t^*)} D_{t+i} \qquad (7.a)$$

satisfies the Euler equation (6.a). The right side of (7.a) is called the fundamental value of the asset. If $\{B_t\}_{t=0}^{\infty}$ is a non negative sequence satisfying:

$$u'(c_t^*) \cdot B_t = \beta \cdot u'(c_{t+1}^*) \cdot B_{t+1} \qquad (7.b)$$

then the sequence $\{P_t^* + B_t\}_{t=0}^{\infty}$ also satisfies the Euler equation. The extra-component B_t here is interpreted as a bubble. If the transversality condition is necessary, the bubble component must vanish and the price of an asset must always be equal to the fundamental value. In stochastic problems, bubbles can also be ruled out under some conditions. But there are some pathological cases in with bubbles are possible (Kamihigashi, 1998; Montrucchio & Privileggi, 2001).

Note also that, Kamihigashi (2018) establishes a simple no-bubble theorem that applies to a wide range of deterministic sequential economies with infinitely lived agents. He shows that asset bubbles never arise if at least one agent can reduce his asset holdings permanently from some period onward. His no-bubble theorem is based on the optimal behavior of a single agent, requiring virtually no assumption beyond the strict monotonicity of preferences.

3. Real Effects of Bubbles

3.1 Theoretical Approaches from Literature

In the years 2000, the economic statistics being reported for the U.S. Economy have been very contradictory (Shiller, 2000). The stock market has soared to record levels. Profits for the major corporations have never been higher. Meanwhile, the manufacturing and farming economies are essentially in recession, and personal bankruptcies are at record levels. Why should a part of U.S. economy is doing so well, while other parts are suffering? Henceforth, stock market expansion is associated with popular perceptions that the future is brighter or less uncertain than it was in the past. The appearance of new technologies is now named as a cause of asset price popping. Modern economies often experience large movements in asset prices that cannot be explained by changes in economic conditions or fundamentals. It is usual to refer to these episodes as asset price bubbles popping up and bursting. Do bubbles generate substantial macroeconomic effects? Blanchard and Watson (1982), Tirole (1985), Olivier (2000), Yanagawa and Grossman (1993), Caballero and Hammour (2005), have analyzed the real effects of bubbles.

Tirole (1985) show that bubbles can exist in overlapping generation model with infinite number of infinite-lived rational agents, in a dynamically inefficient equilibrium; that is, in equilibrium where too much capital is being accumulated. Consequently, bubbles crowd saving away from investment in physical capital; bubbles in Tirole's model also raise the welfare.

According to Blanchard and Watson (1982), if an asset is not reproductible, the bubbles on this asset will simply lead to rents to initial holder. Many assets subject to bubbles are partly reproducible. Blanchard and Watson consider bubbles on housing and on stock market. If a firm is initially in equilibrium, then, the marginal product of capital should be equal to the interest rate. "In absence of bubble, the value of a title to a unit capital, a share, is just equal to the replacement cost and the firm has no incentives to increase its capital". If a bubble starts on a share and increases its price by 10% above market fundamentals, one could think that the firm should add the capital stock until the marginal product of capital is reduced by 10%. The market fundamentals thus decrease by 10% and the share price is again equal to the replacement cost. Initial shareholders have made a profit on the new share issued. The story is similar for housing.

Standard neoclassical theory predicts that investment is inherently tied with the stock market through Tobin's "q". The essence of "q" theory is the following argument: if the repurchase cost of capital is less than the net present value of additional profits it will bring at the margin, then the company should invest (Panageas, 2005). The only thing preventing the ratio of the two values "known as q" from being always equal to 1 is adjustment costs: it is expensive to install new capital and thus a deviation of q from 1 can exist, but it should diminish over time. The link between investment and the stock market is that: the value of a company is the net present value of its profits and thus, whenever one sees the stock market rising, one should simultaneously observe an increase in investment in order to bring the numerator and the denominator of the "q" ratio into line.

Employing an overlapping-generation endogenous growth model with a linear technology, Grossman and Yanagawa (1993) proved that asset bubbles reduce the welfare of all generations born after the bubble emerges, while they improve the welfare of the first generation. Olivier (2000) shows that in a small open economy, when the speculative bubbles arise on equity, the market value of the firm increase. Agent can get strong incentives to create new .rms. Bubbles are growth-enhancing. But, if bubbles appear on unproductive asset, then, their effects will be similar to that of Yanagawa and Grossman (1993). Bubbles on unproductible asset raise the equilibrium interest rate and lower the market value of theorem. Hence, investments and growth fall.

A distinctive characteristic of the U.S. speculative expansion of the 1990s is that it was concentrated in the new technology sector. The stock market price of “new economy” technology and growth companies boomed, while the price of traditional “old economy” companies did not appreciate. In the same period, the share of aggregate investment that went to technology capital experienced a sharp increase. More generally, speculative growth episodes typically have been associated with the expansion of newly emerging sectors of the economy (Shiller, 2000).

Caballero and Hammour (2005), propose a framework for understanding historical episodes of vigorous economic expansion accompanied by extreme asset valuations, as exhibited by the U.S. in the 1990s. They interpret this phenomenon as a “high-valuation equilibrium with a low effective cost of capital based on optimism about the future availability of funds for investment”. They show that increased productivity growth provides increased future income, which fuels the key feedback from growth to saving. In Their model, a technological revolution can be considered an integral part - both as cause and consequence - of speculative growth equilibrium. Caballero and Hammour show that such feedback arises naturally when an expansion comes with technological progress in the capital producing sector, when the rest of the world has lower expansion potential, ... These ingredients were all simultaneously present in the U.S. during the 1990s. Caballero and Hammour also show that speculative growth episodes facilitate the emergence of (rational) bubbles. These bubbles can now arise even if interest rates exceed the rate of growth of the economy, and exhibit positive rather than negative co-movement with real investment.

Bubbles also seem to have existed in the commodities market. Since 2007 the world experienced dramatic swings in internationally traded food commodity prices. In June 2008, December 2010 and more recently in the autumn of 2012, food prices increased sharply and subsequently declined from their peak. The prices of many commodities experienced a spectacular run up during the period leading into the recent financial crisis. Gold prices, for example, rose by 500% between 2000 and 2011 before losing a third of their value by 2013.

Standard economic theory suggests that changes in price levels will be governed by the laws of supply and demand. But, for market participants, extreme price swings over protracted periods cannot be justified fundamentally, leading to suggestions that they may arise from speculation. Commodities are seen as an investable asset class, believed to have good diversification benefits, low correlations with stocks and bonds, and good hedging properties against inflation. As a result, many new commodities index funds were established and their activities increased trading volumes and altered the balance of transactions between hedgers and speculators (see, for example, Irwin & Sanders, 2012).

Commodities are core inputs to the production process or are consumption goods. For many media, the behavior of commodities prices, similar to that of a roller coaster, has real consequences. In particular, there have been concerns that price spikes have adversely affected the social welfare of consumers, especially those in developing countries (see, e.g., Leyaro, 2009), since households there spend a relatively high proportion of their incomes on basic food and energy. Many commentators in the media explicitly laid the blame for the price rises and increased volatility squarely at the door of speculators, arguing that investment banks and funds were immoral to engage in strategies that may have pushed up food prices. In one particularly extreme example, Johann Hadri (Note 6), writing in a blog for the independent newspaper, argues that Goldman “gambled on starvation”. Persistent food price volatility can also have significant effects, for net food importing developing countries. Rising prices can negatively affect the balance of payments, foreign currency reserves and worsen the ability to implement social safety programs.

According to Shiller (2000) and Fantcho (2007, 2021), technological innovation brings with it a new sense of freedom and possibility, and a widespread awareness that these personal values could be achieved by new technologies. The financial crisis of 1929 was preceded by the mass diffusion of automobiles. The price boom of 1967 was preceded by the mass diffusion of television in households. The financial bubble of the 2000s was preceded by the arrival of internet. The diffusion of technological innovations leads to economic growth and euphoria on the financial markets. For example, using the Internet gave people a sense of mastery of the world. They can electronically roam the world and accomplish tasks that would have been impossible before. They can even put up a Web site and become a factor in the world economy themselves in previously unimaginable ways. This sensation has created euphoria in the financial markets and a dramatic rise in prices in the new technology sector. Using Reel Business Cycle Model and Structural VAR, Fantcho (2007) shows that, technology shock increases the return of stock price; while monetary shock reduces the return.

For some economists, financial crises follow economic cycles. According to Kindleberger (2005), financial crises occurred regularly at about ten-year intervals. For historians each event is unique. In contrast economists maintain that there are patterns in the data and particular events are likely to induce similar responses. The business cycle is a standard feature of market economies; increases in investment in plant and equipment lead to increases in household income and the rate of growth of national income.

A model developed by Hyman Minsky is used to interpret the financial crises in the United States, Great Britain, and other market economies. Minsky highlighted the pro-cyclical changes in the supply of credit, which increased when the economy was booming and decreased during economic slowdowns. Some of these crises involved the failure of a large number of banks, some involved the lack of confidence in the ability of a country to maintain the parity for its currency and a few involved the implosion of a bubble in stock markets and in real estate markets.

In the model developed by Martin and Ventura (2012), newly created bubbles reallocate resources because they are sold by productive to unproductive agents, either directly or indirectly through the credit market. This wealth effect of bubble creation has been a recurrent theme in the literature. Another strand of literature stresses the role of bubbles as providers of liquidity. In these models, bubbles enable agents to transfer resources over time, from periods in which they are unproductive to periods in which they are productive. Thus, rational agents are willing to hold bubbles because they expect to sell them or borrow against them in the future, when the time comes to invest. In this paper, we examine the effects of speculative bubbles on output, on the wealth of productive companies, banks, insurance and households. We start our study with the balance sheet of a financial company.

3.2 The Balance Sheet Approach

Bank balance sheets report the assets and liabilities. The assets are items that the bank owns. This includes fixed assets, loans, securities, reserves and cash. Liabilities are items that the bank owes to someone else or to itself. This includes Capital, deposits and bank borrowing from other institutions The capital is called “equity” or “bank equity”. Bank equity is funds that are raised either by selling new shares or from retained earnings, that the bank drives from its lending and financial investment activities. Financial securities include stocks, bonds, treasury bills, derivatives, etc. The following is an example of a bank balance sheet:

Table 1. Balance sheet of a Bank

Assets	*(Amount)*	**Liabilities**	*(Amount)*
Reserves and cash items	(X)	Checkable deposits	(A)
Financial Securities	$(P \cdot N)$	Nontransaction deposits	(B)
Loans	(Y)	Borrowings	(C)
Fixed assets and other assets	(Z)	Bank equity	(D)
TOTAL:	$(PN + X + Y + Z)$	TOTAL:	$(A + B + C + D)$

First, note that the total on the left side must always equal the total on the right side of the balance sheet, That’s:

$$P \cdot N + X + Y + Z = A + B + C + D \qquad (BS)$$

Where, N is the average number of financial securities and P denotes their average price. In this first bubble-free balance sheet, P reflects the fundamental value of asset prices. We are more interested in how a bank balance sheet is changing, rather than the total assets and liabilities on the balance sheet. How does the balance sheet evolve when a new bubble appears, with a surge in the prices of financial securities P. Now suppose asset prices rises sharply and becomes, $\bar{P}, \bar{P} > P$. This change in the price of financial assets will modify the Bank’s balance sheet. The total asset will increase because $\bar{P}N > PN$. Everything happens as if the Bank has made profits on its financial investments. If earnings are not redistributed to shareholders, they will increase the total Balance Sheet Liabilities. In particular, the amount of equity will increase by ($\bar{P}N - PN$). From now, the Bank has the ability to increase loans to the economy or to buy more financial assets. The Bank’s balance sheet is improved following the expansion of a bubble which sharply increased asset prices. The increase of loans (credits to economy) will boost economic growth, stimulate investment and production. Thus, the development of a bubble reviving economic activities. The Bank’s new balance sheet is as follows:

Table 2. Bank's balance sheet after the birth of a bubble

Assets	*(Amount)*	**Liabilities**	*(Amount)*
Reserves and cash items	(X)	Checkable deposits	(A)
Financial Securities	$(\bar{P}N)$	Nontransaction deposits	(B)
Loans	(Y)	Borrowings	(C)
Fixed assets and other assets	(Z)	Bank equity	$(D)+(\bar{P}-P)N$
TOTAL:	$(\bar{P}N+X+Y+Z)$	TOTAL:	$(A+B+C+D)+(\bar{P}-P)N$

Now, suppose that the bubble bursts and financial asset prices dramatically drop, with the new asset price $\underline{P}$, $\underline{P}<\bar{P}$. Then, everything happens as if the value of the Bank's financial assets had sharply fallen. The total assets will abruptly decrease and the Bank will experience losses. These losses significantly reduce the equity value by the amount of $\left(\bar{P}-\underline{P}\right)N$. The Bank's new balance sheet is as follows:

Table 3. Bank's balance sheet after the bubble's bursting

Assets	*(Amount)*	**Liabilities**	*(Amount)*
Reserves and cash items	(X)	Checkable deposits	(A)
Financial Securities	$(\underline{P}N)$	Nontransaction deposits	(B)
Loans	(Y)	Borrowings	(C)
Fixed assets and other assets	(Z)	Bank equity (Note 7)	$(D)-\left(P-\underline{P}\right)N$
TOTAL:	$\left(\underline{P}N+X+Y+Z\right)$	TOTAL (Note 8):	$(A+B+C+D)-\left(P-\underline{P}\right)N$

Balance sheet crises, in which asset prices collapse, pose particular economic challenges. Banks' equity fall abruptly, Banks will not be able to grant as much credit to the economy as in the past. Economic activity will contract, there will be a reduction in investment and production. A financial crisis can then cause an economic crisis.

The analysis made on speculative bubbles and the balance sheet of commercial banks can be extended to insurance companies; With the only difference that the insurance companies do not massively grant loans to the economy.

When a household holds a speculative bubble asset, then the presence of a growing bubble gives the impression that his wealth is growing unexpectedly. This sudden and quick enrichment increases the household's welfare and his possibilities of consumption, investment and savings. In contrast, when the bubble bursts, the household has the impression that its wealth has sharply fallen, his portfolio has lost much of its value. The household is poorer, his ability to consume, save and invest is harshly reduced. The impacts of bubbles also depend on who owns the bubbles assets. The effects of speculative bubbles are intensified when it is banks that hold financial assets. For example, when a bubble bursts, in addition to financial losses, financial institutions also lose their ability to finance the economy. This could lead to a contraction in economic activities, a drop in investment and production (Shiller, 2000).

Basel Requirements provided guidelines for the calculation of minimum regulatory capital ratios. In general, Basel Accords require that the ratio of capital to credit granted to the economy be greater than 8%. Thus, if equity decreases by one unit, credits granted to the economy will decrease by around 12.5 units. Since the bursting of a bubble mainly attacks the level of equity, the financing capacity of financial institutions is greatly reduced. The financing capacity of financial institutions could be reduced by $12.5\times\left(\bar{P}-\underline{P}\right)N$. Where $\underline{P}$ is the lowest price observed when the bubble burst; and $\bar{P}$ the highest price recorded at the time of the dramatic rise in asset prices.

The intensification effect is the reverse in the event of a spectacular increase in asset prices. When asset prices rise dramatically (all else equal), banks' profits rise sharply, as does the level of capital. The financing capacity of the economy of banks substantially increases. Economic activity is revitalized. Investment and production are stimulated. The financing capacity of banks could be increased (Note 9) by about $12.5\times\left(\bar{P}-\underline{P}\right)N$.

When Alan Greenspan, chairman of the Federal Reserve Board in Washington, used the term irrational exuberance to describe the behavior of stock market investors in an otherwise staid speech on December 5, 1996, the world fixated on those words. Stock markets dropped precipitously. In Japan, the Nikkei index dropped 3.2%; in Hong Kong, the Hang Seng dropped 2.9%; and in Germany, the DAX dropped 4%. In London, the FT-SE 100 index was down 4% at one point during the day, and in the United States, the Dow Jones Industrial Average was down 2.3% near the beginning of trading. The words irrational exuberance quickly became Greenspan's most famous quote—a catch phrase for everyone who follows the market.

According to Shiller (2000), an unprecedented increase just before the start of the new millennium has brought the market to this great height. The Dow Jones Industrial Average stood at around 3,600 in early 1994. By 1999, it had passed 11,000, more than tripling in five years, a total increase in stock market prices of over 200%. At the start of 2000, the Dow passed 11,700. Over the same period, U.S. personal income and gross domestic product rose about 30%. Corporate profits and total assets of financial institution rose less than 60%.

Large stock price increases have occurred in many other countries at the same time. In Europe, between 1994 and 1999 the stock market valuations of France, Germany, Italy, Spain, and the United Kingdom roughly doubled. The stock market valuations of Canada, too, just about doubled, and those of Australia increased by half. In the course of 1999, stock markets in Asia (Hong Kong, Indonesia, Japan, Malaysia, Singapore, and South Korea) and Latin America (Brazil, Chile, and Mexico) have made spectacular gains.

The table 4 gives the results of the 10 largest European banks between the year 1999 of irrational exuberance, and the year 2002 of the bubble burst. This table shows that the net profits of the largest banks fell sharply between 1999 and 2002. The net profits of the ING group fell from 12,131 million euros to 4,387 million euros, a drop of almost 65% in profit net of this bank. Some banks, such as Deutsche Bank in 2002, no longer appear in the ranking of the 10 largest European banks and have lost more than half of their net profit. Overall, between 1999 and 2002, Return on Equity (RoE) declined significantly. For example, IN Group's RoE fell from 37% in 1999 to 17% in 2003. During the year 1999, the Return on Equity of most banks was above 20%. In 2002, only one major European bank, Lloyds TSB, had a RoE above 20%.

Table 4. Some results from European banks (Note 10)

	Year 1999			Year 2002		
Rank	**Bank**	**Net profits (million euros)**	**RoE (%)**	**Banks**	**Net profits (million euros)**	**RoE (%)**
1	ING Group	12 131	37.32	HSBC	7 677	10.5
2	HSBC	8 700	17.29	Royal Bank	6 005	11.12
3	Allianz	6 467	23.4	Lloyds TSB	4 696	22.93
4	UBS	5 226	20.51	ING Group	4 387	14.6
5	DEUSCHE BANK	4 949	17.44	UBS	4 309	12.41
6	PNB Paribas	4 548	18.57	PNB Paribas	3 958	7.98
7	Lloyds TSB	4 447	29.39	Barclays	3 913	12.84
8	Crédit Suisse	4 114	20.19	HBOS	3 780	13.97
9	BSCH	4 014	21.3	Crédit Suisse	3 467	12.89
10	Bank of Scoland	4 002	19.7	ABN AMRO	3 415	14.24

In the following paragraphs, we measure the impact of speculative bubbles and their bursts on the activity (total assets) of the largest banks around the world. We use data from Global Finance Magazine (Note 11), which each year gives the rankings of the 50 largest banks in the world according to total assets. Let's call Y_{it} the total assets of bank *i*, for the year *t*, and write the following linear regression:

$$Y_{it} = \alpha_i + \beta \mathbb{1}_{t_j} + \gamma \mathbb{1}_{t_k} + \varepsilon_{it}, \quad i = 1,2,\dots,n = 24, \quad t = 1,2,3.$$

α_i measures the specific effects of the Bank *i*. β measures the consequences of bubbles on total assets, in years of spectacular increases in asset prices. Thus, the explanatory variable $\mathbb{1}_{t_j}$ takes the value 1, in years $t = t_j$ when the bubbles appear, and 0 otherwise. The index *j* describes the years in which the bubbles appeared. The index k describes the years when the bubbles burst. Thus, the coefficient γ measures the effects of financial crises on the total assets of bank *i*. The explanatory variable $\mathbb{1}_{t_k}$ takes the value 1, in years $t = t_k$ when the bubbles burst, and 0 otherwise. ε_{it} are the error terms, which we assume to be independent, and normally distributed, with mean 0 and constant variance.

We choose the year 2002 as the year when the bubbles burst. Indeed, the dotcom bubble began to collapse at the end of the year 2000. Companies such as Pets.com declared bankruptcy, and in 2001, the bubble burst, taking away many dotcom companies. The trillions of dollars in market value lost during the crash of the stock market between 2000 to 2002. We choose the year 1999 as the year when the bubble was present. Indeed, in 1999, the Dow Jones had tripled its value in five years and the total increase in stock prices exceeded 200%. In 2005, asset prices appear to have returned to their usual average value. We note that 2005 was a year without major financial disruption.

Table 5. Results of regression

Method: Least Squares
Date: 04/02/24 Time: 09:26
Sample: 1 72
Included observations: 72

Variable	Coefficient	t-Statistic	Prob.
ABN_AMRO	517.299	6.218015	0.0000
Agricultural_Bank_of_China	716.343	7.217882	0.0000
Banco_Bilbao	421.935	5.739484	0.0000
Banco_Santander	739.549	7.334413	0.0000
Bank_of_America	1153.946	9.415355	0.0000
Bank_of_China	776.583	7.520386	0.0000
Bank_of_Tokyo_Mitsubishi	1057.299	8.930031	0.0000
Barclays_Bank	1122.480	9.257345	0.0000
BNP_Paribas	1371.851	10.50958	0.0000
China_Construction_Bank	744.055	7.357044	0.0000
Citibank	1112.997	9.209723	0.0000
Commerzbank	607.813	6.672890	0.0000
Credit_Agricole	1033.494	8.810492	0.0000
Deutsche_Bank	1394.604	10.62384	0.0000
Industrial_Comm_Bank_Chi	994.3060	8.613702	0.0000
ING_Group	922.857	8.254917	0.0000
JPMorgan_Chase	1069.534	8.991471	0.0000
Landesbank	407.546	5.667225	0.0000
Lloyds	723.441	7.253528	0.0000
Norinchukin_Bank	586.848	6.567609	0.0000
Rabobank	515.671	6.210189	0.0000
Societe_Generale	815.392	7.715267	0.0000
Sumitomo_Bank	865.961	7.969204	0.0000
UBS	980.083	8.542280	0.0000
BUBBLES_Effects	360.511	12.02912	0.0000
BURSTING_Effects	-291.297	-10.58209	0.0000
R-squared	0.827517	Mean dependent var	860.4922
Adjusted R-squared	0.733776	S.D. dependent var	642.2643
S.E. of regression	331.3882	Akaike info criterion	14.7186
Sum squared resid	5051633.	Schwarz criterion	15.5407
Log likelihood	-503.8716	Hannan-Quinn criter.	15.0459
Durbin-Watson stat	1.774486		

Our study covers 24 major banks around the world, which were consistently named among the world's 50 largest banks between 1999 and 2010 by Global Finance Magazine. The observation years are 1999, 2002 and 2005. Table 5 gives the results of the linear regression. All regression coefficients are significant, at 5% risk threshold. The P-values are all very close to 0. In this table, we observe the fixed effects, specific to each bank in the study.

These are coefficients α_i described above. These coefficients describe the average amount of assets held by each bank. For example, ABN AMRO Bank of Netherlands holds on average total assets of US $517.3 billion. The total assets of banks can change greatly, depending on whether we are in periods of spectacular increases in asset prices, in periods of tranquility or in periods of drastic fall in assets prices. The coefficient β, called here Bubbles_effects, describes on average how total assets will increase in years when bubbles are present. In presence of speculative bubbles, the total assets held by the largest banks will increase on average by US $360.5 billion. In contrast, during periods of drastic declines in asset prices, the total assets held by the world's largest banks will decrease by US $291.3 billion. Thus, $\gamma = -291.3$ describes the loss in the level of total assets when asset prices fall dramatically. In table 5, γ is called Bursting_effects. Thus, over time, after a business cycle (recovery, recession, recovery), the total assets of the world's largest banks increase by an average of US $90 billion.

6. Conclusion

We have seen that the existence of speculative bubbles in financial markets is a controversy problem. Some well reputed economists claim that even the most famous historical bubbles, e.g., the Dutch Tulip Mania from 1634 to

1637, as well as the worldwide new economy boom in the 1990s can be explained by fundamentally justified expectations about future returns on the respective underlying assets. Speculative bubbles are not ruled out by rational behavior in financial markets. We have also seen that, bubbles likely have real effects on economy. In particular, price spikes on commodities would adversely affect the social welfare of consumers, especially those in developing countries, since households spend a relatively high proportion of their incomes on basic food and energy. From balance sheet, we learn that the effects of bubbles depend on who owns the bubbles assets. The effects of speculative bubbles are intensified when it is banks that hold financial assets. Banks' balance sheets are improving following the expansion of a bubble that sharply increases asset prices, earnings and equity. Balance sheet crises, in which asset prices collapse, pose particular economic challenges. Banks' equity fall abruptly, Banks may not be able to grant as much credit to the economy as in the past. Economic activity will contract, there will be a reduction in investment and production. A financial crisis can then cause an economic crisis. The total assets of banks can change greatly, depending on whether we are in periods of spectacular increases in asset prices, in periods of serenity or in periods of drastic fall in assets prices. In presence of speculative bubbles, the total assets held by the largest banks will increase on average by about US $360.5 billion. In contrast, during periods of drastic declines in asset prices, the total assets held by the world's largest banks will decrease by about US $291.3 billion.

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Notes

Note 1. Irrational exuberance" is the phrase used by the then-Federal Reserve Board chairman, Alan Greenspan, in a speech given at the American Enterprise Institute during the dot-com bubble of the 1990s. The phrase was interpreted as a warning that the stock market might be overvalued. Greenspan's comment was made during a televised speech on December 5, 1996.

Note 2. From 2005 through 2008, US financial market showed a rapid increase in commodity futures prices coupled with greater overall trade volumes and larger positions held by commodity index funds. In 2009, asset prices fell to their lowest valuations in more than 20 years.

Note 3. The Chinese housing market had experienced an unprecedented boom since 2008. The price in Shenzhen had nearly quadrupled from January 2008 to June 2017. Some have described this rise in assets price as a speculative bubble (Zhi, T. et al., 2019).

Note 4. The hypothesis that the expected stock return is constant through time is sometime known as martingale model of stock prices. But a constant expected stock return does not imply a martingale for stock price itself. Recall that a martingale for price requires: $E_t(P_{t+1}) = P_t$, whereas (1.a) and (1.b) imply: $E_t(P_{t+1}) = (1+R)P_t - E_t(D_{t+1})$.

Note 5. We can notice that the second term of the equation (2.b): $B_t = \lim_{T\to+\infty} E_t\left[\left(\frac{1}{1+R}\right)^T P_{t+T}\right]$ satisfies (3.c). P_t is a solution to (1.c) if only if P_t satisfies (3.a), (3.b) and (3.c); there is an infinite number of solutions to (1.c) depending to the form of bubble term.

Note 6. www.independent.co.uk/opinion/commentators/johann-hari/.

Note 7. The amount of equity becomes: $(D) + (\bar{P} - P)N - (\bar{P} - \underline{P})N = (D) - (P - \underline{P})N$

Note 8. Indeed, the total balance sheet liabilities equal: $(A + B + C + D) + (\bar{P} - P)N - (\bar{P} - \underline{P})N = (A + B + C + D) - (P - \underline{P})N$

Note 9. On average, the financing potential of banks increases rather by $12.5 \times (\bar{P} - \mathrm{P})N$, when there is a spectacular rise in prices. Similarly, this financing potential decreases on average by $12.5 \times (\bar{P} - \mathrm{P})N$ in the event of a fall in asset prices. Where P is the asset price without bubbles. P is the fundamental value of asset prices.

Note 10. References to this table can be found in the journal Leschos (2001, 2004) and can be accessed on the sites:
https://www.lesechos.fr/2001/07/le-palmares-2000-des-100-premieres-banques-europeennes

https://www.lesechos.fr/2004/07/le-palmares-2003-des-100-premieres-banques-europeennes

Note 11. https://gfmag.com/award/award-winners/worlds-50-biggest-banks

Note 12. https://gfmag.com/award/award-winners/worlds-50-biggest-banks

Appendix. The World's Top 50 Largest Banks by total Assets

Year 1999		Year 2002		Year 2005	
Rank	**BANK**	**Rank**	**Bank**	**Rank**	**Bank**
1	Deutsche Bank	1	Citibank	1	BNP Paribas
2	BNP Paribas	2	Mizuho Financial Group	2	Deutsche Bank
3	Bank of Tokyo-Mitsubishi	3	UBS	3	HSBC Holdings
4	UBS	4	Sumitomo Bank	4	Barclays Bank
5	Bank of America	5	Deutsche Bank	5	The Royal Bank of Scotland Group

6	Sumitomo Bank	6	Bank of Tokyo-Mitsubishi	6	Bank of America
7	Bayerische Hypo-und Vereinsbank	7	JPMorgan Chase	7	Credit Agricole
8	Norinchukin Bank	8	ING Group	8	JPMorgan Chase
9	Dai-Ichi Kangyo Bank	9	HSBC Holdings	9	Industrial Commercial Bank
10	Sakura Bank	10	BNP Paribas	10	Citibank
11	ABN AMRO	11	Bayerische Hypo-und Vereinsbank	11	Mizuho Financial Group
12	Fuji Bank	12	Credit Suisse	12	Bank of Tokyo-Mitsubishi
13	Credit Agricole	13	Royal Bank of Scotland Group	13	ING Group
14	Industrial Commercial Bank	14	UFJ Holdings	14	China Construction Bank
15	Societe Generale	15	Barclays Bank	15	Banco Santander
16	Dresdner Bank	16	Bank of America	16	Bank of China
17	Barclays Bank	17	ABN AMRO	17	Agricultural Bank of China
18	Sanwa Bank	18	Credit Agricole	18	Lloyds
19	Landesbank	19	Morgan Stanley	19	Societe Generale
20	Commerzbank	20	Societe Generale	20	UBS
21	Industrial Bank	21	Industrial Commercial Bank	21	Groupe BPCE
22	ING Group	22	HBOS	22	Wells Fargo
23	Fortis	23	Fortis	23	Sumitomo Bank
24	JPMorgan Chase	24	Merrill Lynch	24	UniCredit
25	Citibank	25	Commerzbank	25	Credit Suisse Group
26	Bank of China	26	Bank of China	26	Commerzbank
27	Banca Intes	27	Dresdner Bank	27	Goldman Sachs Group
28	National Westminster Bank	28	Norinchukin Bank	28	Banca Intesa
29	Tokai Bank	29	Rabobank	29	Rabobank
30	Credit Suisse	30	Groupe Caisse d'Epargne	30	Norinchukin Bank
31	Abbey National	31	Dexia	31	China Development Bank
32	Lloyds	32	Goldman Sachs Group	32	Nordea Bank
33	Landesbank	33	Wells Fargo	33	Dexia
34	Rabobank	34	DZ Bank	34	Banco Bilbao
35	Agricultural Bank of China	35	Wachocia	35	Royal Bank of Canada (RBC)
36	Asahi Bank, Japan	36	Resona Holdings	36	National Australia Bank
37	China Construction Bank	37	Banco Santander	37	Commonwealth Bank of Australia
38	Halifax	38	Lloyds	38	Toronto-Dominion Bank (TD)
39	Landesbank Baden-Württemberg, Germany	39	China Construction Bank	39	Westpac Banking Corporation
40	Banco Santander	40	Landesbank	40	Bank of Communications
41	DG BANK Deutsche Genossenschaftsbank	41	Agricultural Bank of China	41	KfW
42	Banco Bilbao	42	Banca Intesa	42	Danske Bank
43	First Union	43	Banco Bilbao	43	Scotiabank (Bank of Nova Scotia)
44	Hongkong and Shanghai Banking Corporation	44	Abbey National	44	Standard Chartered
45	Zenshinren Bank	45	Bank One	45	Australia & New Zealand Banking Group
46	Nordea Bank	46	Washington Mutual	46	DZ Bank
47	Washington Mutual	47	Almanij	47	ABN AMRO
48	Resona Holdings	48	CDC Ixis	48	Banque Fdrative du Crdit Mutuel (BFCM)
49	Danske Bank	49	Kredistan	49	Landesbank
50	Commonwealth Bank of Australia	50	Nordea Bank	50	Banco do Brasil

Source : Global Finance Magazine (Note 12).

NB: For reasons of confidentiality, we do not provide details on the banks' balance sheets.