Fama on bubbles

Tom Engsted

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Abstract

Eugene Fama has repeatedly expressed his discontent with the notion of an 'irrational bubble'. However, he has never publicly expressed his opinion on 'rational bubbles'. This is peculiar since such bubbles build naturally from the rational efficient markets paradigm that Fama strongly adheres to. On empirical grounds Fama rejects bubbles by referring to the lack of reliable evidence that price declines are predictable. However, this argument cannot be used to rule out rational bubbles because such bubbles do not necessarily imply return predictability. On data samples that include the 1990s, there is evidence of an explosive component in stock market valuation ratios, consistent with a rational bubble.

JEL Classification: G12
Keywords: Eugene Fama, irrational and rational bubbles, return predictability, explosive stock prices.

[†]*CREATES*, Department of Economics and Business, Aarhus University, Fuglesangs Allé 4, DK-8210 Aarhus V, Denmark. E-mail: tengsted@creates.au.dk. Phone: +45 87165572.

1   Introduction

Two of the three 2013 Nobel laureates in Economics, Robert J. Shiller and Eugene F. Fama, have very different opinions on how prices are set in financial markets. While Shiller believes that psychologically motivated irrationality plays an important role, Fama contends that as a good approximation prices rationally reflect available information such that markets are 'informationally efficient'. In their Nobel lectures these different views are expressed very clearly (Fama, 2014; Shiller, 2014).

This difference in opinion extends to the notion of a 'bubble'. At the center of Shiller's definition of a bubble are "the epidemic spread, the emotions of investors, and the nature of the news and information media." (Shiller, 2014, p. 1487). He argues that irrational bubbles account for a substantial part of movements in financial markets, and that irrational mispricing can extend over several years (see also Shiller, 2000).

Fama (who is rightfully considered the 'father of modern finance'), on the other hand, completely rejects the idea that speculative bubbles are a main feature of asset price movements. Sometimes Fama seems to reject the whole notion of a bubble. On several occasions he has stated that "the word 'bubble' drives me nuts" (e.g. in the blog post "Fama: What's a Bubble?", Fama/French Forum, November 12, 2013) and that nobody has ever formally defined what a bubble is. For example, in a recent interview his response to a question about credit bubbles is: "I don't know what a credit bubble means. I don't even know what a bubble means. These words have become popular. I don't think they have any meaning." (Cassidy, 2010). In his oral Nobel lecture Fama says: "When people use the word 'bubble' they never tell you what they mean." (www.nobelprice.org).[1]

While Fama has clearly expressed his discontent with the notion of an 'irrational bubble', to my knowledge he has never publicly expressed his opinion on 'rational bubbles'. This is peculiar since such bubbles are well-defined, have a large - both theoretical and empirical - literature, and build naturally from the rational efficient markets paradigm. In this short paper I call for Fama's views on rational bubbles and I discuss whether such bubbles are inconsistent with Fama's empirical findings on return predictability. In his Nobel lecture Fama rejects bubbles on empirical grounds by referring to some of his own earlier results showing that expected stock returns are never negative (Fama, 2014, pp. 1474-1475). I point out, however, that since rational bubbles do not necessarily imply return predictability, such results do not rule out rational bubbles. If Fama's rejection only

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[1]To my knowledge, the third of the 2013 Nobel laureates, Lars Peter Hansen, has not publicly expressed strong opinions on bubbles.

refers to irrational bubbles, this rejection is fragile; I point to other empirical findings that may be interpreted that sometimes expected returns are substantially negative. Finally, I point to empirical evidence for an explosive component in stock prices, consistent with the presence of a rational bubble.

2   Rational bubbles and Fama's neglect of them

2.1   Rational bubbles

It will be useful to start by stating the standard definition of a rational bubble and briefly summarize the restrictions that economic theory implies for such a bubble (see, e.g., Campbell et al., 1997). In a world with constant expected returns[2], R, and rational expectations, stock prices are in general determined as $P_t = F_t + B_t$, where F_t is the present discounted value of expected future dividends - called *fundamental value* -,

$$F_t = E_t \sum_{i=1}^{\infty} \beta^i D_{t+i}, \tag{1}$$

where $\beta = (1+R)^{-1} < 1$, and B_t is the rational bubble component that evolves as

$$B_t = \beta E_t B_{t+1}. \tag{2}$$

As seen from (2), the bubble exists today only if it is expected to exist tomorrow; thus it reflects a self-fulfilling expectation.

To eliminate the bubble component, a transversality condition needs to be imposed: $\lim_{k \to \infty} (\beta^k E_t P_{t+k}) = 0$. In this case prices reflect only fundamental value. The interesting thing is that in general economic theory cannot unambiguously rule out such bubbles. The theoretical literature on rational bubbles is too vast to be surveyed here. Some key references are Tirole (1985), Diba and Grossman (1988a), Gilles and LeRoy (1992), and Santos and Woodford (1997).[3] The main result in this literature is that although the restrictions that economic theory puts on such bubbles are quite strict, they cannot be ruled out completely on theoretical grounds. Among the restrictions are that rational

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[2]The constant expected returns assumption is without loss of generality here. In section 2.2 I discuss time-varying expected returns.

[3]Stiglitz (1990) briefly summarizes the early literature on rational bubbles, dating back to the 1960s.

bubbles cannot be negative, if they exist today in an asset they must have existed since trading began in the asset (thus, rational bubbles cannot burst completely and then restart at a later date), and they cannot exist if there is an upper limit on the price (e.g. assets with a fixed value on a terminal date). In addition, rational bubbles in dynamically efficient economies (i.e. the rate of return exceeds the growth rate of the economy) are impossible. But in dynamically inefficient economies, where the rate of return is below the growth rate due to overaccumulated savings, rational bubbles may exist as an equilibrium phenomenon.

A problem with the early literature on rational bubbles is that it is unclear what generates the bubble in the first place. The behavioral finance literature has been more clear on the inception of irrational bubbles, e.g. the *precipitating factors* in Shiller (2000). In the more recent literature attempts have been made to construct models containing both irrational and rational agents. For example, Abreu and Brunnermeier (2003) develop a model where bubbles arise initially due to irrational investors' overconfidence and other psychological biases, and where rational investors find it optimal to 'ride the bubble' for a while due to short sales constraints and asymmetric information. In this model an equilibrium exists where it is optimal for the rational investors to hold assets they believe are overvalued and where there is a risk of not getting out before the bubble bursts. Brunnermeier and Nagel (2004) document that many hedge funds by the end of the 1990s behaved in accordance with the rational investors in this model.

In a similar vein, LeRoy (2004) interprets the stock market boom of the 1990s as a rational bubble. He argues that the strict theoretical arguments against bubbles are implausible and that a looser but also more plausible interpretation of a rational bubble is simply that agents are aware that they trade at bubble-inflated prices and that there are no unexploited profitable trading opportunities, despite the bubble. LeRoy argues against the common view that the boom of the 1990s was mostly irrational. He also emphasizes that since rational bubbles cannot be ruled out on theoretical grounds, it is an empirical issue whether such bubbles exist. These views should have special appeal to Fama who has often emphasized that he is an empiricist and that the empirical evidence does not suggest the existence of profitable arbitrage opportunities. However, to my knowledge Fama has never publicly expressed his views on rational bubbles, see the next subsection.

2.2 Fama on (ir)rational bubbles

There is a kind of neglect in Fama's public statements about asset markets. On the one hand he expresses strong belief in the rational efficient markets paradigm. But on the other hand he is completely silent about the part of that paradigm that deals with rational bubbles.

In his authoritative survey article from 1991 on efficient capital markets, Fama refers to bubbles several times but only the irrational ones (Fama, 1991). "Irrational bubbles" appears 10 times in the article, and in those few additional cases where the word "bubble" appears without "irrational" in front of it, it is clear from the discussions in which it figures that Fama refers to irrational bubbles. There is no mention at all of "rational bubbles". Fama's insistent reference to "irrational bubbles" in the article rather than just "bubbles", indicates that he is aware of the distinction between irrational and rational bubbles (of course he is!) and that he deliberately only wants to discuss the irrational ones. It is peculiar that he in such a detailed survey does not find it relevant to discuss the already by then large literature on rational bubbles. This is even more peculiar since at the time of writing the survey (probably 1989-1990), rational bubbles were an extraordinarily hot topic in the academic literature with both theoretical and empirical inportant contributions being published during the second half of the 1980s, e.g. Tirole (1985), West (1987), and Diba and Grossman (1988a,b). The year before Fama's survey, *Journal of Economic Perspectives* published a symposium on bubbles with several papers and where rational bubbles were widely discussed.

After the 1991 survey it appears that Fama neglected bubbles altogether for many years. For example, in Fama's (1998) detailed scrutinization of the behavioral finance literature, neither irrational nor rational bubbles are discussed; the word "bubble" is not even mentioned. It almost seems that from 1991 to around the outbreak of the recent financial crisis, Fama considered bubbles completely uninteresting and not worth of discussion.

Recently, however, Fama has reentered the discussion of bubbles, mostly in the form of blog posts and interviews (cf. the examples in the Introduction) but in his Nobel lecture there is a subsection labeled "Bubbles" (Fama, 2014). In this lecture Fama discusses policy statements that "seem to define a "bubble" as an irrational strong price increase that implies a predictable strong decline. This also seems to be the definition implicit in most recent claims about "bubbles"" (p. 1475). Thus, Fama confines the discussion to irrational bubbles. As with his 1991 survey, Fama does not discuss the possibility that

stock market run-ups and subsequent declines could reflect *rational* overvaluation.

In the Nobel lecture Fama rejects bubbles on empirical grounds with reference to his own earlier research: "there is no statistically reliable evience that expected stock returns are sometimes negative. Fama and French (1987) find that predictions from dividend yields of negative returns for market portfolios of US stocks are never more than two standard errors below zero. Fama and Schwert (1977) find no evidence of reliable predictions of negative market returns when the forecast variable is the short-term bill rate." (Fama, 2014, pp. 1474-1475).[4] He further states: "But the available research provides no reliable evidence that price declines are ever predictable", and this "seems sufficient to conclude that "bubble" is a treacherous term" (p. 1475). Fama also points to the fact that stock prices seem to forecast real activity and he concludes: "All this is consistent with an efficient market in which the term "bubble", at least as commonly used, has no content." (p. 1475).

Fama's conclusion regarding the lack of negative expected returns contrasts with other evidence. In January 2000 Robert Shiller concluded that a scatter diagram of long-term returns against the price-earnings ratio "suggests substantially negative returns, on average, for the next ten years" (Shiller, 2000, p. 13). Similarly, according to Campbell and Shiller (2001): "Linear regressions of price changes and total returns on the log valuation ratios suggest substantial declines in real stock prices, and real stock returns below zero, over the next ten years." In any case, even if Fama's claim (no predictable price declines or negative returns) is true, it does not constitute evidence against *rational* bubbles. A rational bubble in a model with constant expected returns (like the model in section 2.1) does not imply predictable price declines. The bubble may have a positive probability of bursting every period and it may burst almost surely within a finite time period, but still expected returns are constant and it is impossible to predict when and how the bubble will burst (Blanchard, 1979; Diba and Grossman, 1988a; Campbell et al., 1997).

Some studies - including Fama's own, e.g. Fama and French (1988) - find a small but statistically significant predictable component in short-horizon stock returns, and that this predictability increases in magnitude when the return horizon increases. In most of these studies dividend yields appear as an important predictive variable. Cochrane

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[4]The reference to Fama and French (1987) lead to (in the References) a paper by Fama and French published in the Journal of Business in 1987. I suppose this is an error and that the proper reference should be Fama and French's paper "Dividend yields and expected stock returns" published in the Journal of Financial Economics in 1988. This latter paper does not, however, figure in the References in Fama (2014).

(2008) presents an up-to-date account on these findings. Fama's interpretation of the evidence is that expected returns vary over time as a reflection of rational time-varying risk-premia; according to Fama return predictability is not due to (irrational) bubbles. However, Engsted et al. (2012) challenge the time-varying risk-premia explanation of return predictability. They show in a simulation study that in a finite sample a periodically and partly collapsing rational bubble of the Evans (1991) type - in which expected returns are constant - produces exactly the short-horizon return predictability found in the return predictability literature that uses dividend yields as a predictive variable. Thus, the kind of return predictability that has been found in the empirical literature does not in itself rule out rational bubbles.

As emphasized earlier, Fama is an empiricist. What he cares about are the empirical facts. However, to my knowledge Fama has never addressed or otherwise commented on the large empirical literature on rational bubbles. There are several econometric tests for rational bubbles (West, 1987, is an early well-known example; Flood and Hodrick, 1990, and Gurkaynak, 2008, critically discuss this literature). Some of these tests suffer deeply from the joint hypothesis problem that Fama pointed to many years ago (Fama, 1970): tests of market efficiency are also tests of an underlying equilibrium model. This also holds for tests for rational bubbles where the underlying equilibrium model may be misspecified. In general, strong price increases are not necessarily due to a bubble but could in principle reflect expectations of strong future earnings and dividends or a large fall in risk-aversion and/or risk-premia.

However, there is a special feature of a rational bubble that makes it less susceptible to the joint hypothesis problem: it has an explosive root in its autoregressive representation, cf. Equation (2). Thus, since it is difficult to argue for explosiveness in expected dividends, earnings, or returns, the finding of an explosive component in prices would be a strong indication of the presence of a rational bubble. Early econometric studies do not find explosive roots in stock prices (Diba and Grossman, 1988b; Craine, 1993), but recent studies that include data from the 1990s indeed find direct evidence of explosiveness in stock prices but not in dividends, e.g. Engsted (2006), Phillips et al. (2011) and Engsted and Nielsen (2012), and an explosive root is contained in the confidence interval for the log dividend-price ratio's largest autoregressive root reported by Campbell and Yogo (2006).[5]

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[5]Of course, explosive growth in expected 'fundamentals' cannot be ruled out for individual stocks and may well have characterized some of the IT stocks in the 1990s. However, the recent empirical literature finds no evidence of *common* explosive components in long-term broad stock indices and their associated dividends or earnings; the explosive component in stock prices is not found in standard 'fundamentals'

A simple illustration of these results is an OLS estimation of the AR(1) coefficient, γ, in the model for the price-dividend ratio: $(P/D)_t = \alpha + \gamma(P/D)_{t-1} + \varepsilon_t$. Using the monthly S&P Composite Stock Price Index and associated dividends from Shiller (2000) (available at www.robertshiller.com) produces an estimate of $\widehat{\gamma} = 1.008$ (0.003) in the sample 1881:02 - 2000:04, where the number in parenthesis is the standard error. For the post war sample 1948:01 - 2000:04 the estimate is $\widehat{\gamma} = 1.012$ (0.003). Using the cyclically adjusted price-earnings (CAPE) ratio instead of the price-dividend ratio produces similar results, as does the use of annual instead of monthly data.[6] Thus, by including data from the 'dot-com bubble' period there is clear evidence of explosiveness in stock market valuation ratios. Taking into account the well-known finite-sample downward bias of $\widehat{\gamma}$ (cf. Kendall, 1954) strengthens this conclusion.

Fama (2014, pp. 1475-1476) concludes that "(i) the absence of evidence that price declines are ever predictable, and (ii) the evidence that the prime "bubble" candidates seem to be associated with rather impressive market forecasts of real activity are sufficient to caution against use of the "bubble" word without more careful definition and empirical validation." Again, Fama seems to be referring to only irrational bubbles. In the rational bubbles literature a "bubble" *is* carefully defined and several empirical validation studies exist.

3   Conclusions

Being the father of modern finance, a Nobel laureate, and probably the most authoritative source on empirical asset pricing, it is a hole in our common knowledge that we do not know Fama's views on rational bubbles. It would be interesting to learn what Fama thinks of the empirical evidence for and against rational bubbles (as opposed to irrational bubbles). More generally: when Fama rejects the whole notion of a bubble, does this rejection also include rational bubbles?

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variables.

[6]In the monthly data I have chosen the end date to be 2000:04 which corresponds to the peak of the market associated with the 'dot-com bubble'. The finding of an explosive root is not highly sensitive to this choice. An explosive root is found for all end dates between 1997:07 and 2002:05.

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