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Joseph E. Stiglitz

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Symposium on Bubbles

Joseph E. Stiglitz

The papers in this symposium represent the divergent views of economists on an important issue: the extent to which prices of assets represent “fundamental” values. If asset prices do not reflect fundamentals well, and if these skewed asset prices have an important effect on resource allocations, then the confidence of economists in the efficiency of market allocations of investment resources is, to say the least, weakened.

The problem of determining the fundamental value of an asset to be held for an extended period of time has three parts: first, the problem of estimating the returns received over time (the rent on the land, the dividends on the stock); second, the problem of estimating the terminal value the asset will have at the end of the period; and third, the problem of deciding upon the discount rates to be used for translating future returns into current values.

If the expectations of investors change in such a way that they believe they will be able to sell an asset for a higher price in the future than they had been expecting, then the current price of the asset will rise. While the papers in the symposium present different formal definitions of what a bubble is, the basic intuition is straightforward: if the reason that the price is high today is *only* because investors believe that the selling price will be high tomorrow—when “fundamental” factors do not seem to justify such a price—then a bubble exists. At least in the short run, the high price of the asset is merited, because it yields a return (capital gain plus dividend) equal to that on alternative assets.

In the 1960s, the golden years of growth theory, several economists asked whether market forces could ensure that bubbles do not arise, or that every bubble must eventually be broken. Focusing on models where individuals had “rational expecta-

tions” and no uncertainty (what were called perfect foresight models in those days) Hahn (1966), Samuelson (1967), Shell-Stiglitz (1967) and others argued that in the absence of a complete set of futures markets, extending infinitely far into the future, no market forces could ensure that the economy would not set off on a path with a bubble. In many of these models, every bubble eventually broke, so that a sufficiently long-lived speculator could make a profit and thereby puncture the bubble. But given any limit to the life of speculators, some speculative bubbles could always survive.

The underlying issue in much of this work was the movement of asset prices over time. If the asset price increased more slowly than the discount factor, eventually the terminal price became of negligible importance as viewed from today. Under such circumstances, the value of the asset had to be just equal to the discounted value of the stream of returns it generated, and no bubbles could exist. But as long as no one in the economy has an infinite planning horizon, there was nothing to ensure that this condition on prices (called the transversality condition) would be satisfied.

This condition could be looked at another way. In efficient economies, the rate of interest exceeds (or equals) the rate of growth. If, for some asset, the rate of price increase equals (or exceeds) the rate of interest, then the share of the value of all assets accounted for by this asset would grow without bound, a condition inconsistent with long run equilibrium. Only in the special boundary case of an economy with a growth rate equal to the interest rate might such a bubble persist.

Occasionally, the term “bubble” takes on another meaning. Is it possible that differences in beliefs generate different dynamic paths—with those beliefs having *real* effects which are self-justifying? In other words, are there “boot-strap equilibria” where the price of an asset today is high because the market believes that the price will be high in the future, but those beliefs result in changes in the underlying fundamentals which might justify the eventually higher price of the asset? To put the matter somewhat differently, are there multiple paths to the economy, all of which are consistent with rational expectations and all of which satisfy the transversality condition? Numerous studies (for example, Shell, Sidrauski, and Stiglitz, 1969; Stiglitz 1973) have by now established that it is easy to construct simple and plausible models with this property. In these models, bubbles need never break. From this perspective, bubbles are simply an intertemporal manifestation of a general lesson: markets may have multiple equilibria.

The theoretical debate on these issues took a curious twist in the 1970s. Up to that time, economists had looked for assumptions under which the economy converged to some stable long run equilibrium for a wide range of initial asset prices. Since futures markets were not complete enough to ensure that the transversality condition was satisfied, models in which there was a unique (or a few) path(s) satisfying that condition were viewed as suspect. Shell, Sidrauski, and Stiglitz, for instance, constructed a rational expectations model with money in which the economy converged to the long run equilibrium from a variety of initial conditions.¹ But then the idea of

¹Equivalently, there were many stable equilibrium paths corresponding to any initial capital stock and money supply, each with a different initial price of goods relative to money.

what was a “good” model shifted to infinitely-lived representative agent models. Models in which a single path satisfied the transversality condition were deemed to be good, because it meant that there was a determinate equilibrium price today, and no bubbles existed.

The debate between these different modelling approaches was never joined: individuals are not infinitely-lived, and the market institutions which would ensure that the transversality condition be satisfied do not exist. Unless one accepted the assertion that the economy acted *as if* there were futures markets extending infinitely far into the future as an adequate answer, the questions posed by Samuelson, Hahn and Shell-Stiglitz were not addressed, but simply ignored.

Even if (or when) it can be shown that bubbles will eventually burst—and individuals know that they will eventually burst—does this mean that they will burst right away? If all speculators know that in the year 2000, that a bubble for land prices in Los Angeles is going to break, then it will break in the year 1999, for no one in that year will pay the high price of land knowing the next year it will decline. But if they know that it will break in 1999, it must break in 1998. Reasoning like this, it becomes clear that bubbles cannot exist. Or can they?

In this symposium, Andrei Shleifer and Lawrence Summers argue that as long as uncertainty exists about when the bubble is going to break, and as long as investors are short-lived and risk averse, markets will not be “fully arbitrated,” and bubbles need not be completely eliminated. The first two hypotheses—the presence of uncertainty, and the limited lifetime of speculators—seem unquestionable. And even if some risk-neutral or risk-loving speculators do exist, they are likely to have only a limited effect on markets because they are likely to have only limited access to capital. The assumption of limited access to capital seems eminently in accord with observations concerning capital markets, and consistent with theories of capital markets under asymmetric information (Stiglitz and Weiss, 1981).

Thus, just as Grossman and Stiglitz (1980) had earlier shown that as long as information was costly, capital markets could not be efficient and perfectly arbitrated—there was an equilibrium amount of disequilibrium—Shleifer and Summers argue that as long as individuals are risk averse, a bubble may persist for a very long period of time, even if arbitragers recognize the existence of the bubble and believe that it will eventually disappear.²

Several papers in this symposium find that testing for the presence of a bubble is no easy matter. Part of the difficulty is that when data extend over a limited period of time, the initial price may well be consistent with the terminal price plus interim

²Other recent studies have shown how, with imperfect and costly information, “rational” markets may actually create noise, that is, deviations from fundamentals. Allen and Gorton (1989) describe a market with a finite number of rational traders with finite wealth, who hire portfolio managers and reward them with an optimal incentive scheme, which they show effectively takes the form of a call option. In their model, asset prices can deviate from their fundamental values and be subject to bubbles. In product markets, it is well-known that when information is costly, not only may there be imperfect arbitrage, but the market may actually in effect create noise. For a review of this literature, see Stiglitz (1989).

returns. The question is, how do economists test whether the terminal price can be justified by fundamentals, without having data extending infinitely far into the future? Peter Garber argues that in several of the “classic” cases of bubbles—including the tulip bulb mania and the Mississippi bubble—prices may indeed have been consistent with market fundamentals from the viewpoint of those who had to make investment decisions in those markets at the time. Robert Flood and Robert Hodrick introduce the recent econometric work that has aimed at resolving these issues, and conclude that no study has yet managed to solve the problem of separating bubble movements from the possibility that the underlying fundamental model is misspecified.

Given these difficulties, some researchers have looked for indirect evidence; for instance, can the variation in asset prices be reconciled with variations in the (expectations of) future returns? Shiller, in his by now classic paper (1981) argued that stock prices were far more volatile than expectations concerning the underlying dividend streams would warrant. In his paper in this symposium, he extends that analysis to other markets and answers some of the criticisms that have been raised concerning his earlier work.³

Shleifer and Summers point to other evidence—for instance the findings of French and Roll that stock market volatility was reduced when the stock market was closed on Wednesdays in the 1960s—that suggests that prices do not just reflect fundamentals.

After all, even a marked decline in the price of an asset need not be interpreted as the breaking of a bubble. The price of oil today depends in part on a speculative element—the chance of developing a petroleum substitute which will markedly reduce the scarcity value of oil. A sharp decline in the price of oil *could* be related to new information concerning the likelihood of such a development in the future. It seems plausible to me, however, to interpret marked price declines which occur without any apparent new information as the breaking of a bubble.

To nonspecialists, the dramatic collapse of the stock market in October 1987 provides all the evidence that is needed to prove the existence of bubbles: otherwise, what event led to a downward revision of the value of the U.S. capital stock by a quarter within hours? While the stock market crash of October 1987 and the tumble of October 1989 remain subjects of ongoing research,⁴ similar questions arise in interpreting the stock market boom of the 1920s and the crashes of 1929. In this symposium, Eugene White provides a convincing interpretation of the stock market boom and bust of the 1920s as a speculative bubble, by carefully ruling out possible alternative explanations of the changes in prices.

In a sense, the possibility of persistent bubbles should not come as a surprise, given the numerous instances of less subtle forms of capital market inefficiency that

³Among the more interesting interpretations of the Shiller paradox is that of Grossman and Shiller (1981), who attempt to see if variations in the discount rate can account for the variability in current price.

⁴The Summer 1988 issue of this journal contains a symposium on the stock market crash of 1987.

have been uncovered, or rediscovered, in recent years.⁵ For instance, Tom MaCurdy and John Shoven (1990) have shown that the equity-premium puzzle—the fact that equities yield a substantially higher return than bonds—almost surely cannot be explained by risk aversion. For long holding periods, for every date of purchase since 1926, investors would have been better off purchasing a diversified equity portfolio than a bond portfolio.

For those persuaded of their presence and pervasiveness, these bubble-like phenomena present a challenge to the foundations of the economics theory of rational individual behavior and general equilibrium (including macroeconomic) models based on those foundations. For those not persuaded of the existence of bubbles, the challenge is to provide persuasive interpretations of events like the Great Depression, the stock market crash of October 1987, and other apparent bubbles.

■ *Thanks to Kenneth Rogoff for his work as Associate Editor in stimulating the papers in this symposium.*

⁵Some of these have been discussed in the “Anomalies” column in past issues of this journal. Similarly, it is hard to reconcile much of the trading on the stock market with rational, risk averse individuals. If individuals simply held the market, they would do just as well as the market—neither better nor worse. On average, those who speculate (not holding the market) also do just as well as the market, but there is greater variability to their returns. Trading might be justified if individuals were purchasing portfolios, say, to “insure” their human capital, but there is little evidence that this is an important source of trades in the stock and futures market. See Stiglitz (1982), Tirole (1982), and Milgrom and Stokey (1982).

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