Theories of aggregate stock price movements

#4

A comparison between the demand-side view and the supply-side view of the stock market; no simple theory works.

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Most research in finance has concentrated on explaining the relative price movements of individual securities rather than on explaining movements in the stock market as a whole. One reason for this concentration of effort is that we have vast amounts of data on individual firms, but we have only one stock market as a whole. We have all seen the available data for the U.S. Some of us have it displayed on wall charts in our offices. Those are all the data there are.

Although the available data are limited, the movements in the stock market as a whole are extremely important for movements in individual stocks. We do not want to forget, for example, that prices of stocks soared in the 1920s and then plunged dramatically into the early 1930s. How much do we understand with any confidence about this and other events?

Recent advances in theoretical finance and in statistical methods have suggested fresh ways of looking at our limited data on the aggregate stock market. The advances in theoretical finance are applications of sound economic theory to the study of financial markets, as developed by Merton [1971], Lucas [1978], Cox, Ingersoll, and Ross [1978], and others. The notable recent developments in this theory are the "consumption beta" models of Breeden [1979] and Rubinstein [1976]. The advances in statistical methods are developments in the theory of stochastic processes and spectral analysis. The statistical advances have taken place largely from the side of mathematicians, theoretical statisticians, physical scientists, and engineers over the last 30 years. They have produced a new "language" for handling random data.

Drawing on recent work of my own [1981a, 1981b, 1982], Sanford Grossman and I [1981] have used some of these recent advances to re-examine the behavior of the aggregate stock market. Here I shall discuss some theories we considered that have important testable implications for stock prices. These theories have also been studied by LeRoy and Porter [1981], Hansen and Singleton [1981], and others. The theories represent points of departure for the emerging "intertemporal substitution" school of macroeconomics.

WHAT MAKES PRICES CHANGE?

By way of introduction to the theories, it is worthwhile first to recall a basic economic principle that relates to *any* price change. Let me make the point with regard to a specific example. Consider the Great Depression of the 1930s, with reference to a commodity that we may find easier to understand than the stock market: food.

In the Great Depression, the price of food fell very low relative to the prices of other commodities. Between 1929 (the stock market peak) and 1932 (the stock market bottom), the Consumer Price Index for food at home fell 35%, while the Consumer Price Index for all items fell only 20%.[1] According to the Bureau of Labor Statistics, the price of a pound of chuck roast fell from 31¢ to 18¢, a pound of butter from 56¢ to 28¢, and a pound of coffee from 48¢ to 29¢.[2]

The reason for the low price of food has never been controversial. Farmers were not generally unemployed in the Depression, since they were largely

1. Footnotes appear at the end of the article.

self-employed, and they continued to produce more or less as they did in better times. Incomes of consumers were so low, however, and so many were unemployed, that the demand for food at the original price fell. If food prices had not fallen so far, people would have tried to get by with much less beef, butter, and coffee. This is simple textbook economics. Thus, the prices of these abundant commodities fell further than the prices of other commodities whose production fell more sharply in the Depression. People ended up eating fairly well in those years — real consumption of food fell only 7% between 1929 and 1932 — and doing without things with prices that did not fall so much, such as new clothes (real consumption of clothing and shoes fell 21% between 1929 and 1932).[3]

Demand

The same general explanation might also be offered for the decline in the price of corporate stock. I will refer to this as a demand-side theory, since it relies on changing demand for a fixed supply. We may regard corporate stock as a long-term savings medium that one may choose to do without in a depression, hoping to replenish one's savings in better times. There is thus plausibly a decline in demand for shares in an economic downturn.

The decline in demand for shares may not be accompanied by a decline in supply. Corporate shares are a claim on the future profits of business from now to infinity. The supply of such shares cannot contract suddenly to reflect the decline in demand. If a single individual wishes to cash in his shares on a "rainy day," to consume the proceeds to maintain his standard of living, he can always do it by selling his shares to someone else. When everyone has a rainy day on the same day, however, there is no one to buy the shares (or the assets of the corporation), so the price must fall.

If we could *physically* liquidate corporations, we could reduce the supply in a depression. While corporations could dismantle their factories and send out a drill press to stockholder A or a section of conveyor belt to stockholder B, most people have no use for these things in pieces. Since physical liquidation is impossible, people were going to end up holding roughly the same shares in 1932 as they had in 1929, just as they were eating roughly as well in 1932 as they had been in 1929. The only way this could have been an equilibrium is if the prices of food and stocks had fallen relative to other prices.

The demand-side stories for food and for stock sound similar and thus perhaps equally plausible. Sanford Grossman and I [1981] proposed that the demand side might account for the majority of stock market movements, not just that of the Great Depression. The demand-side story, however, is strikingly contrary to conventional wisdom. There seem to be a couple of competing stories that are so attractive, at least superficially, that they have received all the attention.

And supply

The explanation of market fluctuations that seems to have dominated most discussion is what might be called a "supply-side" story. By this explanation, the main reason for the decline in stock prices in the Depression was the decline in expected future profits and hence of the expected future supply of dividends.

The theory sounds plausible. Certainly the outlook for profits must have declined in the Depression; the only question is whether this is enough to account for the market decline. In its extreme form (and many people seem to accept the extreme form!) the theory implies that stock prices move *only* because of new information about future dividends. The theory is generally expressed today in conjunction with the assumption of efficient markets. Thus, real (i.e., corrected for inflation) stock prices equal the present value (with a constant discount factor) of optimally forecasted future real dividends.

The principal argument for the supply-side story has been that it is consistent with the efficient markets (or "random walk") evidence that there is no way to judge whether it is a good time or bad time to enter the market and therefore expected returns will always be the same. On the other hand, as I have argued elsewhere, strong evidence for this form of the efficient markets hypothesis is actually not available despite frequent vague references to the "vast literature" on efficient markets [1981a, 1981b].

I will call a third theory of stock market fluctuations a "market fads" theory. According to this theory, stock prices move because people tend to be vulnerable to waves of optimism or pessimism and not because of any economically identifiable shocks either to demand or supply. Statements by influential figures or highly publicized events have impact on the market far beyond their true import. Casual evidence suggests there may well be an element of truth to such a theory, and that is why I mention it here. There is, I think, an emerging interest by economists in psychology and irrational behavior, illustrated by the recent discussions by Arrow [1982]. Nevertheless, at this point there is little concrete to say about such a psychological theory.

The discussion below will concentrate exclusively on what I have called the extreme "supply-side" and extreme "demand-side" theories. The discussion will be exploratory and unrigorous, aimed at helping the reader gain an impression as to the dimensions of the theories, rather than at evaluating a formal model. The truth may well be a blend of all three theories. The blending will be left to the reader.

THE "SUPPLY-SIDE" THEORY THAT PRICE MOVEMENTS ARE DUE EXCLUSIVELY TO INFORMATION ABOUT FUTURE DIVIDENDS

The extreme supply-side efficient markets theory of stock prices makes real stock prices the present value of expected future real dividends with a constant discount rate. By "expected," we mean the true optimal forecast of the future dividend. By "real," we mean the nominal value divided by a general price index. The expression for a stock price then is:

$$P_t = \sum_{k=1}^{\infty} E_t \frac{D_{t+k}}{(1+r)^k}, \qquad (1)$$

where P_t is the real ex dividend price of a share at time t, $E_t(D_{t+k})$ is the mathematical expectation conditional on information at time t of the real dividend accruing to a share at time t + k, and r is the real discount rate. If the theory is to attribute all price changes to information about future dividends, then r must be constant through time. If r changed through time, then real stock prices might move even in the face of constant real dividends.

We should first be clear that the constant discount rate is not as implausible as it may at first seem. Nominal interest rates are observed and certainly do change through time. Expected real interest rates, equal to nominal rates minus expected inflation, are not directly observed. They *are* probably less variable than nominal interest rates, since nominal interest rates vary due to a changing inflation premium. Even so, the assumption that real discount rates are *absolutely* constant seems unlikely.

The point of considering the model (1), however, is that most people would probably attribute only a small portion of the total variance of stock prices to changes in real discount rates. The standard deviation of the annual percentage change in the real Standard and Poor's stock price index is on the order of 20%. In a "typical" year, the real value of the index might easily change up or down by 20%, and it is not uncommon to see changes of ±40% in one year. Most people would not attribute such changes to changes in rates of discount.

In any event, the model (1) has had a great many promoters who, at the very least, would offer as an explanation of a particularly large movement in stock prices that some new information about future earnings must be responsible. I have written papers to try to show that this model does not seem supported by the data [1981a, 1981b], and that stock prices appear to be too volatile for this theory.

One particularly striking way of presenting the evidence can be had by rewriting the model (1) in the form:

$$P_t = E_t(P_t^*), \qquad (2)$$

where:

$$P_t^* = \sum_{k=1}^{\infty} \frac{D_{t+k}}{(1+r)^k}. \qquad (3)$$

The variable P_t^* is the "perfect foresight" or "ex post rational" stock price, which is the present value of actual future dividends. We can derive expression (2), which says that price is the optimal forecast of the perfect foresight price, just by moving the expectation sign in (1) to the left, a legitimate operation in any linear model. We do not know dividends out to infinity, but we do have roughly a century of dividend data on Standard and Poor's stocks. One can therefore rewrite (3) in the form:

$$P_t^* = \sum_{k=1}^{1981-t} \frac{D_{t+k}}{(1+r)^k} + \frac{1}{(1+r)^{1981-t}} P_{1981}^*, \ t \le 1981. \qquad (4)$$

If we replace P_t^* by the actual price P_{1981} (which is by the model (1) the best guess available to P_{1981}^*), then we can get an approximation P_{st}^* to the ex post rational price:

$$P_{st}^* = \sum_{k=1}^{1981-t} \frac{D_{t+k}}{(1+r)^k} + \frac{1}{(1+r)^{1981-t}} P_{1981}, \ t \le 1981. \qquad (5)$$

This P_{st}^* is a good approximation to the true P_t^* for t much less than 1981, because then the last term in (5) is heavily discounted and therefore small. The subscript s refers to the supply-side theory. We will contrast this below with a demand-side theory P_t^*.

I computed P_{st}^* with Standard and Poor's data on dividends converted to real terms with the consumption deflator for nondurables and services, using for r the average real return on the market over the sample period: r = 7%. This is plotted along with the real Standard and Poor's price index P_t in Figure 1.

It should be obvious that P_t and P_{st}^* meet in 1981 by construction. Before that date, however, the two series are quite divergent. It appears that P_{st}^* behaves much like a simple growth trend, while P_t oscillates wildly around it. The reason that P_{st}^* is so smooth and trendy is that it is basically a weighted moving average of dividends, and moving averages serve to smooth the series averaged. Moreover, real dividends are themselves a fairly stable and trendy series.

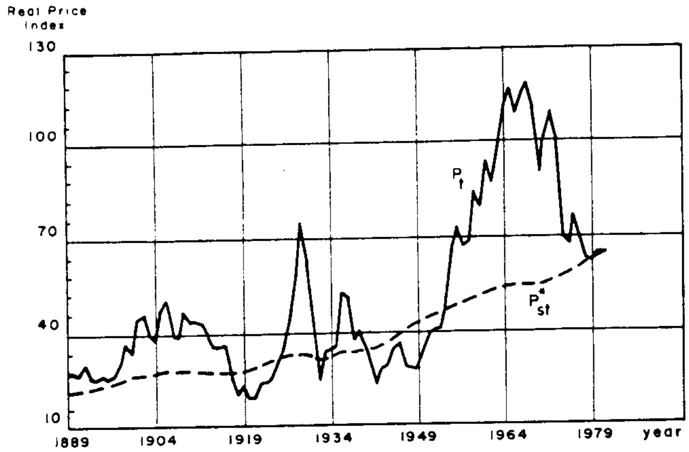

FIGURE 1. *Real Stock Price Index and Ex Post Rational Counterpart Based on Real Dividends, 1889-1981*

P_t: Standard and Poor's Composite Stock Price Index divided by the consumption price index. P^*_{st}: Ex post rational or perfect foresight stock price as given by expression (5) in the text, where D_t is the dividend per share adjusted to the index for the Standard and Poor's series (before 1926 from Cowles [1938]), divided by the consumption price index. The consumption price index here and elsewhere in this paper is the deflator for consumption on nondurables and services from the national income accounts (before 1929 from Kendrick [1961]).

Figure 1 shows that actual dividend movements of the magnitude "forecast" by price movements never appeared in nearly a century of data. We *might* have observed big movements in P^*_{st} that corresponded to big movements in P_t and that would mean that movements in P_t really did appropriately forecast movements in future dividends. On the other hand, this just did not happen. Look, for example, at the stock market decline of the Great Depression, from 1929 to 1932. P^*_{st} did go down then, but only very slightly, far less than the decline in P_t. The reason is that real dividends declined substantially only for the few worst years of the Depression. These few lean years have little impact on P^*_{st}, which depends in effect on the longer-run outlook for stocks.

THE "DEMAND-SIDE" THEORY THAT PRICE MOVEMENTS ARE DUE EXCLUSIVELY TO VARYING RATES OF DISCOUNT

We now consider for the sake of argument the extreme opposite of the supply-side theory of the preceding section. Suppose real dividends are always expected to grow perfectly along a steady trend path. Thus, the supply of real income provided by shares is never expected to vary. Of course, actual real dividends do vary. We are assuming here that observed fluctuations in real dividends are always viewed as transient and never as a reason to change one's forecast of future dividends.

Thus, $E_t(D_{t+k}) = f(t + k)$ where f(t) is a trend line. We will suppose the trend is of the constant growth rate variety: $f(t) = f_0(1 + g)^t$, where g is the growth rate of real dividends. Suppose g = 0.011, which is the historical growth rate of real Standard and Poor's dividends (1.1% per year).

We now allow the *demand* for shares to vary through time, as a function of the level of aggregate demand in the economy. There are many possible ways to model such demand fluctuations. The way Sanford Grossman and I did this [1981] is, I think, particularly appealing in that it accords well with basic economic theory.

By way of introduction, let us review our basic economic theory, using a well-known device called a two-period consumption diagram, which we can examine in Figure 2. On the vertical axis, we measure the amount consumed at time t, while on the horizontal axis we have the amount consumed at time t + 1. The individual has income Y_t at time t and Y_{t+1} at time t + 1.

How does the rational individual choose how much to consume and how much to save? He or she could consume at point A on the diagram by consuming all income in both periods. He could also decide to save something at time t, invest it until time t + 1, and then consume both his income and the value of the investment at time t + 1.

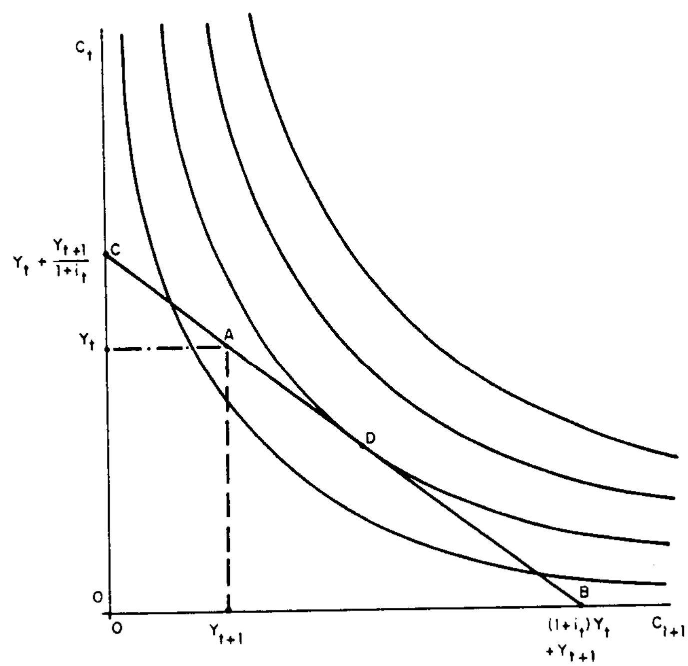

FIGURE 2. *Two-Period Consumption Diagram*

C_t is an individual's consumption in year t, C_{t+1} his or her consumption the following year. Y_t is his income in year t, Y_{t+1} his income the following year. The point A corresponds to consuming income each year, neither saving nor dissaving. If the 1-year interest rate is i_t, his budget constraint is the line segment BC. He will choose to consume at point D, at the highest indifference curve consistent with his budget constraint, a point of tangency between the budget constraint and indifference curve. Since the point D implies less consumption this year than point A implies, the individual with indifference curves as shown here chooses to save this year. Or, to put it differently, the higher the interest rate, the flatter the slope of BC, and the less the amount of this year's consumption.

Suppose the return on the investment asset is i (e.g., i = 0.05 or 5%). He could, if he saved all his income at time t, consume $(1 + i)Y_t + Y_{t+1}$ at time t + 1. This point is denoted B on the diagram. Alternatively, he could borrow against his future income to consume more at time t. If he can also borrow at rate i, he could consume as much as

$$Y_t + \frac{Y_{t+1}}{1 + i}$$

at time t and use all his income at time t + 1 to pay back the loan. This point is denoted C on the diagram. Clearly, he can choose *any* point along the straight line connecting B and C, as well as points A, B or C. This line is therefore known as his "budget constraint."

The person chooses the point along his budget constraint that he or she likes best. One way of representing this point uses what are called indifference curves, several of which are shown on the diagram. These curves are just graphical representations of a person's preferences, albeit in a form that most readers will find unfamiliar. The person could express his "utility" or "happiness" in terms of the consumption he enjoys. Indifference curves are then defined as contours of his utility function, much as isobars on weather maps are contours representing air pressure. He is indifferent between any two points of any one indifference curve, i.e., his utility is constant along the curve. On the other hand, he always prefers a point on a higher indifference curve to a point on a lower indifference curve. Anyone who can state his preferences will always be indifferent among *some* alternative consumption patterns, and these patterns are represented by the indifference curves. He will then choose the highest indifference curve consistent with his budget constraint.

On the diagram he will choose point D, where an indifference curve is tangent to his budget constraint. At such a tangency, the slope of the budget constraint line must equal the slope of the indifference curve. It should be obvious from the diagram that utility maximization implies equality of these slopes.

We can also restate this result in terms that those who took Economics I in college may remember (although those who don't remember may not be helped by this restatement!). We call the slope of the indifference curve the "marginal rate of substitution" between consumption at time t and consumption at time t + 1. We will use the symbol S_t to denote this slope. S. is the rate at which the individual is freely willing to exchange small amounts of consumption at time t for small amounts of consumption at time t + 1. We call the slope of the budget constraint line (which is, disregarding the minus sign, $1/(1 + i_t)$) the marginal rate of transformation between consumption at time t and consumption at time t + 1. It is the rate at which the individual can, in the market place, exchange small amounts of consumption at time t for small amounts of consumption at t + 1 by foregoing consumption at time t, investing money at interest rate i until t + 1, and consuming the proceeds.

Now, if the individual is maximizing utility, it ought to be true that the rate at which he is *willing* to exchange consumption at time t for consumption at time t + 1 equals the rate at which he *can* exchange them. Thus, the marginal rate of substitution *must* equal the marginal rate of transformation. If you can find your crib sheets for the Economics I final examination, look for the equation MRS = MRT. And you thought you'd never see this again!

In symbols, the equality of the marginal rates of substitution and transformation can be written $1/(1 + i_t) = S_t$. We like to rewrite this in a slightly different way by multiplying both sides of the equation by $1 + i_t$ to give $(1 + i_t)S_t = 1$. The reason for writing it this way is that it is then very easy to incorporate uncertainty about the budget constraint into the analysis. People do not know the exact position of the budget constraint at time t, because they do not then know their future income, Y_{t+1}, nor do they know exactly the real return, correcting for inflation, on their investment i_t.

THE CONSUMPTION BETA

The point is that, with uncertainty, maximization of expected utility implies under certain assumptions that $E_t((1 + i_t)S_t) = 1$ or, loosely speaking, that $(1 + i_t)S_t$ equals, on average, one. Breeden [1979] showed that this relation implies a "consumption beta" relation. The expected return on an asset depends only on its "beta," but the beta is not determined by the covariance of the asset with the market portfolio. Rather, the beta is determined by covariance with S and, by implication, with consumption.

The consumption beta relation has a simple intuitive interpretation. High beta stocks are stocks whose return tends to be very high when consumption is increasing and very low when consumption is decreasing. These are stocks, then, that fail you when you need income most, in a depression, and that do well when you need income the least, in prosperous times. Such is the essence of true risk. In contrast, a stock with a negative beta would tend to do well in a depression and poorly in prosperous times. Such a stock would be in great demand, and thus the market would bid up its price until its expected return was low. If in fact the aggregate stock market has a high average real return (with the 91 years of data here, 7.2% a year) and short-term real interest rates a low average real return (the 4- to 6-month prime commercial paper return averaged 1.8% a year over the same period), we can explain this because stocks do tend to do better than short debt in booms and worse in busts. The consumption beta models are actually a natural improvement on the old beta models. The old models effectively assumed that the market portfolio of stocks is the only source of income for consumption, while in fact such income is actually a small part of total income and poorly related to consumption.

Figure 3 illustrates, in terms of our two-period consumption diagram, why the consumption beta is related to expected return. The essential point now is that the budget constraint is uncertain to the investor. In each panel *several* budget constraints are shown, reflecting some possibilities that the investor thinks likely when he chooses his consumption at time t, considering uncertainty both in his income next period and in the return i_t.

After choosing C_t, he will later discover which of these budget constraints is relevant and thus what his consumption C_{t+1} will be. For example, if he consumes C_t, as shown on any of the diagrams, and the budget constraint turns out to be at the position indicated by the numeral 1, then he will be able to consume ${}_1C_{t+1}$ next period, as shown on the diagrams. The ultimate position of the budget constraint for investment in a given stock is influenced by the nonproperty income of the investor and on returns on other investment assets, given the investor's choices regarding these assets.

In the left-most panel, we see budget constraints for an investment in a positive beta stock. For this stock, returns are relatively high (and hence the slope of the budget constraint is relatively less steep) when incomes next period, Y_{t+1}, and hence consumption next period, C_{t+1}, are high, and returns are relatively low when income and thus consumption are low next period. The middle panel illustrates a zero beta stock whose return is the same regardless of income or consumption. Thus, this zero beta stock pays the "risk-free" rate. The right-most panel shows a negative beta stock (presumably an unusual case), in which returns are high when income and hence consumption next period are low.

The middle budget constraint (numbered 2) in each panel is drawn using the expected or average return $E(i_t)$, and with it is shown an indifference curve with the expected marginal rate of substitution $E(S_t)$ at C_t. The middle diagram then looks just like Figure 2, i.e., the budget constraint (numbered 2) is tangent to the indifference curve, despite the uncertainty in income.

In the positive beta case, in the left-most diagram of Figure 3, however, the middle budget constraint is *not* tangent to the indifference curve, reflecting the fact that the expected return is greater than the risk-free rate. The diagram seems to suggest that the individual investor would like to hold more of the stock and consume less this period, say, at C_t'. The middle budget constraint is tangent to a higher indifference curve at C_t'. Note, however, that he will incur more undesirable uncertainty about consumption next period, because the budget constraints are more widely separated below C_t than at C_t. Thus,

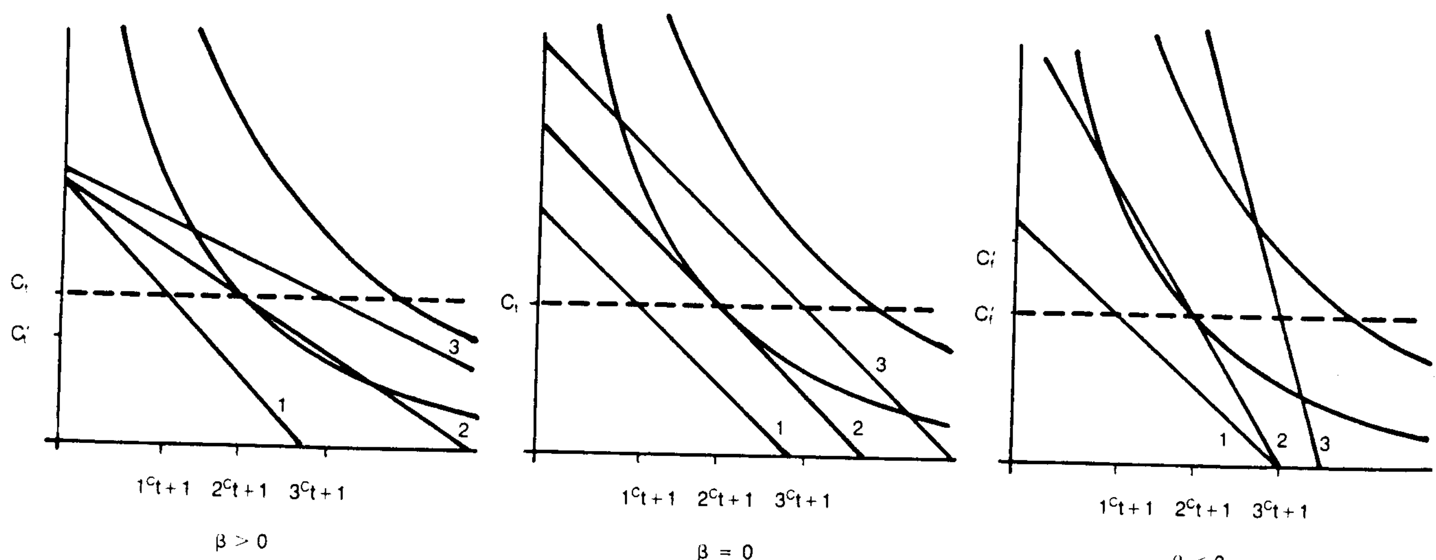

FIGURE 3. Indifference curves for consumption and possible budget constraints for positive, zero, and negative consumption beta stocks. For positive consumption beta stocks (left), the higher the budget constraint, the flatter its slope. For zero consumption beta stocks (middle), the slope of the budget constraint is the same for higher or lower budget constraints. For negative consumption beta stocks (right), the higher the budget constraint, the steeper its slope.

under our assumptions, he is not encouraged by the higher expected return on the positive beta stock to invest more in the stock. In other words, the higher expected return on the positive beta stock does not represent an "unexploited profit opportunity," properly interpreted, and is instead what we would expect given a positive beta. The negative beta case, in the right-most diagram of Figure 3, can be analyzed in the same way. Comparing slopes suggests the individual would like to consume more this period, say at C_t', by selling some of his negative beta stock. However, if he does this, he again incurs greater uncertainty in consumption next period, since the budget constraints are more widely separated above C_t, and that dissuades him from doing so.

WHY ARE STOCK PRICES PROCYCLICAL?

Grossman and I showed that if i_t is the return on the stock (found by dividing the sum of capital gain and dividend by price) between t and t + 1 and if $E_t(1 + i_t)S_t = 1$ at all times, then price is the expected value of P_t^*, where P_t^* is the present value of dividends discounted by marginal rates of substitution:

$$P_t = E_t(P_t^*),\ P_t^* = \sum_{k=1}^{\infty} S_t^{(k)} D_{t+k}, \qquad (6)$$

and $S_t^{(k)}$ is the marginal rate of substitution between C_t and C_{t+k}. We shall now see that this expression, under our demand-side theory, will predict a sense in which stock prices should be procyclical, as observed by students of the business cycle long ago.

Let us hypothesize a simple functional form for the marginal rate of substitution $S_t^{(k)}$ in terms of C_t and C_{t+k}. The function that Grossman and I chose for illustrative purposes was $S_t^{(k)} = \delta^k(C_t/C_{t+k})^4$, i.e., the marginal rate of substitution is proportional to the consumption ratio to the fourth power. This functional form embodies the concavity we expect in indifference curves, i.e., the marginal rate of substitution declines as C_{t+k} rises relative to C_t. We might have chosen some positive power other than the fourth. The number four was chosen because it makes P* roughly fit the data, as we shall see below. The δ^k represents impatience, so that (if $\delta < 1$) at a zero interest rate the person would consume more this period than in future periods.

Substituting this expression for the marginal rate of substitution into (6), and assuming that dividends are expected to follow the trend $D_t = D_0(1 + g)^t$ with certainty, then we find:

$$P_{Dt}^* = C_t^4\left[D_0(1 + g)^t \sum_{k=1}^{\infty} (\delta(1 + g))^k C_{t+k}^{-4}\right]. \qquad (7)$$

This expression for the ex post rational stock price P_{Dt}^* (the subscript D means according to the demand-side theory) makes the price at time t proportional to consumption at time t (to a power). This is multiplied by an expression (in the square brackets) that includes a time trend and a moving average of reciprocals of future consumption (to a power). Since moving averages serve to smooth the series averaged, then — unless consumption is very unstable — the value of the expression inside the square brackets ought to be fairly stable through time. Thus, expression (7) and the assumption that $P_t = E_t(P_{Dt}^*)$ means essentially that stock prices ought to be high when aggregate consumption is high, and low when consumption is low.

Therefore, basic economic theory has left us with a sense in which stocks *should* be procyclical, high in prosperous times, low in depressions! Of course, people do not have perfect foresight, and so actual stock prices P_t need not equal P_t^*. We argue that even under imperfect information we might expect P_t to resemble P_t^*, though if information is very bad the resemblance could be very weak.

A plot of P_{Dt}^* along with actual price P_t appears in Figure 4, computed using actual aggregate real per capita consumption. In constructing the plot of P_{Dt}^*, it was necessary to make some assumptions, not about *dividends* after 1981, but about *consumption* after 1981. This was done in Figure 4 in such a way as to make $P_{D1981}^* = P_{1981}$ by construction, just as with P_{St}^* in Figure 1.

Note that P_{Dt}^* moves a great deal more than P_{St}^* did in Figure 1. If the functional form chosen for the marginal rate of substitution is reasonable, then we have found a source for the observed fluctuations in aggregate stock prices. Moreover, there are a num-

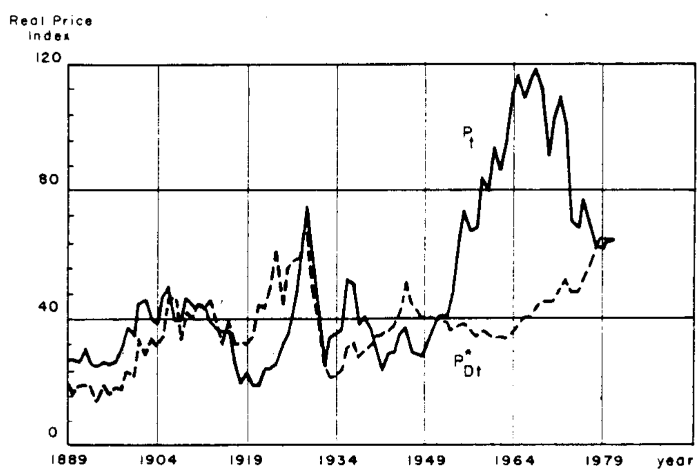

FIGURE 4. *Real Stock Price Index and Ex Post Rational Counterpart Based on Real Consumption, 1889-1981*

P_t: Standard and Poor's Composite Stock Price Index divided by the consumption price index, as in Figure 1. P_{Dt}^*: Ex post rational stock price index as given by expression (7) in the text, subject to assumptions about consumption after 1981 so that $P_{D1981}^* = P_{1981}$. Real consumption on nondurables and services from the national income accounts and Kendrick [1961] is used for C_t in (7).

ber of comovements in the data. P^*_{Dt} and P_t resemble each other much more than P^*_{St} and P_t did. Unfortunately, the theory appears to break down after 1950. It is interesting nevertheless that the theory did work before 1950, and we might turn to special effects such as the rise of institutional investors or the baby boom to explain why the model has not worked well in the period of our own memory. The recent failure of the model could also be attributed to forecast errors, in which case the model may again perform well in the future.

Is the functional form assumed for the marginal rate of substitution reasonable? One can judge the plausibility in the following way, illustrated with the Depression example again. In 1932, aggregate per capita consumption expenditures in real terms were 18% lower than in 1929. Try to imagine what it must be like to suffer an 18% drop in consumption. Then ask yourself: How much would the stock market have to drop so that you would become convinced that stocks were such a bargain that you would not sell in 1932 any of the shares you held in 1929? If your answer is that stocks would have to fall to 45% of their real value in 1929, then you are confirming the reasonableness of the assumed functional form.

BEHAVIOR OF OTHER ASSET PRICES

The demand-side theory would suggest that real prices of other assets besides corporate stocks should also show procyclical behavior. If people dump their stocks in a depression, shouldn't they also dump their long-term bonds? their land? their housing? Here is the principal problem with the demand-side theory: There is little similarity in the behavior through time of real prices of these other assets (Figure 5).[4]

It should be emphasized that abstract theory does not imply that these different asset prices should have similar patterns through time. To get such an implication, we need to add the assumption that there is some similarity through time in the "dividend" paid by these other assets. The "dividend" on housing is the market value of the shelter it provides — the rent the house could earn. Similarly, the dividend on land is the amount it could be rented for. Unfortunately, we lack long time series data on rents on housing or land.

We do have data on the real dividends accruing to bonds — i.e., the real value of their coupons. The nominal value of coupons is fixed, so the real value of the coupons moves opposite from the price level. Since the trend in consumer prices has generally been upward (with the exception of the early 1890s and early 1930s), the real value of the fixed nominal dividend on long-term bonds has been trending downward fairly smoothly. We therefore expect a downtrend in bond prices rather than the uptrend observed in stock prices. On the other hand, since the downtrend in dividends on bonds has been quite smooth, we would expect that the big movements around the trend with stocks ought to be reflected as well in movements around the trend in bond prices. For example, we would expect real bond prices to fall in the Great Depression.

Unfortunately for the theory, this does not happen. Moreover, one might suppose that real rents on housing or land should be smooth through time, albeit with trends or long-wave movements that are different from real dividends on corporate stocks. If so, then there should be some similarity in the short run in movements of the real prices. This does not seem to be the case with the data in Figure 5.

CONCLUSION

The supply-side efficient markets theory discussed here does not look promising. Movements over the last century in aggregate real dividends just fail to explain the movements in aggregate stock prices.

There are various apologies for the theory that might be offered. These apologies may assert that dividends are potentially much more variable than their movement around the historical trend would suggest. It has been claimed that dividends may be a nonstationary process that follows a trend only by coincidence. It has been claimed that disasters like those that befell some foreign stock markets, such as in Russia after the Revolution of 1917, might conceivably affect our own; although that did not happen in the last century, it may have always been a risk. These apologies might be right, but it is hard to see that they could offer any inspirational salvation for the supply-side model. The stories have no predictable consequences that might be tested effectively with the data.

The demand-side theory looks more promising in some respects. It seems to rely on effects that are of the right order of magnitude to justify actual stock price movements. It predicts a business cycle correlation for stock prices which was, at least until after 1950 or so, actually observed. On the other hand, the demand-side story also has its problems. It fails to explain the dramatic hump-shaped pattern of real stock prices since World War II. Moreover, the demand-side theory suggests that bond, land, and housing prices should show a similarity to stock prices that we do not observe.

There are, of course, possible apologies for these problems. Perhaps bonds, land, and housing are regarded differently by investors, who would not

FIGURE 5. *Real Prices of Stocks, Housing, Land, and Bonds, 1889-1981*

All series are divided by the consumption price index noted above to convert them to real terms.

Top panel: P, real Standard and Poor's Composite Stock Price Index, as in Figures 1 and 3.

Second panel: P_H, housing price index derived by linking together the Grebler-Blank-Winnick index of prices of one-family owner-occupied houses 1890-1934; the Fisher median asking price of one-family homes in Washington, DC, 1934-1948; the Boeckh construction cost index for residences 1948-1953; the home purchase component of the Consumer Price Index 1953-1963; and Census Bureau's price index for new one-family houses sold 1963-1981.

Third panel: P_L, index of average value of farm real estate per acre, U.S. Department of Agriculture, 1912-1980.

Fourth panel: P_B, the price of a 25-year 5% coupon bond whose yield is the Moody AAA corporate bond yield average (1936 to 1981) for the second trading day of the year, and Macaulay's railroad bond yield index (1890 to 1935) for January.

think of selling the house, say, or the family farm in a depression. Perhaps market segmentation might be responsible for the lack of similarity of prices. Bonds may have been held more by persons or institutions that did not have the same incentives. The price of housing may be influenced by the flows of funds into mortgage lending institutions. The price of land may not have fallen in the Depression because of the efforts, or perceived potential future efforts, of the Federal Farm Land Bank System. Unfortunately, these apologies will have to be developed more carefully if there is to be an inspiring case for the demand-side theory.

We are left in an unsatisfactory situation at this point, with no simple theory that seems to be suggested by all the phenomena studied. We could fall back on a market fads or psychological theory. We could hope that more diligent economic research might turn up some missing variable that would clarify what has really been happening. Or, we could wait another hundred years, and let our progeny attack the problem again with a data set twice as big as that used in this study.

[1] Source: U.S. Bureau of the Census [1975], Series E135 and E137, p. 211.

[2] Source: *Op. cit.* Series E190, E193, and E200, p. 213.

[3] Source: U.S. Bureau of Economic Analysis [1976], Table 2.4, Items 7 and 8, p. 335.

[4] The data and their accuracy are described in Shiller [1982].

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