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The Stock Market and the Economy

THE STOCK MARKET decline of 1973–74 marked the longest and steepest fall in corporate-stock prices since the depression of the 1930s. The loss of stockholder wealth in market prices amounted to $525 billion, or 43 percent.[1] The magnitude of this decline in stock values, in conjunction with the subsequent collapse of aggregate demand in 1974–75, has sparked a renewed discussion of the role of the stock market in business cycles. The debate—as is so frequently the case—is not new to economics. Several significant contributions recently made at both the conceptual and empirical levels seem, however, to justify a reexamination of the issues.

The dispute about the import of changes in the stock market revolves around their causal role in economic fluctuation: Are they a source of variation in aggregate demand? Does the causation run solely in the opposite direction? Or do the levels of economic activity and of stock prices simply respond similarly to other, more basic, economic forces, with no direct causal link between the two? This third interpretation is consistent with a view that the stock market reflects investors' attempts to forecast economic trends. The fact that movements in stock prices foretell major

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1. Derived as the change between December 1972 and December 1974, as shown in Board of Governors of the Federal Reserve System, unpublished detail accounts, from the flow of funds (July 1975).

cycles in business activity is, thus, only evidence that investors' forecasts are better than random guesses.

As figure 1 demonstrates, the stock market and economic activity do move in similar cyclical patterns. Because several previous studies have found that changes in the stock market tend to precede changes in business conditions by an average of about four months,[2] the stock-price index is a major component of the index of leading indicators.[3] The cyclical pattern is particularly evident in the latest recession. Stock prices peaked at the beginning of 1973, then declined sharply for two years. Industrial production, however, continued to rise throughout most of 1973, and its collapse did not begin before late 1974.

On the other hand, as others are quick to point out, this behavior does not imply a causal relation between the stock market and real economic activity. Furthermore, focusing only on major cycles in economic activity means ignoring the numerous periods when the stock market changed sharply and nothing happened to the economy. Saul Hymans, for example, reports a negative and insignificant correlation between lagged stock prices and an index of current economic activity for the period 1948–72 in an equation that includes other cyclical variables.[4] Thus, it remains unclear whether the collapse of the stock market had a direct role in the 1974–75 recession, or simply mirrored depressive developments elsewhere. In the sections that follow, an effort will be made to assess the role of changes in stock prices in two major components of aggregate demand: personal consumption and business fixed investment.

Consumer Demand

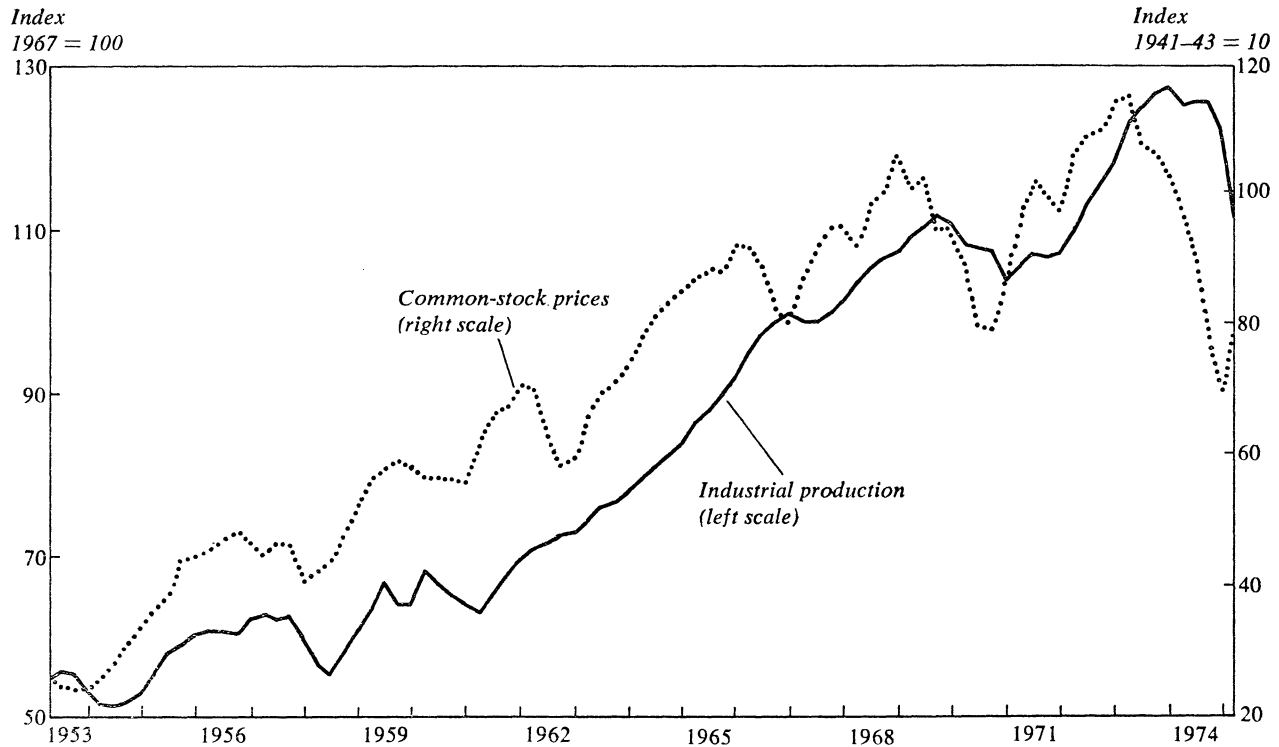
In the vast literature on consumer demand, only a few studies have focused directly on the influence of changes in stock prices and of their associated capital gains and losses. In addition, those studies that have explored

2. See, for example, Geoffrey H. Moore and Julius Shiskin, *Indicators of Business Expansions and Contractions*, Occasional Paper 103 (Columbia University Press for the National Bureau of Economic Research, 1967), pp. 44–45.

3. For a description of the current version of this index, see Victor Zarnowitz and Charlotte Boschan, "Cyclical Indicators: An Evaluation and New Leading Indexes," *Business Conditions Digest* (May 1975), pp. v–xix.

4. Saul H. Hymans, "On the Use of Leading Indicators to Predict Cyclical Turning Points," *BPEA, 2:1973*, p. 346.

Figure 1. Industrial Production and Prices of Common Stock, 1953–75



Sources: Index of industrial production—Board of Governors of the Federal Reserve System, *Industrial Production, 1971 Edition* (1972), p. S-23, and Federal Reserve monthly releases, "Industrial Production," G.12.3 (1972–75 issues); index of stock prices—500 common stocks, Standard and Poor's, as published in *Business Conditions Digest* (October 1974), p. 111, and subsequent issues.

this relationship differ in their emphasis on two distinct mechanisms by which the stock market might affect consumer demand. The first, which is closely identified with the life-cycle model of consumer behavior, emphasizes the effect of changes in wealth. The second uses the stock market as a proxy measure of optimism or pessimism (so-called "consumer sentiment").

While in many applications the distinction between these two mechanisms is not important, it is central to an evaluation of the impact on consumption of changes in monetary policy. The demand for corporate stock is commonly viewed as dependent upon (1) expectations of corporate earnings, and (2) the rate of return on alternative assets. Monetary policy can, therefore, affect the price of corporate stock through altering rates on competing assets, without changing expectations of profits or economic activity in any regular, predictable fashion. Thus, if the correlation between changes in stock prices and consumption found in previous studies reflects the role of the stock market as a crude proxy for consumer sentiment, monetary policy would have no direct causal impact on consumption. If, on the other hand, the observed correlation represents a wealth effect, an explanation for the behavior of stock prices that includes a link to monetary policy becomes crucial.[5]

Any estimate of stock-market effects must rest on an evaluation of the importance of wealth in consumer behavior. If one accepts the view that consumption reflects an attempt to maximize intertemporal utility subject to the constraint of total available resources, current earned income is a poor measure of that constraint. Individuals can both save for and borrow against the future; and they receive income claims from sources other than current production—for example, inheritances, gifts, and capital gains. Wealth, however, is highly collinear with permanent or normal income; and motives related to estate building complicate the interpretation of the effect of wealth accumulation on consumption. Moreover, a conceptual complication arises because the definition of income used in the national income accounts (NIA) already reflects all earnings on wealth—exclusive of capital gains.

Capital gains on corporate stock raise other, specific, issues. Corporate-stock holdings are highly concentrated among the rich, and one might well

5. Changes in stock prices that result from changes in other rates may or may not be associated with a change in expectations or sentiment. The significant point is that there may be no stable relationship, so that different assumptions can lead to sharply different conclusions about the impact of variations in monetary policy.

be dubious that unrealized capital gains and losses have a constraining influence on the consumption decisions of such individuals. For example, in 1971, 51 percent of all stock-market assets were held by those in the top 1 percent of the income distribution, and 74 percent by the top 10 percent.[6] In addition, capital gains and losses on such assets are highly transitory and only a small proportion are actually realized. Data developed by Kul Bhatia imply that realized gains account for only a fifth of accrued gains.[7] Moreover, the two components of capital gains are not closely correlated. Realized capital gains are not included in the NIA definition of income although they do incur an increase in taxes and thus a decline in measured disposable income.

A WEALTH VIEW OF COMMON STOCKS

It is convenient to use the consumption equation of the MIT-Pennsylvania-Social Science Research Council (MPS) model of the United States as a vehicle for examining some of the issues. The equation fitted to 1954–70 relates the quarterly flow of real per capita consumption services (*CON*) divided by population (*N*) to current and previous values of disposable income (*Y*), household net worth exclusive of corporate stock ($W - S$), and an average of recent values of corporate-stock holdings (*S*):

$$(1) \qquad \frac{CON}{N} = \sum_{i=1}^{12} b_i \left(\frac{Y}{N}\right)_{t-i} + 0.054 \left(\frac{W-S}{N}\right)_{t-1} + \sum_{i=1}^{8} c_i \left(\frac{S}{N}\right)_{t-i} + 0.74u_{t-1},$$

where

$$\sum b_i = \underset{(12.7)}{0.66} \; ; \; \sum c_i = 0.054.$$

Here and in subsequent equations the numbers in parentheses are *t*-ratios and *u* is an error term. The sum of the coefficients on corporate stock is constrained to equal the coefficient on wealth, so that separate measures of

6. Marshall E. Blume, Jean Crockett, and Irwin Friend, "Stockownership in the United States: Characteristics and Trends," *Survey of Current Business*, vol. 54 (November 1974), p. 17.

7. Kul B. Bhatia, "Capital Gains and the Aggregate Consumption Function," *American Economic Review*, vol. 62 (December 1972), p. 869.

significance are not available; but the overall term is highly significant.[8] Since the original formulation indicated autocorrelation of the residuals, the equation is estimated with an autoregressive transformation of the data. The serial correlation parameter of 0.74—the coefficient on the previous period's error (u_{-1})—implies that the problem is severe.

This is an appealing equation as it stands. The long-run coefficients on income and wealth are in close agreement with earlier estimates by Franco Modigliani, Albert Ando, and Richard Brumberg. Also, if wealth is a significant determinant of consumption, one can argue plausibly that wealth accumulated through capital gains on corporate stock has long-run effects no different from those of wealth in other forms. The lag on stock-market assets can thus be interpreted as a smoothing or discounting of transitory variations in stock values with an imposed constraint of long-run equality between the effects of corporate stock and of other components of wealth. The equation does imply a major impact on consumption of variations in stock prices. For example, the 1972–73 decline in stock values, if permanent, would have depressed consumer demand directly by $30 billion, or a 3 percent increase in the saving rate.

The major issues posed by the equation are whether wealth belongs as an argument in the consumption function, and, if so, how long it takes before capital gains and losses are fully incorporated into individuals' evaluation of their wealth positions. More specifically, why should the lag on capital gains and losses in the stock market be shorter than that for income in general (eight versus twelve quarters)? If current income is a poor measure of resources available for consumption and lifetime resources form the relevant measure, transitory variations in asset values should have minimal influences on consumption; but this is not the implication of the MPS version. Since the primary impact of transitory changes in income and wealth should be reflected in saving, an extra effect of gains and losses in the stock

8. The MPS concept of consumption treats the purchase of durable goods, CD, as investment and such outlays enter into the estimate of consumption only when they are "consumed." In the national income accounts, durables are included in consumer expenditures at the time of purchase. The empirical relationship between the two concepts is given by

$$CON = C_{NIA} - 0.935CD + 0.26KD_{t-1},$$

where KD is the stock of durables. In essence, this formulation replaces purchases of durable goods with a smoothed average of past purchases. Thus, in terms of cyclical variance, the series is most nearly comparable to previous studies of consumption of nondurables plus services.

market might show up in the durables-purchases equation (defined as saving) of the model; but it does not.

The implication for consumption spending of variations in stock-market prices has been examined in studies by Arena and Bhatia.[9] However, because both of these authors included the market value of corporate stock in the definition of initial wealth, they tested only the contemporaneous effect. In the equations estimated by Arena, the wealth coefficients ranged from 0.03 to 0.09 and were frequently significant, but the contemporaneous capital-gains coefficients were less than half as large and never significant. One can reject neither the hypothesis that capital gains have no contemporaneous effect nor the alternative extreme that the capital-gains coefficient was equal to that of the wealth components. Equations specified by Bhatia, which used a permanent-income concept in place of wealth, resulted in marginal significance for a measure of realized expected gains, but insignificant results for accrued capital gains. A second form of equation constrained the sum of the coefficients on current and past capital gains to equal that of total wealth with lags extending over five years. Again, because the definition of beginning-of-period wealth included corporate stock at market prices, the equation implies only a hypothesis about expected contemporaneous capital gains rather than providing a test of the consumption response to short-term fluctuations in prices of capital assets.

VIEWS EXCLUDING WEALTH AND CAPITAL GAINS

Despite its popularity, the wealth version of the consumption function has not been closely compared with the specifications of other researchers. Certainly, all would agree that a simple moving average of income is an inadequate predictor of cyclical changes in consumer demand. The alternative approach, which excludes any specific wealth variable, emphasizes some disaggregation; a purchase rather than a consumption concept of durable goods; and the inclusion of special variables in the individual equations such as lagged stocks, measures of anticipated and unanticipated inflation, an index of consumer sentiment, complementary demands—particularly in the area of housing—and the unemployment rate. If it uses stock prices at all, it views them as a proxy for consumer sentiment.

9. See John J. Arena, "Postwar Stock Market Changes and Consumer Spending," *Review of Economics and Statistics*, vol. 47 (November 1965), pp. 379–91; Arena, "Capital Gains and the 'Life Cycle' Hypothesis of Saving," *American Economic Review*, vol. 54 (March 1964), pp. 107–11; and Bhatia, "Capital Gains."

Previous *BPEA* papers on consumption all rely on empirical equations that do not provide a role for wealth.[10] Hymans obtained a small and insignificant effect on automobile demand in his first paper and concluded that "the net worth variable is clearly no panacea. It has shifted the dating of the errors, but they persist. . . . If a wealth variable ultimately proves itself, it is most likely to be in the form of a marginal addition. . . ."[11]

The absence of a wealth variable in these studies stands in sharp contrast to its significance in the MPS equation; so far, neither approach has demonstrated its superiority satisfactorily. The comparison is complicated by severe statistical problems introduced by the presence of strong serial correlation in all of the time-series data. Also, the wealth version uses a measure of consumption that includes an estimate of the rental or service value of the stock of consumer durables rather than the direct expenditure on durables used in the national income accounts and most other studies. The following sections attempt to explain the source of this disagreement over the role of wealth and examine the evidence on the role of short-term capital gains and losses.

AN EMPIRICAL COMPARISON OF ALTERNATIVES

Because the alternative approach, which omits wealth, is disaggregated by components of consumption, the MPS equation was reestimated under a variety of specifications in order to obtain comparable equations. These are shown in table 1 for the period 1954–72.[12] First, the removal of the constraint of long-run equality between the effects of corporate stock and other

10. Saul H. Hymans, "Consumption: New Data and Old Puzzles," *BPEA, 1:1970*, pp. 117–26, and "Consumer Durable Spending: Explanation and Prediction," *BPEA, 2:1970*, pp. 173–99; F. Thomas Juster and Paul Wachtel, "Inflation and the Consumer," *BPEA, 1:1972*, pp. 71–114; Arthur M. Okun, "The Personal Tax Surcharge and Consumer Demand, 1968–70," *BPEA, 1:1971*, pp. 167–204; and Lester D. Taylor, "Saving out of Different Types of Income," *BPEA, 2:1971*, pp. 383–407.

11. Hymans, "Consumption," p. 126.

12. The data are primarily from the national income accounts, published in the *Survey of Current Business*, or the data bank of the MPS model. The service concept of consumption, net worth, income, and the corporate-stock variable are from the model equation book. The definition of disposable income is slightly different from that of the national income accounts because it excludes consumer interest payments and includes an imputation for income from the stock of durables, and because the timing of tax liabilities is computed differently. The measure of corporate stock is created by dividing dividend payments of the national income accounts by Standard and Poor's dividend-price ratio. All the variables are measured in 1958 prices.

Table 1. Wealth Formulations of Consumption-Demand Equations, 1954–72[a]

Annual rates in billions of 1958 dollars

Variable and summary statistic	*Total consumption (1)*	*Nondurables plus services (2)*	*Consumer durable services*[b] *(3)*	*Consumer durable purchases*[b] *(4)*
Variable				
Constant	2.511	29.4	−26.47	−9.0
	(0.6)	(6.5)	(9.8)	(0.6)
Nonstock wealth	0.069	0.061	0.002	−0.037
	(3.8)	(3.2)	(0.7)	(1.6)
Corporate stock[c]	0.046	0.059	0.007	−0.008
	(4.7)	(6.0)	(2.4)	(0.6)
Income[d]	0.612	0.418	0.201	0.204
	(10.4)	(7.0)	(16.8)	(1.9)
Lagged stock of durables	...	...	...	0.201
				(1.6)
Summary statistic				
R^2	0.999	0.999	0.999	0.993
Standard error	1.34	1.35	0.23	1.87
Rho[e]	0.73	0.7	0.99	0.5
Dynamic standard error	22.5	16.7	44.0	4.5

Sources: See text note 12, where detailed information is also given.

a. The numbers in parentheses are *t*-ratios.

b. The services concept of consumer durables is that of the MPS model. Purchases are as reported in the national income accounts.

c. The coefficient is a sum of an eight-quarter lag series.

d. The coefficient is a sum of a twelve-quarter lag series.

e. Autocorrelation coefficient, estimated by an interactive search routine to minimize the standard error of estimate.

wealth (column 1) alters the earlier results only slightly.[13] The long-run income effect is reduced, that of wealth is raised, and the corporate-stock coefficient is about 67 percent of that on wealth. More important, all of the coefficients are highly significant in a statistical sense. The parameter estimates are also very stable when the equation is refitted for a variety of subperiods. The evidence suggests, however, that the assumption that the serial correlation of the error term follows a first-order scheme is not realistic.[14]

13. These equations also differ from (1) above by excluding the deflation for population growth. This exclusion has very little impact on the estimates and facilitates interpretation of the standard errors.

14. This assumption can be tested by generating a predicted series for the dependent variable that uses lagged estimated (instead of actual) values for the autoregressive transformation. A sharp deterioration in the R^2 and standard error of estimate would imply a more complicated scheme for the error term. For the above equation, the standard error of the dynamic predictions increases by a factor of 17.

Second, dividing total consumption into (1) nondurables plus services and (2) durables reveals that the effects of the capital-gains and wealth terms are heavily concentrated in the consumption of the former. Evidently, the creation of a rental or service-flow concept of durables from the outstanding stock has produced a data series that depicts little more than a secular trend. Also, a few problems become apparent. For nondurables alone, the lag coefficients on income become negative after a few periods, an effect that persists even if the overall lag is shortened. Without the correction for autocorrelation, corporate stock has a highly significant negative impact in the durable-services equation. In both cases, the autocorrelation is very high and has a pronounced impact on the point estimates of the parameters.

For purposes of comparison, equations that excluded any wealth or stock-market variable were estimated for several components of consumption. The specification of these equations draws heavily upon previous published papers and the major econometric models.[15] Although these models usually have a greater degree of disaggregation, the results that follow apply to the consumption of nondurables plus services and purchases of durable goods. Further disaggregation did not alter the conclusions about the role of wealth and the stock market.

Nondurables plus services. For the nondurables and services component, alternative formulations have relied heavily upon current and lagged values of income. The major additional variables have been the housing stock (measuring the complementarity of utilities services and the stock of homes), population, and relative prices. In order to parallel the durables equation presented below, the unemployment rate, the index of consumer sentiment, and price changes were tried in the initial formulation but proved insignificant. A three-period average of the change in income was included to reflect the fact that some nondurables display the stock-adjustment attributes normally assigned to durables.[16] The final equation for the 1954–72 period had the following form:

$$(2)\qquad CNS = \underset{(5.2)}{-35.14} + \underset{(11.5)}{0.33}\, KH_{t-1} + \underset{(2.8)}{0.11} \sum_{i=0}^{2} \Delta\, YD_{t-i} + \underset{(22.3)}{0.44} \sum_{i=0}^{11} w_i\, YD_{t-i} + 0.61 u_{t-1},$$

$$R^2 = 0.999; \text{ standard error} = 1.28.$$

15. See, for example, Hymans, "Consumer Durable Spending."

16. The equation formulation can also be justified by reference to the dynamic model in H. S. Houthakker and Lester D. Taylor, *Consumer Demand in the United States: Analyses and Projections* (2d ed., Harvard University Press, 1970).

where

CNS = consumption of nondurables plus services, 1958 dollars
KH = stock of housing, 1958 dollars
YD = disposable income, 1958 dollars.
w_i = weights on income estimated from second-degree polynomial with sum of unity.

This version of the equation fits the data as well as the equation with a wealth variable does, and there has been some reduction in the extent of autocorrelation in the residuals. However, the coefficient on the housing stock is about twice the value that one would expect from comparing housing-related services to the value of the stock. Since this variable is highly correlated with population, permanent income, and total wealth, it is likely to reflect factors other than the link between a home and the consumption services that are associated with it.

As a test of a wealth effect, a second equation was estimated by adding the corporate-stock and wealth variables to equation (2). A two-year lag structure was included for the corporate-stock term, as in the MPS equation. Both the wealth and corporate-stock terms were highly significant in a statistical sense:

$$(3) \qquad CNS = \underset{}{-5.74} + \underset{(4.1)}{0.177}\, KH_{t-1} + \underset{(3.1)}{0.11} \sum_{i=0}^{2} \Delta\, YD_{t-i}$$

$$+ \underset{(8.8)}{0.385} \sum_{i=0}^{11} w_i\, YD_{t-i} + \underset{(2.5)}{0.041}\, (W - S)_{t-1}$$

$$+ \underset{(3.3)}{0.030} \sum_{i=1}^{8} v_i\, S_{t-1} + 0.49\, u_{t-1}.$$

$R^2 = 0.999$; standard error = 1.17.

In addition, the coefficient on the housing stock has a far more plausible value and other coefficients in the equation have not changed significantly. The steady decline in the weights for lagged values of corporate stock is consistent with a notion of smoothing or discounting of transitory fluctuations in asset prices. When the equation is refitted to various subperiods, it is evident that all of the significance of the corporate-stock variable arises

after 1965. For periods ending prior to 1966, the corporate-stock coefficient is small and clearly insignificant.

Consumer durables. The need for a distinction between the purchase of durables and their consumption has long been recognized; in fact, it is indispensable to stock-adjustment formulations of investment in durable goods. However, the MPS model transforms the stock data to a flow basis prior to estimation, whereas most other studies have embedded the stock-flow distinction within a model of investment demand. Regardless of whether purchases of durables are defined as consumption, as in the national income accounts, or as saving, as in the MPS model, it is important to determine whether they are influenced by the stock market. The equation reported in column (3) of table 1 relates to the service flow from durable goods and thus does not directly answer the question of whether fluctuations in wealth and stock prices affect purchases of such goods.

The model does include an equation for durable purchases that is not dissimilar from that of other studies, but it includes no direct role for either wealth or fluctuations in the stock market. Instead, total consumption is used to scale all variables in the equation: in effect, the equation explains the ratio of purchases of durable goods to total consumption. As a result, changes in the stock market have only an indirect effect through the change in total consumption. A direct test of the capital-gains and wealth terms in a durables-expenditure equation is shown in column (4) of table 1. The lagged stock of durables was included to capture the stock-adjustment effects, but it was highly collinear with wealth and both are insignificant and of the wrong sign. The lags on the income and corporate-stock terms were both significantly negative after a few periods.[17] This is a highly simplified purchase model, but it does indicate that the wealth formulation does not apply directly to durable purchases.

The alternative equation for consumer durables relates the desired stock (K^*) to income and the housing stock (as a measure of complementary demand for household furnishings). Because of the statistical problems of estimating an equation with a lagged dependent variable, net purchases (NCD) are related to current and previous changes in the desired stock:

17. Because of the presence of a lagged-stock term the equation was estimated by an instrumental-variable technique to obtain a consistent estimate of the degree of autocorrelation. The multicollinearity among the variables greatly increased the standard errors and leaves one with little faith in any of the point estimates.

$$(4) \qquad NCD = f\left(\sum_{i=0}^{n} w_i \Delta K^*_{t-i}\right).^{18}$$

In addition, recent studies of the demand for durables have included the unemployment rate for males, an index of consumer sentiment, and the rate of price inflation. These variables could be interpreted as elements of the desired stock (implying that they would enter with lags on the changes) or as cyclical variables that affect the timing of the adjustment process (in which case they would enter in level form). In practice, the specific form was determined by experimentation. Finally, the level of income was also included in the equation because not all items in the category of durable-goods purchases can be regarded as additions to stocks. Many are more like nondurables, for which purchase and consumption are nearly simultaneous. The final equation for the 1954–72 period is

$$(5) \qquad \begin{aligned} NCD = {} & -8.2 + \underset{(3.2)}{} \; 0.69 \underset{(2.6)}{} \sum_{i=0}^{10} w_i \Delta YD^*_{t-i} - \underset{(5.3)}{1.69}\, RUM_{t-1} \\ & + \underset{(5.2)}{0.57}\, ICR_t - \underset{(2.8)}{1.19}\, CPI + \underset{(3.9)}{0.025}\, YD^*_{t-1} \\ & + 0.62\, u_{t-1}, \end{aligned}$$

$R^2 = 0.96$; standard error = 1.0.

where

NCD = consumer-durable purchases less depreciation, 1958 dollars
YD^* = disposable income less transfer payments, 1958 dollars
RUM = unemployment rate for males
ICR = two-quarter average of residential construction, 1958 dollars
CPI = two-quarter change in the consumer price index.[19]

18. This is a simple transformation, with a more flexible lag, of the more standard stock-adjustment formulation:

$$NCD_t = \gamma(K^*_t - K_{t-1}).$$

The problem of a lagged dependent variable with autocorrelated errors can be seen easily by adding K_{t-1} to both sides of this equation,

$$K_t = \gamma K^*_t + (1 - \gamma)K_{t-1},$$

recognizing that NCD is the current change in that stock.

19. The data on expenditure, income, and residential construction are from the national income accounts, published in *Survey of Current Business*. Depreciation of consumer durables is from the Board of Governors of the Federal Reserve System, "Flow of Funds Accounts," various issues. The filtered index of consumer sentiment, as described in Juster and Wachtel, "Inflation and the Consumer," pp. 110–12, was initially included in the equation, but was of very low significance in this final version. Quarters containing serious strikes were eliminated from the estimation period.

In concept, relative prices should also appear in the equation; but, at this level of aggregation, their influence was small and insignificant with no apparent effect on the coefficients of other variables. An attempt was made to include a survey measure of expected prices, but it was also insignificant. The negative sign on the actual inflation rate accords with several recent studies of demand for durable goods. The coefficient on new construction (measuring changes in housing stock) seems rather large, but is confirmed by other durables-purchases equations, such as that of the MPS model. Attempts were made to include some measures of credit stringency (reflecting a belief that housing may be a proxy for such factors), but they were not significant.[20]

As with nondurables, net worth and the change in the values of corporate stock were added to equation (5). In this case, both variables were clearly insignificant in the equation, with the coefficient on wealth nearly identical to zero. Variations in the lag structure made it possible to obtain a positive coefficient for corporate stock, but it never approached statistical significance. The coefficients of the other variables in the equation were not significantly affected. The equation was also estimated without the housing variable, but this change made no difference for the effect of wealth or the stock market. At least for purchases of durable goods, it is difficult to find evidence in the aggregate time-series data of a significant influence of fluctuations in the stock market.

The results for nondurables and services offer very strong support for a stock-market effect on consumption. But one would not anticipate a priori the extreme result obtained in these equations of a positive wealth and stock-market effect on nondurables and services and no effect of either on durables purchases. Purchases of durables should be postponable and thus responsive to changes in stock values. In addition, if durable purchases are very sensitive to cyclical changes in income, one would expect a similar response to cyclical changes in wealth. Viewed through the concept of net worth, the results may seem more plausible: the rich spend more on housing and other services. But these differences do not seem great enough to account for the failure of wealth and stock-market fluctuations to have any effect on durable purchases while exerting a strong impact on other consumption components.

20. The housing variable has a coefficient too large to be simply a reflection of complementary demand. There is also a correlation between autos and housing. Thus, the housing variable must be reflecting credit or expectational factors that cannot be captured with more direct measures.

THE 1973–74 STOCK-MARKET DECLINE

The depth of the decline in the stock market in the years 1973–74 provides an opportunity to evaluate the equations outside the period of estimation. The results of using the previous equations to forecast 1973–74 are shown in table 2 by half-years. The most striking aspect of the table is the enormous overprediction of consumer expenditures on nondurables and services during the period, particularly 1973. This error is reflected in the large rise in the personal saving rate between 1972 and 1973, from 6.6 percent to 8.2 percent. In essence, none of this increase was predicted by equation (2), which excludes the wealth and stock-market variables. The inclusion of the wealth variable in equation (3) significantly reduces the error, but the residuals remain far larger than would have been expected from the standard error of estimate over the data period.

Column (3) of the table shows that, even though they remain consistently negative, the prediction errors for the nondurables and services equation are sharply reduced when the period of estimation is extended through 1974. As might be expected, the coefficients on wealth and corporate stock rise by about two-thirds and the sum of the weights on income drops. Much of the improvement in the residuals results from a rise in the autocorrelation parameter from 0.49 to 0.71. In addition, the reestimated equation consistently underpredicts consumption in the stock-market declines of 1970, 1966, and 1962.

As mentioned earlier, the MPS formulation—equation (1)—constrains the effect of capital gains to equal that of wealth and thus it implies a larger effect of the stock-market decline. As shown in column (4), this equation also overestimates consumption, but by a smaller amount than the equation without the wealth and stock-market terms. The projections benefit somewhat from the higher estimate of the autocorrelation parameter.

The errors for the durables-purchases formulation—equation (5), which has no stock-market variables—display no distinct pattern (column 5). They offset the errors in other consumption until the oil embargo of late 1973. Actual expenditures run above the predicted amounts throughout the middle of 1974, a pattern that might be explained in part by the announcement of the huge price increase on the 1975 automobile models. About half of the $14 billion drop in expenditures on durables in the fourth quarter of 1974 is predicted by the equation.

The overall results of the predictions tend generally to support the earlier

Table 2. Prediction Errors[a] for Consumer Expenditures, Second Half 1972–1974

Annual rates in billions of 1958 dollars

Year and half	*Nondurables and services without wealth variable* (*1*)	*Nondurables and services with wealth variable*		*MPS model equation* (*4*)	*Consumer durables* (*5*)
		1972 equation[b] (*2*)	*1974 equation*[c] (*3*)		
1972:second	0.1	−0.2	−0.1	0.9	−0.4
1973:first	−4.1	−3.2	−1.1	−0.3	2.1
second	−5.6	−5.4	−2.1	−3.0	−1.5
1974:first	−7.1	−5.7	−0.9	−1.6	2.5
second	−5.0	−2.7	−0.1	1.7	−1.4

Source: Calculated by the author from text equations (1), (2), (3), and (5). The indicated residuals include a correction for autocorrelation based on the estimated equations. As such, they should be interpreted as averages of one-quarter forecasts.

a. Actual minus predicted.
b. Text equation (3).
c. Text equation (3) reestimated with data for 1954–74.

conclusions. There is no evidence that durables outlays are lower than predicted during the period of decline in stock prices. On the other hand, a major proportion, but not all, of the shortfall in outlays on nondurables plus services can be accounted for by reference to the stock market and to the deterioration of wealth, particularly on the basis of the 1964 equation.

CROSS-SECTION RESULTS

Potentially, surveys of individual family units offer a much richer base for testing hypotheses about consumer behavior because their data provide far wider independent variation. Unfortunately, they introduce new statistical problems as well. For one thing, very few surveys have collected the balance-sheet data required to compute a direct measure of wealth. Second, the problem of measurement error is likely to be more severe than it is for time-series data because the surveys must usually rely on the memory of interviewees. Third, the effect of economic variables is difficult to disentangle from that of tastes in comparing individuals in different circumstances. That two individuals in different economic positions consume differently does not mean that, should their economic positions become the same, they would then adopt the same consumption patterns.

An extensive survey of the financial characteristics and income of individuals was conducted by the Federal Reserve Board in 1963.[21] Respondents were reinterviewed in 1964 to obtain data on their income and saving in 1963.[22] The direct measurement of net worth in these surveys has permitted several investigators to use it to test the life-cycle hypothesis—that the consumer unit saves so that its total lifetime resources are distributed over the life cycle in the most favorable pattern of consumption. Regressing saving on income and net worth for several age categories and comparing the results with values previously hypothesized by Modigliani, Brumberg, and Ando,[23] Projector concluded from the differences between the survey's coefficients on wealth and the hypothesized values that the survey evidence was unfavorable for a narrow interpretation of the hypothesis.[24] However, more important for the purposes here, in explaining saving she did obtain significant negative coefficients on net worth in half of the age classes and a highly significant overall effect.

A somewhat more elaborate test with the same data was done by Robert Rasche.[25] He adjusted the income and wealth data prior to estimation to reflect different stages of the life cycle and used a two-year average of income to approximate normal income. Saving was then related to income and beginning-of-period assets. His aggregate equation supports the role of net worth in the saving function, for he obtains a highly significant and plausible coefficient. Unfortunately, disaggregation of the data into five age classes resulted in extremely wide variation in the net-worth coefficient (to the extent that a significant positive coefficient was obtained for individuals under 35 years of age). Thus, he concluded that the results were mixed and inconclusive.

While these studies are only indirectly related to the issue of stock-market effects on consumption because they test the broader issue of the role of

21. Dorothy S. Projector and Gertrude S. Weiss, *Survey of Financial Characteristics of Consumers* (Board of Governors of the Federal Reserve System, 1966).

22. Dorothy S. Projector, *Survey of Changes in Family Finances* (Board of Governors of the Federal Reserve System, 1968).

23. Albert Ando and Franco Modigliani, "The 'Life Cycle' Hypothesis of Saving," *American Economic Review*, vol. 53 (March 1963), pp. 55–84; Modigliani and Richard Brumberg, "Utility Analysis and the Consumption Function: An Interpretation of Cross-Section Data," in Kenneth K. Kurihara, ed., *Post-Keynesian Economics* (Rutgers University Press, 1954).

24. Projector, *Survey of Changes*, pp. 1–2, 17–23, 87.

25. Robert H. Rasche, "Impact of the Stock Market on Private Demand," *American Economic Review*, vol. 62 (May 1972), pp. 224–28.

wealth, a recent study by Irwin Friend and Charles Lieberman includes a direct test of the capital-gains effect.[26] From detailed data about individual stock holdings in the FRB survey, they computed the market value of stock at the beginning and at the end of 1963, as reported on the stock exchanges, and thus were able to estimate capital gains during the year. Friend and Lieberman regressed household saving on normal income (two-year average), transitory income, beginning-of-period net worth, their estimate of capital gains, and several age, occupation, and family-size variables.

The results of their test offer evidence that capital gains and losses do have a contemporaneous effect on saving. The coefficients range between −0.015 and −0.041 and are frequently significant. Since this is a one-year effect only, the results are quite consistent with the MPS time-series equation. This study is a major step in reducing the uncertainty about the effects of capital gains and losses.

As is always the case, however, some doubts arise. First, contrary to the outcome of Rasche's study, the effect of net worth is small and generally insignificant. Good reasons suggest that the wealth coefficient will be biased toward zero in a cross-section analysis (principally, its correlation with "tastes"), but it is difficult to reconcile such divergent results for two studies based on the same data. An effect of capital gains without a corresponding role for wealth again introduces the problem of distinguishing between a wealth and a "sentiment" mechanism. Second, when the data were disaggregated into five age categories, the capital-gains coefficients ranged between −0.165 and −0.003 and were never significant (though perhaps this was a problem of small sample size). In addition, the wealth coefficients changed signs in some cases and were significant for only one age category. Finally, 1963 was a year of major advance for stock prices (the composite index of the New York Stock Exchange rose 18 percent). Thus, to some extent, using capital gains for one year will identify those who have large stock holdings, and thus intensify the problem of correlation with "tastes."

The results of the Friend and Lieberman study are sufficiently strong to justify an attempt to verify the results with other survey data. A four-year panel study of 1,400 families between 1967 and 1970, conducted by the Survey Research Center of the University of Michigan, included the required data on income and balance-sheet items, as well as information on automo-

26. Irwin Friend and Charles Lieberman, "Short-Run Asset Effects on Household Saving and Consumption: The Cross-Section Evidence," *American Economic Review*, vol. 65 (September 1975), pp. 624–33.

biles and other durable-goods purchases.[27] While the quality of the data on net worth is not as high as that of the FRB survey, the panel study offers the major advantage of following the same individual over four interviews.

Estimates of capital gains are limited to two years, 1968 and 1969, because of changes in the form of the questions. These estimates are based on respondents' answers about the market value of their holdings rather than actual market prices, as in the Friend and Lieberman study. These estimates may be wrong, but they seem to be most relevant to the question of what impact capital gains have on consumption behavior.

The total sample was limited to 191 families because most of the interviewees did not own stock, others would not answer all of the questions, and some cases contained obvious errors. This sample is smaller than the 303 cases of households that owned stock, available to Friend and Liberman, but since the data span two years, the number of observations is substantially larger. In addition, 1968 was a year of sharp gains in average stock values, whereas prices fell in 1969.

From the data, a measure of saving can be constructed that excludes the effects of all revaluations of asset prices, while including net purchases of durable goods. As in the Friend and Lieberman study, saving is defined to include an estimate of depreciation on owner-occupied homes.

The saving estimate is, however, subject to serious measurement error. If capital gains are disregarded, saving is equal to the change in net worth: $S_t = NW_t - NW_{t-1}$. In an equation in which beginning-of-period net worth is used to explain saving, there will be an automatic negative correlation between saving and net worth as a result of any measurement error in reporting net worth. The problem was minimized for some asset items because respondents were asked about net purchases, but for most debt items, only beginning- and end-of-period estimates are possible. Friend and Lieberman observed that taste effects would bias the expected negative net-worth coefficient toward zero: households with a high propensity to save will have high net worth. The measurement error, however, will bias the coefficient on net worth in the opposite direction.

The results can be summarized simply: none of the tests yielded a significant coefficient for net worth or capital gains. But in some cases the coeffi-

27. More detailed information about the nature of the survey is contained in Gary Hendricks and Kenwood C. Youmans, *Consumer Durables and Installment Debt: A Study of American Households* (University of Michigan, Institute for Social Research, 1973).

cients on capital gains had the expected sign even though they did not achieve common standards of statistical significance. Most of the equations for durables expenditures were fitted in the following model:

$$(6) \quad EXP_t = a + b_1 YN + b_2 \Delta Y + b_3 NW_{t-1} + b_4 CG_t + b_5 K_{t-1} + DV,$$

where

Y = after-tax income
YN = normal income, defined as the four-year average of after-tax income
ΔY = income growth, defined as the average income of 1968–69 minus that of 1966–67
K_{t-1} = beginning-of-period stock of durables
NW_{t-1} = beginning-of-period net worth
CG_t = capital gains on corporate stock, defined as the change in market value minus net purchases during the year
DV = demographic variables—age of the head of family and family size.

Directly measured expenditures included net purchases of automobiles, household durables, recreational equipment, and vacation expenses. Regressions were estimated for the total as well as individual components; the years 1968 and 1969 were analyzed separately, combined as a two-year sample, and stacked as a single series of observations.[28]

The most favorable results in support of a capital-gains effect on durable-type expenditures were obtained by pooling the data for 1968 and 1969 into one sample and dividing all variables by YN:

$$(7) \quad \frac{EXP_t}{YN} = \underset{(4.7)}{0.143} + \underset{(1.2)}{0.021}\frac{\Delta Y}{YN} - \underset{(0.4)}{0.0015}\frac{NW_{t-1}}{YN} + \underset{(1.4)}{0.023}\frac{CG_t}{YN} - \underset{(1.6)}{0.123}\frac{K_{t-1}}{YN} + DV.$$

This equation explains about 23 percent of the variation in the total of the four expenditure categories. The capital-gains coefficient has the expected positive sign, but it is of marginal significance and the coefficient on net worth is negative.

28. Some equations were also corrected for heteroskedasticity by using YN as the scale variable, but with little effect.

The corresponding equation for saving (*SAVE*) of the combined two-year sample yielded a larger coefficient on capital gains, but again it was not significant, and the coefficient on net worth was not of the expected sign:

$$(8) \quad SAVE_t = \underset{(2.0)}{1553.24} - \underset{(1.9)}{0.244}\, YN + \underset{(4.6)}{0.499}\, \Delta Y + \underset{(1.3)}{0.011}\, NW_{t-1} - \underset{(0.9)}{0.038}\, CG_t + DV.$$

$$R^2 = 0.18.$$

For the regressions based on individual years and individual expenditure components, the capital-gains coefficients were smaller than those reported above and sometimes of the opposite sign. An index of consumer sentiment was also constructed for each individual, using the questions asked in compiling the aggregate index of the Michigan Survey Research Center. This variable was never significant and did not affect the size of the capital-gains coefficient. Thus, the statistical results do not strongly support a capital-gains effect, although the magnitude of the coefficients is within the same range as those reported by Friend and Lieberman.[29] Also, the reported equations yielded the most positive results that were obtained in favor of a stock-market effect. The results for net worth were never significant, and the capital-gains coefficient sometimes bore the unexpected sign.

This survey of the empirical evidence is disappointing in that it does not permit a firm acceptance or rejection of the hypothesis that stock-market fluctuations affect consumer expenditures. Nevertheless, I believe that some tentative conclusions emerge. First, the weight of the evidence supports a positive impact of the stock market on consumption. The impact is not heavy, but extreme fluctuations in stock prices can cause it to be significant in some periods. Second, the results indicate that fluctuations in stock prices do not help explain the erratic short-term behavior of durable-goods purchases. An improved understanding of the behavior of this component probably requires the incorporation of other factors.

IMPLICATIONS FOR MONETARY POLICY

According to the MPS model, the effect that capital gains and losses have on consumption through the wealth mechanism is a major channel through

29. One might argue that relying on respondents' estimates of capital gains results in a larger measurement error than does the method used by Friend and Lieberman. Thus, the standard error in the coefficient would be expected to be larger and the problem is simply that my sample was too small.

which monetary policy alters aggregate demand. This mechanism is completed with the specification of a relationship between rates of return on corporate stock and other assets. By changing market rates of interest, monetary policy can change stock prices, and thus create and destroy wealth.[30] However, this notion that interest-rate changes lead to a chain of changes in stock prices, wealth, and consumption has some conceptual problems, because it combines the effects on consumption of changes in wealth and changes in interest rates even though they may have substantially different behavioral implications.

Stock prices change for a variety of reasons: they may decline because individuals' expectations of total future incomes have declined, because they expect a smaller share of this income to accrue to owners of corporations, or because rates of return on other assets have risen. When stock values decline because of lower expectations of income, consumption can be expected to fall in the current and future periods.[31] This is an unambiguous income effect. If the decline in stock prices results from a rise in interest rates, however, there is a negative substitution effect on current consumption (which was not present in the previous case) plus an income effect from higher interest payments in future periods. The sign of this income effect on current consumption will depend upon whether the individual intended to be a saver or a borrower before the interest-rate change.[32] Although the substitution effect arising from an increase in interest rates depresses current consumption, its magnitude is unrelated to the income effect of the first case, in which expected future income fell. Second, given a negative substitution effect and an indeterminate income effect, the net impact of a change in interest rates on current consumption is uncertain. Thus, the implications for consumption of changes in stock prices spurred by shifts in earnings expectations on the one hand and interest rates on the other have little in common.

30. This issue is discussed in considerable detail in Franco Modigliani, "Monetary Policy and Consumption," in *Consumer Spending and Monetary Policy: The Linkages*, Monetary Conference Series 5 (Federal Reserve Bank of Boston, 1971), pp. 9–84.

31. It is assumed that consumption is not an inferior good.

32. The effect of interest-rate changes on consumption is discussed in greater detail in articles by M. S. Feldstein and S. C. Tsiang, "The Interest Rate, Taxation, and the Personal Savings Incentive," *Quarterly Journal of Economics*, vol. 82 (August 1968), pp. 419–34; M. J. Farrell, "The Magnitude of 'Rate-of-Growth' Effects on Aggregate Savings," *Economic Journal*, vol. 80 (December 1970), pp. 873–94; and James Tobin and Walter Dolde, "Wealth, Liquidity and Consumption," in *Consumer Spending and Monetary Policy*, pp. 104–15.

Certainly, over the postwar period changes in stock prices have reflected primarily changes in expectations of earnings—if for no other reason than that sharp variations in interest rates are a relatively recent phenomenon. Thus, it is questionable that any observed correlation between stock prices and consumption over the postwar period can be used to deduce the effect on consumption of monetary policy. Since the influence of monetary policy involves a substitution effect between current and future consumption, the focus should be upon consumption equations that include an interest-rate variable.

This reasoning conflicts with some formulations of the life-cycle hypothesis of consumption. That hypothesis is commonly interpreted to imply that current consumption is a function of current wealth and the present discounted value of current and future nonproperty income. Since current wealth is simply the present value of future property income, current consumption is a function of the present value of current and future income:

$$C_t = k(PV).$$

If interest rates go up, the present value of future income declines and the hypothesis predicts that consumption in the current period will fall. This prediction appears to contradict the previous statement—that the income effect of interest-rate increases can be positive. The contradiction reflects a misinterpretation of the original hypothesis.

The original budget constraint of Modigliani and Brumberg related the present value of current and future nonproperty income, Y, plus beginning-of-period net assets, a_t, to the present value of current and future consumption, C, over the remainder of an individual's lifetime, L, plus any bequests.[33] If bequests are ignored, this relation can be expressed as

$$a_t + \sum_{\tau=t}^{L} \frac{Y_\tau}{(1+r)^{\tau+1-t}} = \sum_{\tau=t}^{L} \frac{C_\tau}{(1+r)^{\tau+1-t}}, \tag{9}$$

where r is the rate of interest. If current consumption and income are separated, the relationship is

$$C_t = a_t(1+r) + Y_t + \sum_{\tau=t+1}^{L} \frac{Y_\tau - C_\tau}{(1-r)^{\tau-t}}. \tag{10}$$

However, the hypothesis has frequently been used in a form that relates current consumption to the present value of current and future income and

33. "Utility Analysis and the Consumption Function," p. 391.

ignores the present value of future consumption. In equation (10), a rise in interest rates will change both the present value of current wealth, a_t, and the present value of future saving, $(Y_\tau - C_\tau)$. If a_t is positive, a rise in r will reduce its present value; but if the individual has positive current wealth, future expected saving must be negative and a rise in r will increase its present value and thus offset the drop in wealth. The converse will hold for a debtor, who must be planning to have positive future saving.

A rise in stock values that results from revised expectations of future earnings will have a positive effect on current consumption. An equal rise in value that results from lower interest rates will also have a wealth effect on current consumption, but this will be partially offset by a rise in the present value of future consumption. In addition, the interest-rate change will induce some price substitution between current and future consumption. Thus, the two mechanisms by which stock prices can change have different effects on current consumption and one cannot infer an interest-rate effect on consumption from evidence of correlation between such expenditures and changes in stock values.

In summary, the coefficient on wealth in a consumption equation measures an average effect of (1) changes in earnings expectations, and (2) changes in interest rates. There is reason to expect that the first effect will be the larger and that the coefficient on wealth overestimates the impact of changes in interest rates. If an interest rate were included directly in the equation, some of the ambiguities would be resolved, but past efforts (including my own) to do so have been unsuccessful. In the meantime, the current formulation is of limited value in measuring the impact on consumption of monetary policy.

Investment

The stock market and investment behavior are intimately bound together since firms invest to earn profits, and activity in the stock market represents an attempt by investors to evaluate the magnitudes of that stream of profits. But any attempt to go beyond that obvious statement to determine a causal relationship involves many issues that remain controversial. Several of these can be illustrated by reference to the neoclassical model of investment demand, which has been used in many empirical studies.

According to the neoclassical model, the competitive firm attempts to

maximize the present value of its future income stream. If there exists a resale market for capital, and if constant returns to scale in production is a close approximation to reality, the firms' desired capital stock in equilibrium, K^*, is given by

$$K^* = A'\left(\frac{P_q}{P_k^s}\right)^{\sigma} Q, \tag{11}$$

where

A' = a constant given by the specific production function and competitive conditions in the product market and factor markets
P_q = price of output
$P_k^s = P_k\left(r + d - \frac{\dot{P}_k}{P_k}\right)$ = rental price of capital
P_k = price of capital
r = discount rate (cost of capital)
d = depreciation rate
σ = elasticity of factor substitution
Q = output.

The logic of the rental-price concept is simply that the cost of holding a unit of capital for one period is equal to the interest cost, plus depreciation, less any capital gain arising from price changes in the resale market.[34]

For such a model the cost of capital can be measured by a weighted average of the cost of different sources of financing.[35] If the value of the firm is the sum of bonds and stocks outstanding, the discount rate is represented by the weighted average of the returns on these two assets. Thus, the stock market seems to affect the firm's investment decisions through its influence on the cost of financing or the appropriate discount rate.

In empirical work the model embodied in equation (11) must be expanded to include the effects on the rental price of capital of numerous tax mea-

34. A more detailed development of the model can be found in Dale W. Jorgenson, "The Theory of Investment Behavior," in Robert Ferber, ed., *Determinants of Investment Behavior* (Columbia University Press for the National Bureau of Economic Research, 1967); Robert E. Hall and Dale W. Jorgenson, "Application of the Theory of Optimum Capital Accumulation," in Gary Fromm, ed., *Tax Incentives and Capital Spending* (Brookings Institution, 1971); and the references included in both studies.

35. See, for example, Franco Modigliani and Merton H. Miller, "The Cost of Capital, Corporation Finance and the Theory of Investment," *American Economic Review*, vol. 48 (June 1958), pp. 261–97.

sures, and to allow for some mechanism by which the actual capital stock is brought to the desired level. Many estimates have excluded the yield on stock from the cost of capital and have used either a constant discount rate or the bond rate alone. Thus, they do not provide direct evidence of the effect of changes in stock prices.

The simplified model can be used to highlight the issues. First, the range of substitution possible between capital and labor in the production process plays a crucial role. If this elasticity is zero, as some investigators have argued, relative prices play no role in the model and stock-market fluctuations are irrelevant. This is the basis of the accelerator model, in which the desired stock is related only to expected output. The argument for a low elasticity of substitution rests on three debatable assertions: (1) alternative production methods do not exist except in the presence of large changes in relative prices; (2) firms do not have full a priori knowledge of the alternative techniques available and of future prices; or (3) firms do not maximize profits. Jorgenson and his associates, on the other hand, have typically assumed an elasticity of one in their studies and cite supporting evidence from specific studies of industry production functions.[36]

Second, the model assumes, obviously contrary to fact, that capital has a full resale market so that it becomes a variable rather than a fixed factor of production. It is this assumption that is responsible for the simple myopic rule that relies solely on current values of the economic determinants of the desired capital stock; there is no need to forecast output and relative prices.

Third, the measure of the cost of capital, r, as a weighted average of bond and stock yields serves merely as a definition for the individual firm. Unless one can specify how the return on stock (expected capital gains as well as dividends) is determined, the relationship has no behavioral implications. Such specification is empirically difficult because expected capital gains are not observable; yet they are a key element of the return on stock. Management must be viewed as approving those projects expected to increase the firm's market value. The weighted-average measure of the cost of firms is

36. This issue still has not been completely resolved, but the arguments are well represented in a series of articles in *Review of Economics and Statistics:* Robert Eisner and M. I. Nadiri, "Investment Behavior and Neo-classical Theory," vol. 50 (August 1968), pp. 369–82; Dale W. Jorgenson and James A. Stephenson, "Issues in the Development of the Neoclassical Theory of Investment Behavior"; and Charles W. Bischoff, "Hypothesis Testing and the Demand for Capital Goods," vol. 51 (August 1969), pp. 346–53, 354–68, respectively.

simply an ex post estimate of the accuracy of those expectations.[37] In addition, the measurement of the cost of capital is not so simple when taxes, transaction costs, and bankruptcy risk are introduced into the model. In this case the market value of the firm, and thus its cost of capital, may reflect its financial as well as its production decisions.

THE STOCK MARKET AND THE COST OF CAPITAL

Bischoff has done considerable empirical work with an investment equation that is a variant of the neoclassical formulation. As applied to business investment in equipment, this equation defines the cost of capital as a weighted average of the bond rate (adjusted for inflation expectations) and the dividend-price ratio. The weight assigned to the dividend-price ratio is about half of that for the bond rate. This measure of the return on corporate stock ignores the expected capital gains, but the inclusion of the stock-market variable seems to improve the performance of the equation.[38]

The equation implies that the elasticity of investment spending in equilibrium with respect to a change in the dividend-price ratio is about 0.12 (with relative prices and tax rates of 1972). This would translate to a decline of about $3.5 billion (1972 dollars) in investment spending for a rise of 1 percentage point in the dividend-price ratio. Even this effect would require considerable time to have its full impact because of the lag between changes in the determinants of investment, the placement of new orders, and production. At a constant level of output, about one-half of the impact would be felt after one year and the full adjustment would be stretched over about four years.

37. If all risk accrues to stockholders, the bond rate can be viewed as approximately exogenous to the firm, but the return on stock reflects the personal-risk characteristics of the firm relative to others and expectations for the specific investment projects that it undertakes. To the extent that the risks associated with individual firms are uncorrelated, diversification by investors or mergers of firms can reduce the importance of the risk component.

38. For the formulation of the equation and a discussion of its properties, see Charles W. Bischoff, "The Effect of Alternative Lag Distributions," in Fromm, ed., *Tax Incentives and Capital Spending*, pp. 61–125. The version used in the MPS model differs in a few minor respects from that reported in the Bischoff chapter, and is published in Albert K. Ando and others, "On the Role of Expectations of Price and Technological Change in an Investment Function," *International Economic Review*, vol. 15 (June 1974), pp. 384–414.

The recent decline in the stock market raised the dividend-price ratio by 2.7 percentage points from fourth quarter 1972 to fourth quarter 1974. Had the decline been permanent, the equation would project a $9 billion shrinkage in investment. This is not a trivial amount but, because of the response lags, it cannot be a major source of the depressive forces at work in 1973 and 1974.

The MPS model uses a similar equation to explain nonresidential construction. The elasticity of substitution is estimated to be 0.45 rather than the 1.0 of the equipment equation; but some offset comes from a larger role for the dividend-price ratio in the cost-of-capital term. As a result, the elasticity with respect to changes in the stock market is nearly identical to that of equipment, 0.12. The dollar magnitude is smaller since outlays for structures are about one-half to one-third of those for equipment. Again, the lag extends over three years with one-third of the effect felt by the end of the first year. A permanent decline of stock values to the levels of the fourth quarter of 1974 would reduce total investment (equipment plus structures) by $15 billion.

THE SECURITIES-VALUATION MODEL

An alternative approach to investigating the link between the stock market and investment, the securities-valuation model, places greater emphasis upon the stock market as a determinant of investment demand. James Tobin and William Brainard, in particular, have used a model in which investment is determined by the ratio of the market value of the firm to the replacement cost of its physical assets.[39] When this ratio, q, is greater than unity, the value of capital in the market is higher than the cost of producing it, and investment is stimulated. In Tobin's model of the financial process, q provides the link between the real and financial sectors since it represents the ratio of the net return on real assets to the return on equity.[40] Monetary policy can influence real activity by affecting the rate of return on equity. An increase in the quantity of money reduces short-term bond rates; and through portfolio-balance adjustments the public's demand for equities is increased, lowering the required return and raising q.

39. William C. Brainard and James Tobin, "Pitfalls in Financial Model Building," *American Economic Review*, vol. 58 (May 1968), pp. 99–122.

40. See, for example, James Tobin, "A General Equilibrium Approach to Monetary Theory," *Journal of Money, Credit and Banking*, vol. 1 (February 1969), pp. 15–29.

Although it appears much different, the securities-valuation model is conceptually identical to the version of the neoclassical model used in most empirical studies. Both are based on the first-order condition for profit maximization by which the marginal product of capital must equal the ratio of its service price to the price of output. In terms of the notation of equation (11), this is

$$\frac{\delta F}{\delta K} = \frac{P_k(r + d) - \dot{P}_k}{P_q}. \tag{12}$$

In most of the work with the neoclassical formulation, as reflected in the studies by Jorgenson and others, a specific form of the production function is assumed and the expression for the marginal physical product of capital is inserted into equation (12). The solution yields a desired capital stock in terms of expected output, relative prices, and the discount rate. The securities-valuation approach, on the other hand, is derived by rewriting the equilibrium condition as

$$\frac{P_q}{P_k}\frac{\delta F}{\delta K} - d + \frac{\dot{P}_k}{P_k} = r. \tag{13}$$

The term on the left-hand side is simply the net marginal revenue product of capital relative to its price. If q is defined as the ratio of this return to the discount rate, r, a value of q greater than unity implies a disequilibrium condition in which the rate of return is greater than the discount rate (cost of capital) and further investment is profitable.

The securities-valuation formulation offers the advantage of not requiring the explicit measurement of the effect of taxes, expected output, and expected prices needed in the neoclassical version. This simplification results from the assumption that the market correctly values the future earning capacity of the firm. If the firm seeks to maximize the discounted value of its future income, and investors have the same information as the firm's managers, the two groups will reach identical conclusions. In other words, an estimate of the discrepancy between the actual and desired capital stock of the neoclassical model is available by comparing the market value of the firm with the replacement cost of its current capital stock.

The model introduces some new problems, however. First, the ratio of the market value of the firm to the replacement cost of its capital is a measure of the average rather than the marginal expected return on capital. Many instances can be given of divergence between these two measures. If a full resale market for capital existed, one could, in principle, adjust the

existing capital stock to reflect the effects of sudden obsolescence; but, in fact, current replacement value must be obtained by assuming a depreciation rate and valuing the stock with prices for new capital. Also, the risk of the potential income from an increment to new investment differs from that associated with existing capital. Moreover, the value of a firm reflects assets other than its physical capital, and at the empirical level the model encounters difficulty in accurately valuing them. Some of these assets, such as patents and knowledge of the market, constitute barriers to the entry of other firms.

The most serious problem with the approach as a vehicle for understanding investment behavior is that it shifts the focus from what determines a firm's investment to what determines values in the stock market. It does not seem practical to focus upon responses in the stock market to measure the impact on investment of a change in tax law. Nor does it seem reasonable to believe that the present value of expected corporate income actually fell in 1973–74 by the magnitudes implied by the stock-market decline of that period, when q declined by 50 percent. Of course, an equilibrium relationship must exist between the market value of a firm and the replacement cost of its capital. But it is quite another thing to infer a causal mechanism from this relationship and to allege that changes in stock prices reflect only revised evaluations of the discounted value of prospects for corporate earnings. As long as management is concerned about long-run market value and believes that this value reflects "fundamentals," it would not scrap investment plans in response to the highly volatile short-run changes in stock prices.

Despite the fact that the securities-valuation model leaves the basic determinants of investment in a black box, it may have some value as a forecasting device if other models cannot accurately reflect the complex forces that drive investment demand in the aggregate. An empirical version has been estimated in studies by Bischoff and by Ciccolo.[41] Bischoff estimated the model for total business investment for the 1953–68 period. The model did not fit the data as well as a simple accelerator model or the MPS version of the neoclassical model, and an extremely high level of autocorrelation required that the equation be estimated in first-difference form. In terms of average estimation errors, the differences among the equations were not

41. Charles W. Bischoff, "Business Investment in the 1970s: A Comparison of Models," *BPEA, 1:1971*, pp. 13–58; and John H. Ciccolo, Jr., "Four Essays on Monetary Policy" (Ph.D. dissertation, Yale University, 1975).

great, however: the standard errors of estimate for the securities-valuation equations were about 20 percent greater than those of the MPS version of the neoclassical model. The results of forecasting beyond the period of fit were more clearly unfavorable to the securities-valuation model: the average forecast error for 1969–70 was about twice that of either the accelerator or the MPS equation.

Ciccolo developed a somewhat more refined measure of q based on data for nonfinancial corporations. He finds a significant relation between total investment, I, deflated by the gross stock of capital, and an eight-quarter lag structure on q for the period 1953–73:[42]

$$(14)\quad 100\, I_t/K_{t-1} = \underset{(3.46)}{7.75} - \underset{(4.2)}{12.16}(500/K_{t-1}) + 5.25 \sum_{i=1}^{8} w_i q_{t-i} + 0.966 u_{t-1}.$$

$$R^2 = 0.98; \text{ standard error} = 0.15.$$

The equation reflects a very strong effect of changes in q on net investment; but the autocorrelation continues to be severe, as in the equation estimated by Bischoff. The equilibrium coefficient of 5.25 on q implies an elasticity of investment with respect to q of 0.77. With this elasticity, the change in the dividend-price ratio between the fourth quarter of 1972 and the fourth quarter of 1974 had a permanent impact on investment of $35 billion, compared with an estimated $15 billion reduction in the MPS model.

Thus, the two models yield substantially different estimated magnitudes of stock-market effects. The MPS model emphasizes the cyclical importance of output and assigns the stock market a secondary role, operating through the cost of capital. The alternative assigns all of the cyclical changes in investment to the stock market.

The MPS equations fit the historical data with a smaller standard error and with less evidence of autocorrelation in the residuals. For these reasons, that version of an investment equation warrants preference. It is also a more interesting way to estimate the effects on investment of changes in tax and monetary policy. However, the securities-valuation model does fit the data nearly as well, and has the advantage of being a very simple formulation.

42. The series on investment data is gross private domestic nonresidential investment, as reported in the national income accounts. The gross capital stock is published in John C. Musgrave, "New Estimates of Fixed Nonresidential Business Capital in the United States, 1925–73," *Survey of Current Business*, vol. 54 (March 1974), pp. 23–27. The estimate of the q ratio is published as an appendix to Ciccolo, "Four Essays."

Table 3. Prediction Errors[a] for Business Investment, Second Half 1972–1974
Annual rates in billions of 1958 dollars

Year and half	*Adjusted for autocorrelation*		*Unadjusted forecast errors*	
	MPS model equation (1)	*Securities-valuation equation (2)*	*MPS model equation (3)*	*Securities-valuation equation (4)*
1972:second	−0.9	0.0	−1.1	1.7
1973:first	0.4	1.2	0.4	−1.3
second	−0.3	0.2	−0.2	−1.3
1974:first	0.0	1.1	−0.1	−3.0
second	−1.1	−1.0	−1.3	−2.4

Source: Calculated by the author. The errors of columns (1) and (2) are adjusted by the estimated autocorrelation coefficients for each equation. These were 0.98 for the securities-valuation model and 0.4 and 0.6 for the equipment and structures equations, respectively, of the MPS model. As such, the errors should be interpreted as averages from one-quarter forecasts. Columns (3) and (4) show the forecast errors with no correction for autocorrelation.

a. Actual minus predicted.

SOME FORECAST RESULTS

As with those for consumer expenditures, these equations can be compared with regard to the accuracy of their forecasts for the 1973–74 period. An equation similar to that of Ciccolo was estimated to exclude the 1973–74 period. The equipment and structures equations of the MPS model were estimated with data that extended only through mid-1968, so that the forecast is well outside its own period. The prediction errors are shown in table 3, both with a correction based on the autocorrelation parameter of the estimated equations and with no adjustment for autocorrelation.

The MPS equations have very small forecast errors throughout the period. Furthermore, they show no obvious tendency to over- or underpredict the actual values. However, the semi-annual presentation of the data does not fully reflect the failure of the equipment equation to forecast the collapse of new orders in late 1974 and early 1975. Orders fell 14 percent in the fourth quarter of 1974 and an additional 12 percent in the first quarter of 1975, but the equation forecast a decline of only half this magnitude.

The securities-valuation model also does very well in the one-period forecasts of column (2), except for a noticeable tendency to underpredict investment in the early period. The equation tends to perform slightly better than the MPS equations during the large declines in investment in late 1972 and

early 1975 (not shown in the table). It predicts a large decline in investment prematurely, but ultimately is proved right. This equation also benefits in a comparison with the MPS equations because the latter are based on new orders for equipment, which is a more volatile data series than that for expenditures. However, the securities-valuation model proves useful as an alternative method of forecasting investment demand.

Aggregate Demand and the 1973–74 Decline in the Stock Market

Previous studies have sought the causes of the current recession in monetary and fiscal policy, the rise in world energy prices, and shortages of food and raw materials. Certainly, the stock market cannot be considered as an additive, independent factor, because it reflected many of these other factors. But to what extent did these depressive influences on aggregate demand operate through the stock market? Although some questions were raised in earlier sections of this paper about the estimated size of stock-market effects within the MPS model, it does provide an order of magnitude for evaluating the importance of the effects on consumption and investment expenditures.

The results of a simulation of the MPS model in which the dividend-price ratio was held at its late 1972 value are reported in table 4. This simulation measures not only the direct effects of the decline in stock prices but also the secondary multiplier effects. The total depressive effect on gross national product is very modest throughout most of 1973, but it rapidly builds to $28 billion (1958 prices) by the first quarter of 1975. Most of the direct effects are concentrated in consumer expenditures, which account for half of the total decline and which in turn account for much of the drop in investment expenditures as a secondary effect. The equipment equation has long lags on changes in relative prices so that less than half of the reduction is due to direct effects of the stock market.

In order to place the simulated decline in some perspective, the final column of table 4 shows the total reduction in GNP from a level consistent with the same ratio of actual to potential GNP that was achieved in the fourth quarter of 1972. Thus, the MPS model implies that approximately one-fourth of the depressive effects on the economy over the 1973–74 period operated through the stock market.

On balance, the results of the first section of this paper imply that the

Table 4. Simulated Effects on Aggregate Demand of Stock-Market Decline, Quarterly, 1973–1975 :1

Annual rates in billions of 1958 dollars

Year and quarter	*Predicted change in demand*				*Total recession gap*[a]
	Consumption expenditures	*Producers' durable equipment*	*Non-residential construction*	*Total gross national product*	
1973:1	0.0	0.0	0.0	0.0	10.5
2	−0.2	0.0	0.0	−0.3	7.0
3	−1.3	−0.1	−0.1	−2.0	2.2
4	−3.3	−0.3	−0.2	−5.3	−1.1
1974:1	−5.8	−1.0	−0.6	−9.8	−24.6
2	−8.6	−2.0	−1.2	−15.1	−36.5
3	−11.3	−3.3	−2.1	−19.9	−48.9
4	−13.7	−4.9	−3.4	−24.4	−76.7
1975:1	−14.9	−6.4	−4.9	−28.1	−109.4

Source: Simulation results of the MPS model with dividend-price ratio held at the value for 1972:4. The values in the table indicate the estimated decline in demand due to the drop in the dividend-price ratio below the value for 1972:4.

a. Reduction in GNP from the 1972:4 level, maintaining a constant ratio of actual to potential GNP.

total effect on consumption of stock-market changes may be overestimated because the effect is constrained in the model to equal that of changes in other forms of wealth. But the estimated effects on investment do not seem to be excessive. Thus, the significant size of the simulated impact on GNP offers a strong justification for further attempts to integrate the stock market more fully into models of the aggregate economy.

Comments and Discussion

Saul Hymans: One of Bosworth's findings perplexes me, and I would like to focus on it. Assuming that the stock market affects aggregate consumer demand by a wealth effect, I would expect it to operate primarily on the purchase of durables. Thus, an increase in stock-market wealth should permit a narrowing of the discrepancy between the actual and the "permanent," or "desired," flow of consumption services from durable goods. But the impact does not work through durables, either in Bosworth's own equations or in his disaggregation of the MPS equation. Rather, it operates through nondurables and services, and that strikes me as a paradoxical result.

Bosworth may provide a clue to the paradox when he points out that the stock market is significant only if post-1965 data are included in the equation. I wonder whether, in fact, it is mainly the 1968 and 1969 data that give the stock market its explanatory power. According to Okun's post mortem of the tax surcharge (*BPEA, 1:1971*), nondurables and services may have overadjusted to the surcharge in 1968–69. In this period stock prices fell, and hence help to explain nondurables consumption in 1968–69. Further, the paper shows that, when 1973–74 data are included, the stock-market movement helps even more to account for the weakness of nondurables and services in that period, although it may enlarge the errors in earlier periods. These instances illustrate a general tendency that I discussed in my first paper for *BPEA, 1:1970:* wealth variables can be used very successfully as devices to shift the big errors of consumption equations from one period to another.

On the other hand, according to Okun's study, auto demand moved perversely in the period of the tax surcharge. Thus, if the stock market helps the nondurables equation because of the 1968–69 episode, it almost surely

has to be a detriment when included in the durables equation. The peculiarities of 1968–69 may thus explain the paradox.

As Bosworth points out and as I indicated in my paper on durables and consumer sentiment (*BPEA, 2:1970*), the stock-market variable may operate through its effect on consumer sentiment or its effect on wealth. If it is operating as a sentiment measure, then it is not terribly surprising that the durables equation is not aided by the stock-market variable, because that equation contains the unemployment rate, the rate of inflation, residential building, income changes, and the like. Those are apparently sufficient indicators of the consumer's frame of mind; even the Juster-Wachtel filter got filtered out of the equation when they were included in it.

In my 1970 paper I found that stock prices helped explain consumer-durables purchases, but only with a marginally significant coefficient and only in the absence of a measure of consumer sentiment. When such a measure was included, especially in a filtered form, the stock-price variable became totally insignificant. It was on that basis that I conjectured in 1970 that the stock-price variable was serving as an incomplete measure of consumer sentiment, rather than playing a wealth role, in the durables equation. Bosworth has repeated that experiment by including the major determinants of the consumer sentiment index rather than the index itself; when he puts in the index as well as those determinants, it is insignificant.

Bosworth cannot eliminate our empirical ignorance, but he can explain its existence by invoking the offsetting income and substitution effects that follow interest-rate changes, according to the neoclassical theory of consumer demand. Given that reasoning, some interest rates must be included if the equations are to operate the way neoclassical demand theory says they should. Yet he can find no role for interest rates in the final consumption equations. That may be a serious omission, and interest rates may flunk the statistical tests because their influence may be reflected implicitly through other variables in the consumption equation. The durables equation has a residential-building variable that will strongly reflect differentials between long and short interest rates. The nondurables equation includes wealth in forms other than corporate stocks, a major component of which is liquid assets, which reflects the cash-balance ratio and hence is moved by interest rates. Therefore, interest rates are indirectly in the equations and are intermingled with the wealth variables.

With all these pitfalls in mind, Bosworth realized that the only way the complex behavioral hypotheses could really be tested is with masses of solid

microeconomic data. Unfortunately, the data he had were of small mass and not too solid, and so they could not deliver unambiguous verdicts.

In the discussion of business fixed investment, I was astounded by table 3, which contains the prediction errors of that component for alternative equations, with and without adjustments for autocorrelation. The MPS equation, fitted only through mid-1968, appears to explain business fixed investment from mid-1972 through mid-1974 with a degree of precision that is usually reserved for forecasts of corporate dividends, capital consumption allowances, and personal transfers to foreigners. Should I believe that the MPS model has really unlocked all the mysteries of capital spending? In any case, the lags in the equation are so long that the stock-market effects on business fixed investment in 1973 and 1974 are minimal.

Because I believe that the main disputes about stock-market effects on both consumption and investment remain unresolved despite Bosworth's diligent and capable efforts, I am skeptical of the final calculation, which simulates the MPS model to conclude that the stock market accounts for about 25 percent of the recent recession.

Franco Modigliani: Barry Bosworth has provided us with a very useful review of present knowledge concerning the impact of the stock market on aggregate demand, at least in the United States. I will concentrate my attention on the portion of his paper dealing with the more controversial effect via consumer expenditure.

First, a good deal of evidence both from time-series and cross-sectional studies now confirms an important effect of wealth on consumption. Bosworth has limited himself to the American evidence, but similar evidence is accumulating for other countries.[1]

However, the central issue for Bosworth is the specific influence of the part of wealth that is embodied in corporate stocks. Both because it is subject to large fluctuations through capital gains and losses, and because its ownership tends to be highly concentrated, this portion could have a smaller effect on consumption. When the consumption function of the MPS model was estimated using data for the years 1954–70, it was found that stock-market wealth had pretty much the same final effect on consumption as the rest of wealth. In the final estimation the coefficients of the

1. Some of this is reviewed in my article, "The Life Cycle Hypothesis of Saving Twenty Years Later," in Michael Parkin and A. R. Nobay, eds., *Contemporary Issues in Economics* (Manchester University Press, 1975), pp. 2–35.

two components of wealth were constrained to be equal since this equality is implied by the standard version of the life-cycle hypothesis (although different coefficients would be consistent with the generalized version allowing for a bequest motive). However, other wealth exerts its effect immediately, whereas the estimated effect of stock wealth is spread over two years, implying that capital gains or losses are only gradually recognized and incorporated into perceived wealth. Bosworth's reestimation of the equation through 1972 yields a stock-market coefficient only moderately lower than that for other wealth. Furthermore, table 2 shows that when the MPS and the reestimated Bosworth equations are extrapolated to 1973 and 1974, the MPS, with the constrained coefficient, performs better.

Nonetheless, Bosworth remains skeptical about the effect of the stock market on consumption primarily because, despite his attempts, he was unable to find much evidence of an effect of capital gains on the purchase of consumer durables. He suggests that if wealth—especially capital gains —has any effect at all on consumer expenditure, it must surely have it on expenditure for durables. Hence, he concludes by questioning the credibility of the "result obtained in these equations of a positive wealth and stock-market effect on nondurables and services and no effect of either on durables purchases."

This conclusion is not warranted. In the first place, Bosworth's results are not altogether inconsistent with the model underlying the MPS equation for durables expenditure which, he acknowledges, is "not dissimilar from that of other studies." That model does not imply a "direct role for either wealth or fluctuations in the stock market." It implies only an indirect effect, in that expenditure depends on the gap between the desired and the lagged stock, the desired stock depends on life resources approximated by consumption and, finally, consumption depends on wealth. But this indirect effect is really negligible, since the coefficient of consumption in the durables equation can be put at around 0.15, and the coefficient of wealth on consumption at but 0.05. Thus, if consumption is eliminated, as in Bosworth's equation in table 1, column (4), the coefficient of wealth should be 0.15×0.05, or less than 0.01, and the coefficients of the distributed lag for capital gains should be but a fraction of this figure. Thus, the poor results obtained for wealth in table 1 are not seriously inconsistent with the implications of the MPS model, especially allowing for the high multicollinearity that clearly plagues the coefficient estimates in column (4).

Bosworth's suggestion to the contrary seems to rest on the consideration

that the MPS formulation, as well as many other models, hypothesize and find a separate effect on durables purchases coming from some measure of transitory income. This result is usually attributed to the fact that most transitory income will not be spent on current consumption, but instead will be saved, and that durables may be a favorite form of investment of this transitory saving, or windfall addition to wealth. Since capital gains also represent a windfall, should they not have a similar effect on durables purchases? I can see three reasons for casting doubt on this conclusion.

In the first place, while the saving out of transitory income will typically be in the form of money, which can be invested in any asset, capital gains will accrue and be embodied in some specific asset: to invest them in durables would require liquidation of some assets and shifts into others. Second, the interpretation of the strong effect of transient income on durables as evidence that windfall additions to wealth tend to be invested in durables to an unusual extent is open to some question. The fact that a variable like unemployment can effectively take the place of transitory income[2] suggests an alternative explanation in terms of cyclical variations in consumers' confidence and perception of uncertainty. Finally, even if there were some tendency for additions to wealth from transitory income to stimulate purchases of durables, it may not operate, at least to any comparable extent, for additions resulting from capital gains. The reason is that transitory income will tend to be distributed far more widely than capital gains from the stock market; in particular, a good portion of transitory income will accrue to younger households, which typically invest most of their net worth in durables and would own a yet larger stock except for their lack of net worth. For these people, an addition to net worth, whether windfall or not, is likely to be invested largely in durables. On the other hand, the stock of durables of those who receive the bulk of capital gains is unlikely to be limited by net worth. Hence, one would not expect them to respond by investing in durables except to the extent that their permanent income has been lifted—which is essentially the rather small effect discussed earlier.

These considerations do not support the view that wealth or capital gains should play a *major* role in explaining purchases of durables. It remains disappointing that Bosworth found *no* role in his time-series analysis and only a very limited one in his cross-section results. On the other hand, Frederic

2. See, for example, F. Thomas Juster and Paul Wachtel, "Anticipatory and Objective Models of Durable Goods Demand," *American Economic Review*, vol. 62 (September 1972), pp. 564–79.

Mishkin, in a yet unpublished paper[3] in which he allows for the effect of default risk on the desired stock of durables, finds a very strong positive effect of (financial) assets and corporate stock in particular, although only when he simultaneously allows for the negative effect of consumer debt.

In conclusion, I suggest that Bosworth both considerably overstates the case for a strong effect of wealth on durables and probably understates the actual effect. On both grounds, his lack of success in establishing an empirically significant effect of wealth on durables does not seem to justify rejecting or seriously questioning the substantial evidence on the effect of wealth on consumption.

The second major issue raised by Bosworth is that "one cannot infer an interest-rate effect on consumption from evidence of correlation between such expenditure and changes in stock values." Stated more operationally, to estimate the effect of a rise in interest rates on consumption as the decline in the market value of wealth due to the rise in capitalization rates (holding the anticipated profit flow constant) multiplied by the coefficient of wealth, as is typically done—in simulations of the MPS, for example—is unwarranted, and apt greatly to overestimate the negative effect. This is an important point, and as I see it, logically valid, even though Bosworth may exaggerate its empirical importance. Unfortunately, it is not easy to clarify the issues in a few lines. Briefly, the life-cycle hypothesis implies that, in the neighborhood of a steady growth path, consumption is linear and homogeneous in permanent labor income (YL) and wealth (A), but with coefficients depending on the long-run real rate of return or capitalization rate (r). If the coefficient of the wealth component is approximated by a linear function of r, then one can write

$$C = \alpha YL + \delta A + \mu rA. \tag{1}$$

Note that in the last term, rA is simply expected permanent property income. Also μ can be shown to be closely (and negatively) related to the strength of the substitution effect. In this sense, the life-cycle hypothesis does allow for interest-rate effects which operate through time preference. In the MPS it is further assumed that, to a first approximation, $\mu \cong \alpha$, so that the last term can be lumped with the first and becomes permanent income. This assumption is a strong one, but is extremely convenient, as it avoids the necessity of allocating taxes between labor and property income

3. "Illiquidity, Consumer Durable Expenditure and Monetary Policy" (Massachusetts Institute of Technology, April 1975; processed).

and is at least vaguely consistent with other evidence (although further work is in progress to test it directly).

Now suppose a one-time change occurs in the capitalization rate, *r:* can its effect be inferred from (1)? Unfortunately, the answer is very different in terms of short- and long-run effects. Given time enough, so that all existing assets are held by people who saved on the basis of the new *r*, equation (1) will hold again, and at the same time the value of assets will have changed to a new steady-state path.[4] One can show that a rise in *r* will raise the asset path and certainly increase consumption, although it may either raise or lower the saving ratio. But the short-run, impact, effect is radically different, and Bosworth is correct in asserting that it cannot be readily inferred from the coefficients of (1). Given an unchanged expectation of the stream of returns from existing (final) assets of society, the rise in *r* will produce a fall in *A*. However, this need not produce an unfavorable "income effect" because the present value of future planned consumption, against which those assets were held, will also decline. The outcome for an individual will depend on how well his portfolio is hedged: a retired person with assets promising a stream exactly matching his consumption plan would suffer no income effect; a nonretired person whose unhedged consumption was to come from later saving would have a favorable income effect. For society as a whole, the net outcome would depend on whether the decline in *A* plus the decline in the present value of expected income exceeded the reduction in the present value of consumption planned by those present at the time. I do not at this time know of any way to assess this net outcome. My hunch is that, on balance, the income effect is likely to be negative, in part because many assets are long-lived relative to consumption horizons, and in part because wealth holders may not attribute the decline in wealth fully to the change in *r*, and hence may fail to discount future consumption appropriately. The problem is further complicated by the effect that a change in interest rates may have on the risk premium intervening between real long-term interest rates and capitalization rates for equity. But even if the overall effect (including the substitution effect) is negative, it is most likely to fall short of δ. On the other hand, the wealth coefficient of the MPS consumption function was estimated over a period in which some of the changes in *A* were the result of changes in *r;* to this extent, that coefficient is likely also to underestimate the parameter δ of (1), though it may still overestimate the true effect of a change in *r*.

4. See the results in "Life Cycle Hypothesis of Saving."

In the light of Bosworth's criticism and the above analysis, I would conclude that (1) further work needs to be done in disentangling the short-run and long-run effects of changes in *r;* and (2) in the meantime, users of the MPS model should be aware that estimates of the impact of monetary policy through consumption must be taken with extra caution, and are likely to be biased upward, in part also because of related objections raised by Tobin and Dolde in the work cited by Bosworth.

Barry Bosworth: I stand somewhere between Hymans and Modigliani in their reactions to the absence of a measured stock-market effect on durables consumption. I cannot fully accept Hymans' demonstration that it is an overwhelming puzzle, nor can I accept Modigliani's assurances that it is no puzzle at all. After devoting a lot of time trying to include interest rates in these equations and taking out some of the other variables that might be correlated with interest rates, I am convinced that the answer does not lie in interest-rate effects or liquidity effects, as Hymans believes.

Hymans' argument about the role of the consumer sentiment index makes sense for the aggregate time series. But the Michigan panel study provided an attitude index for each person; following the individual household through time, I can find no correlation between attitudes and either purchases of durables or saving. The cross-section results cannot be dismissed on the basis that the stock market reflects attitudes. The fact that people own widely varying amounts of stock and thus experience sharply different amounts of capital gains should be enough to break the correlation with overall attitudes. But then my own results from cross-section data were much weaker than those of Friend and Lieberman.

Finally, I would like to reiterate my conclusion that it is inappropriate to use the MPS model to measure the impact of monetary policy on consumption. Modigliani seems to agree with my conclusion, but presents some arguments for believing that the true effect may not be sharply different from the MPS estimate.

General Discussion

A number of participants expressed reservations about Franco Modigliani's explanation of the lack of a significant stock-market effect upon durables consumption. Thomas Juster argued that uncertainty tended both

to shorten the horizons of decisions and to encourage portfolio diversification. He and Arthur Okun felt that, through the first effect, there was as much reason to expect transitory wealth effects on durables as to expect the effects from transitory cyclical changes in income that make durables so cyclically sensitive. Nor could Modigliani's case rest on low income elasticities for durables, asserted both Okun and Martin Feldstein: cross-section studies reveal income elasticities of durables demand at least as high as those of nondurables. James Pierce joined Juster in stressing the portfolio aspect of gains or losses in stock-market wealth, through which holdings of durable consumer goods should be expected to respond. Pierce suggested that relatively minor speedups or slowdowns of purchases of autos and household durables could show up as substantial effects.

Modigliani reiterated his expectation of some stock-market effect on durables but was not surprised that it was small enough to be missed by the equation. One possible explanation for the empirical puzzle might lie in the distribution of capital gains from the stock market: they accrue to wealthy, older individuals, who are not likely to accumulate substantial amounts of durables. In this case, remarked R. A. Gordon, it would be useful to disaggregate the durables equation by income and age class.

Feldstein, John Shoven, R. A. Gordon, and Juster suggested ways that consumer sentiment and expectations might be handled more effectively. Feldstein was concerned about the simultaneous-equation bias that might arise in regressions fitted by ordinary least squares. Shoven elaborated on that point, questioning whether movements in consumption and investment could be validly attributed to the stock market when the stock market itself is strongly influenced by economic forces. Stock prices must be treated as endogenous variables, he concluded. Juster also suggested experimentation with longer lags on the index of consumer sentiment and with other measures of consumer sentiment, such as the variance of expected price changes. Finally, Juster saw a possible defect in the regressions arising from the calculation of wealth other than corporate equities. Much of that is the housing stock, which necessarily is almost perfectly correlated with imputed consumption services from housing. By using that as an "independent variable," Bosworth explains consumption by a variable that includes consumption. R. A. Gordon urged the use of tests that allowed for the possibility that fluctuations of the stock market influenced buying sentiment indirectly even for those who had no stock-market wealth.

Several participants commented, as Saul Hymans had, on the apparent

discontinuity of stock-market effects in different time periods. Lawrence Klein was struck by the 1962 experience, when consumption and GNP kept advancing despite a sharp decline in the stock market. Klein found a similar lack of correlation between the stock market and the real economy during the 1930s, although Jan Tinbergen had found a strong connection during the 1920s. Klein cautioned the panel that the Friend and Lieberman study, though very carefully executed, applied to the rising stock market of 1963 and did not necessarily depict a down-side experience like 1962. Bosworth and Modigliani agreed that the closer connection of the stock market and real activity after 1965 pointed out by Hymans could be explained by the dominance of monetary policy in the swings of stock-market prices since that time. William Nordhaus cited research evidence that the stock market had exerted an important independent influence on the 1929–32 collapse of the economy. Robert Solomon added that the widespread purchase of stock on margin in the 1920s and the subsequent margin calls of the 1930s may have sharpened the impact of the stock market on consumption. That phenomenon is unlikely to recur because of the regulation of margin credit.

Both Michael Wachter and R. A. Gordon emphasized the changing patterns of common-stock holdings in postwar America. An increasing amount of stock is held in pension funds and trusts. In order for some people to change their buying in response to stock-market fluctuations, they have to know what is happening to the value of their annuities and even then their responses might be different from what they would be if they were able to realize capital gains.