F. THOMAS JUSTER*
National Bureau of Economic Research

PAUL WACHTEL*
City University of New York and National Bureau of Economic Research

Inflation and the Consumer

TO JUDGE FROM THE RECENT PRONOUNCEMENTS of the forecasting fraternity, uncertainty about the behavior of consumers is at the heart of differences in view about macroeconomic policy at the present time. The inability of the economic recovery to gather sufficient force to bite into unemployment rates has been widely attributed to the continued hesitancy and caution of consumers, as reflected in exceptionally high ratios of personal saving to disposable income. And differences of opinion about the probable vigor or sluggishness of the recovery are due in considerable part to differences in judgments about the probable consumer response to the unfolding economic situation. One of the major sources of uncertainty about consumer reactions concerns the way that price inflation, both expected and realized, influences consumer decisions about spending or saving.

This paper poses a number of questions and provides some tentative answers:

1. Have consumer reactions to the standard economic determinants of behavior (income, relative prices, the size of durable stocks relative to income, and the like) been different or less predictable during the recent period of historically high price inflation?

* The research reported here grows out of work supported by the National Science Foundation, the National Bureau of Economic Research, and the U.S. Bureau of the Census. Support for the computer work in the paper was provided by Rapidata, Inc., and for research assistance by the Commercial Credit Corporation. Teresita Rodriguez and Tedi McDermott helped with the computations.

2. Have predictions about consumer behavior based on explicit survey measures of expectations and attitudes been less reliable?

3. Have the economic variables that seem to be associated with such survey measures tended to be different?

4. What do consumer spending models, applied to recent experience, tell us about the effect of actual inflation and inflationary expectations on spending?

5. Given the optimal prediction model, what is the probable course of consumer spending and saving behavior under alternative assumptions about the behavior of key variables?

This paper attempts to mine survey measures of consumer expectations, attitudes, and plans in an effort to determine their usefulness in predicting and explaining consumer behavior. We ask two questions: First, what is the role of these anticipatory variables in models designed to forecast consumer behavior? Second, what are the economic variables underlying the movement of consumer anticipations?

The plan of the paper is, first, to examine durable goods demand models—for both automobiles and nonauto durables—based on nonanticipatory or objective variables, and then to examine similar demand models based on anticipations variables, analyzing the features of an optimal demand model that uses both consumer anticipations and other types of variables. Next, we look specifically at the role of price inflation in these models. The following section focuses on models designed to predict the two principal survey variables used in the analysis, the index of consumer sentiment and the index of expected purchases, in both of which the role of price inflation is of special interest. The next section looks explicitly at saving rather than durable goods expenditure functions, using a very simple system of equations in which all the principal allocations of disposable income (saving and durable and nondurable expenditures) are regressed against a standard set of independent variables including income, price change, and the anticipations variables. The last section summarizes the principal results of the paper.

Objective Models of Durable Goods Demand

Our model of demand for consumer durable goods is somewhat different from others that are also based entirely on the standard "objective" economic variables. Certain features, we think, make it a better specification than others, but it is generally representative of the standard distributed lag models of durable goods demand found in the recent literature. The general spirit of the model is that target stocks of durable goods are determined by expected values of income and relative prices, and that observed expenditures reflect both the attempt to adjust beginning-period stock to (changing) target values and the immediate impact on expenditures of transitory income changes that are independent of the expected value of income. These transitory expenditures do alter durable goods stocks and hence the gap between actual and target stocks.

Gross investment or expenditures, G, is thus divided conceptually into planned (G^P) and transitory (G^T) components:

$$G = G^P + G^T. \tag{1.0}$$

The former is determined by long-run expectations and average adjustment lags, while the latter represents the influence of unexpected economic phenomena on durables expenditures.

The familiar partial adjustment model is applied to the planned component. As shown by (1.1), the expenditures a household plans for the quarter will close some proportion of the gap between its desired stock, K^*, and depreciated existing stock, $(1 - \delta)K_{t-1}$:

$$G_t^P = \beta[K_t^* - (1 - \delta)K_{t-1}]. \tag{1.1}$$

The adjustment coefficient is β and the quarterly depreciation ratio is δ. It is assumed that a constant fraction of stock existing at the end of a given quarter will depreciate during the next quarter. The desired level of stock is determined by the household's expectations about economic conditions, as in

$$K_t^* = f(Z_t^e), \tag{1.2}$$

where Z^e is the expected value of a set of objective economic variables such as income and prices. It is assumed that the expected value, Z^e, is formed by the adaptive expectations model of

$$Z_t^e - Z_{t-1}^e = \rho(Z_t - Z_{t-1}^e), \tag{1.3}$$

where ρ is the coefficient of expectations.[1] In this model expectations change in response to the difference between current experience and the

1. For simplicity, in (1.3) we assume an identical expectational structure for all variables in the function, Z, set, and omit the functional notation that appeared in (1.2).

previously formed expectation. Finally, transitory investment is specified to be a function of variables in the set, T, as in

$$G_t^T = g(T_t). \tag{1.4}$$

The reduced form of the model that includes its expectations, adjustment, and transitory features is given by

$$\begin{aligned} G_t = {} & \beta\rho Z_t - \beta(\rho - \delta)K_{t-1} + (1 - \beta)(1 - \rho)G_{t-1} \\ & + g(T_t) - (1 - \rho)\, g(T_{t-1}).^2 \end{aligned} \tag{1.5}$$

The model includes lagged stock, lagged expenditures, the determinants of desired stock, and both the current and lagged values of the transitory function. The lagged stock and lagged expenditures are both in the reduced form because there are two lag mechanisms in the model (for stock adjustment and for expectations formation). The appearance of the lagged transitory function is explained in Appendix A.

Least squares estimates of (1.5) overidentify the parameters β and ρ. The expected signs of the coefficients on lagged stock and lagged expenditures are known because both β and ρ must be positive and less than unity. The coefficient on G_{t-1} must be positive and less than unity; it will be large if adjustment or expectations lags (or both) are long. The coefficient on K_{t-1} will be negative unless expectations are formed very slowly (so that $\rho < \delta$, the quarterly depreciation rate).[3]

The determinants of desired stock, the elements of the set Z, are income and relative prices; the Z function is assumed to be linear. Two alternative versions of the transitory function are tested, the unemployment rate and an independent estimate of transitory income. Transitory income is defined as the difference between actual income and estimated permanent income in each period; permanent income is estimated as a smooth growth path of actual income using the trend equation as described in Appendix B.

All monetary variables are measured in price-deflated dollars per household. Dummies are included in automobile regressions for strikes in

2. A detailed derivation is provided in Appendix A.

3. The model includes the same features as the objective model in F. Thomas Juster and Paul Wachtel, "Anticipatory and Objective Models of Durable Goods Demand," *American Economic Review* (September 1972, forthcoming), which includes a fuller discussion of long-run equilibrium properties. That model, however, applies the system to net investment only; that is, all replacement demand is planned and met without delay. The model just described yields the same reduced form but a somewhat different interpretation of the lag coefficients.

1959:4, 1964:4, 1967:4, and 1970:4, and for compensating expenditures in two post-strike quarters. The coefficients on the strike dummies are not reported. The following variables are used in the empirical analysis:

Y = disposable income per household, in constant prices
YP = expected or permanent income per household, in constant prices
YP' = permanent income based on disposable income per household less transfer payments
PA/PCE = relative price of automobiles
YT = transitory income per household, in constant prices
YT' = transitory income per household less transfer payments
U = total unemployment rate.

AUTOMOBILES

The results of applying the model to quarterly expenditures on automobiles are shown in equation (2):[4]

$$(2) \qquad CAR_t = 54 + \underset{(3.2)}{0.059}\, YP'_t - \underset{(-5.5)}{33}\, U_t + \underset{(4.6)}{26}\, U_{t-1}$$

$$- \underset{(-1.1)}{101}\, (PA/PCE)_t - \underset{(-2.6)}{0.181}\, K_{t-1} + \underset{(7.2)}{0.654}\, CAR_{t-1}$$

Period of fit: 1953:4 to 1971:2.
$\bar{R}^2 = 0.931$; standard error of estimate = 19.1; Durbin-Watson statistic = 2.11.

The dependent variable is *CAR*, real expenditures on new cars and net purchases of used cars.[5] Expenditures on automobile parts, which include the large and growing mobile home component, are classified as nonauto durables and are thus excluded.

The statistical specification seems generally satisfactory except for the coefficient on relative prices, which is small and insignificant. The coefficient of relative price is very sensitive to the time span used for estimation

4. Here and in subsequent equations, the numbers in parentheses are t ratios.
5. Because the equation includes dummy variables for strike and post-strike effects, the lagged dependent variable (CAR_{t-1}) is corrected for the strike influence in all equations so as to remove strike effects from the estimation of the lag structure. This procedure is discussed in the forthcoming study by Juster and Wachtel, "Anticipatory and Objective Models," to be reprinted with additional appendixes by the National Bureau of Economic Research.

and to the specification of the model generally. The specification used above requires that the combined coefficients on the stock variable and the lagged expenditure variable be of such magnitude and sign as to produce stability in the system, and these conditions are satisfied. Finally, the specification requires that the coefficient on the current unemployment rate—the transitory variable in equation (2)—be negative and the coefficient on the lagged unemployment rate positive and smaller in absolute size.[6] These conditions are all satisfied, and the lag structure and income elasticity implied by the model seem reasonable.

An alternative specification of the transitory function, using transitory income proper in current and lagged form, is also a reasonable specification, but it explains less variance than equation (2). In other experiments, involving alternative unemployment rates, the total unemployment rate turned out to be marginally better than the unemployment rate of married males and much better than the insured unemployment rate. In addition, experiments with a rate for married males in conjunction with the difference between it and the rate for all men revealed no gain from distinguishing employment rates for heads of households from those for others. (These tests were performed on the anticipatory model discussed below rather than the objective model.)

Anticipatory Models and Data

The availability of survey data on household plans, expectations, and attitudes makes it possible to construct and test consumer demand models with a structure entirely different from that just described. Planned changes in durable goods stocks can be directly represented by a survey measure of household plans or intentions to purchase, while transitory or unplanned investment is again thought of as influenced by events that were unforeseen or imperfectly foreseen at the time the plans were formulated. The expectations of the household about external events (for example, income and prices) enter into the formulation of its plans, while any difference between

6. Our model interprets unemployment as a transitory income phenomenon that affects transitory investment in durables stock. An alternative interpretation of equation (2) is that the correct unemployment variable is the *change* in unemployment rates, that ΔU is part of the planned investment function, and that there is no transitory investment function.

events and expectations affects the relation between household plans to purchase and actual purchases.[7] Finally, the general state of consumer sentiment or attitudes may influence the relation between plans and behavior via an effect on the firmness with which plans are formulated. Alternatively, sentiment might affect the way in which differences between events and expectations modify behavior relative to plans.

DATA

In this paper we use three variables obtained from consumer surveys: the index of consumer sentiment (S); an index of expected purchases for automobiles (A^*); and an index of price changes expected by consumers (CPI^*).

The index of consumer sentiment has been published since 1953 by the Survey Research Center at the University of Michigan (SRC). The index of expected purchases of automobiles is constructed from both SRC and Census Bureau data. Plans or intentions to purchase automobiles have been obtained regularly by the SRC since the early 1950s. The bureau began to collect similar information in 1959, and in recent years has been gathering data on the mean (subjective) probability that households will purchase automobiles and houses. Comparable data on purchase plans for other durables are less plentiful and consistent.[8] The index of consumer price expectations is compiled from three different segments, all based on SRC

7. Expectations and plans of businesses and households are not alike. Business firms, especially large ones, could hardly survive without explicit sales forecasts or investment plans, and they are apt to devote significant resources to such corporate planning. But households obviously can survive and even prosper without either explicit forecasts or plans, and typically are unlikely to spend much time or energy on planning. Hence data on investment plans, and on expectations about income or prices, obtained from corporate enterprises are probably different from those obtained from households. Operationally, these differences suggest interpreting household anticipations data in a more relaxed framework than might be appropriate for business anticipations data, although the conceptual framework should not be so relaxed as to disappear.

Interestingly enough, data on investment plans of small business enterprises, collected by the Commerce Department and the Securities and Exchange Commission and by McGraw-Hill must, like household expenditure plans, be substantially adjusted for strong and systematic biases.

8. To combine the available data on expected purchases into a single measure is itself a small research project, which the authors undertook some time ago. Other ways of compiling and aggregating the available data on expected car purchases will not yield the same results as those in this paper, and the reader should be aware of that fact.

data. The segments differ in what they measure and in the precision with which the measurements are provided.

Some of these problems in compilation and use of the survey data are sufficiently sharp that we have used the availability of survey materials as one criterion in choosing time spans for the empirical analysis. For example, in examining automobile outlays we chose to start with 1960:1, primarily because the index of expected purchases (which plays a key role in our analysis) presents problems of sampling variability before that time.[9]

AUTOMOBILE DEMAND MODELS

We have experimented extensively with alternative specifications of an automobile demand model based on the survey measures of purchase expectations and attitudes. The expected purchase variable for automobiles, A^*, for part of the period is a direct estimate of the mean (subjective) probability of car purchase of U.S. households and, for the remainder of the period, is a constructed variable based on purchase intentions. Although one could argue that such a variable encompasses all of the adjustment lags and the expectational structure underlying desired stock in the objective models, experience indicates that it must be supplemented, since apparently it does not capture some aspects of consumer optimism and consumer uncertainty.

For example, whether consumer optimism is stable or unstable—either rising or falling—makes a difference to the way in which unanticipated events influence actual spending, for favorable intervening events might have more impact on actual purchases if optimism is rising (or unfavorable events more if it is falling). In addition, the expected purchase measure represents only an estimate of the mean value of a probability distribution, and tells nothing either about dispersion around the mean or about the reliability of any household's estimate of the likelihood it will make a purchase.

The Survey Research Center's index of consumer sentiment is a logical candidate to capture some of these influences. We have examined a number of the alternative ways to use it in econometric modeling: the index proper

9. Before 1960, the index can be obtained only from Survey Research Center materials, whose typical sample size is about 1,300. After 1960, the index can be obtained also from the U.S. Census Bureau, whose sample size is approximately 15,000 households.

(denoted *S*), a two-quarter moving average of "filtered" changes in *S* (denoted *SZ*), and Almon distributed lag versions of these variables.[10]

Of these, the filtered variable, *SZ*, gave the best results and is the version reported on here. It is constructed on the hypothesis that the index of expected purchases, A^*, provides an unbiased estimate of future purchase rates only if *S* is not changing in a systematic way. Therefore, *SZ* equals the change in *S* provided *S* has been changing significantly and systematically, and otherwise equals zero.

The nature of the index of expected purchases suggests that the appropriate dependent variable is consumer purchases of automobiles in units, since the expected purchase variable measures the probability that the family will purchase either a new or a used car without regard to its value. Thus the dependent variable, *A*, is the proportion of U.S. households purchasing new cars, seasonally adjusted at annual rates. Purchase rates are estimated from data on gross expenditures for new cars and average prices paid for new cars, both derived from Department of Commerce data. Thus estimates of real expenditures for new cars based on the anticipations model must be derived from a combination of equations that explain purchase rates and real car prices.

The anticipations model for automobile purchase rates follows the same framework as the objective model for expenditures. The following are the corresponding equations:

$$A = A^P + A^T; \tag{1.0*}$$

$$A^P = f(A^*, S); \tag{1.1*}$$

$$A^T = g(U); \tag{1.4*}$$

$$A = f(A^*, S) + g(U). \tag{1.5*}$$

The unit purchase equation (1.0*) has planned and transitory components. The survey measures (A^* and an *S* variant) constitute the anticipatory counterpart to planned gross investment (1.1*). Equation (1.1*) substitutes for appendix equation (A2), which is the reduced form of the adjustment and expectations mechanisms that determine planned gross investment; the

10. All variables are defined in Appendix B. The filtering procedure is discussed in F. Thomas Juster and Paul Wachtel, "Uncertainty, Expectations and Durable Goods Demand Models," in *Human Behavior in Economic Affairs: Essays in Honor of George Katona* (Amsterdam: North-Holland, forthcoming), and in Saul H. Hymans, "Consumer Durable Spending: Explanation and Prediction," *Brookings Papers on Economic Activity* (2:1970), pp. 173–99.

anticipatory model is, of course, a much simpler equation. The transitory function (1.4*) is the same in the anticipatory model as in the objective model. The reduced form for purchase rates is given by (1.5*); both functions are assumed to be linear.[11] However, (1.5*) explains only unit purchases and must be supplemented by an equation to explain average real car price. Deflated car price (V) is a distributed lag function of permanent income and the price of cars relative to other goods and services:

$$V = h(YP, PA/PCE). \tag{1.6*}$$

Automobile expenditures are then the product of (1.5*) and (1.6*).

In general, the Almon lag versions of S in the equations explaining unit purchases prove superior to the simple variables, and the SZ Almon lag version contains the optimum specification. Equation (2*) below shows the optimal anticipatory model for unit purchases, where the dependent variable is the proportion of households purchasing a new automobile, A:

$$A_t = 0.45 + \underset{(8.2)}{0.115}\, A_t^* + \underset{(6.3)}{0.033} \sum_{i=0}^{3} SZ_{t-i} - \underset{(4.6)}{0.043}\, U_t. \tag{2*}$$

Period of fit: 1960:1 to 1971:2.
$\bar{R}^2 = 0.883$; standard error of estimate = 0.047; Durbin-Watson statistic = 1.90.

The addition of standard economic variables does not appear to improve this equation. For example, the income level takes on the wrong sign; and income change adds nothing to the explanation.

As noted above, equation (2*) must be supplemented by an equation on average real car prices to permit estimates of total real expenditures on automobiles. The best explanation of real car price is a distributed lag on permanent income and relative car price. Other variables that were important in the unit purchase equation, especially those with a strong cyclical influence, have only a random effect on average car price. Some typical results are shown in Table 1. Although relative prices show up weakly in the post-1960 equations, their importance in the full-period equation indicates that they belong in the model. The income variable suggests that rising real income per family will spur upgrading of car purchases, a commonly noted phenomenon. The relative price variables suggest that rising relative prices of cars will affect the extent of upgrading, and that

11. Note that the reduced form of the anticipatory model has only a current period transitory variable (U) and does not contain the lagged transitory (U_{t-1}). This is because the adjustment and expectations lags of the objective model are replaced by (1.1*); the anticipatory reduced form does not involve the solution of a lag function.

Table 1. Estimating Equation for Average Real Car Price, 1953–71 and Subperiod[a]

	Regression coefficients[b,c]				Regression statistics		
Period	*Constant*	YP'_t	$(PA/PCE)_t$	V_{t-1}	$\bar{R}^2$	*Standard error*	*Durbin-Watson statistic*
1953: 4–1971: 2	1,354	0.057 (2.4)	−798 (2.6)	0.683 (9.0)	0.939	64.1	1.93
	143	0.076 (3.1)	...	0.797 (12.2)	0.934	66.8	2.12
1960: 1–1971: 2	1,006	0.154 (1.8)	−635 (0.8)	0.535 (4.7)	0.970	49.5	2.02
	60	0.209 (4.1)	...	0.532 (4.7)	0.971	49.3	2.03

Sources: See Appendix B for derivation of permanent income. Car prices are based on unpublished data from the U.S. Department of Commerce, Office of Business Economics, and are weighted averages of the average price of foreign and domestic cars deflated by the implicit price deflator. Also see discussion in text.

a. The dependent variable is average new car price in constant (1958) dollars, V_t.

b. The numbers in parentheses here and in subsequent tables are t ratios.

c. Symbols used in this table are defined as follows:

YP'_t = Real permanent income per household less transfer payments.
$(PA/PCE)_t$ = Price of cars relative to other goods and services.
V_{t-1} = Average real car price.

people tend to trade down when car prices are rising relative to other prices.

Thus the anticipations model for real automobile expenditures has two equations with rather different independent variables. The unit purchase equation is dominated by the index of expected purchases and the filtered sentiment variable, and, among the standard economic variables usually found in such equations, includes only unemployment rates. The real car price equation includes only real income and relative price as determining forces.

TIME-SPAN DIFFERENCES

We noted earlier that the available survey measures differ rather markedly in their reliability and consistency, both within and between measures. For example, over the 1953–59 period the expected purchase variable has a very much larger sampling error than in later years. Moreover, the expected purchase variable is measured from 1967 on as a mean subjective probability of purchase, but before that as the weighted sum of plans to purchase.[12] Finally, the impact of different inflation rates can be explored by defining periods characterized by varying rates of price inflation.

12. The purchase probability design, in cross-sectional analysis, is clearly superior to the purchase plan or intentions design. See F. Thomas Juster, "Consumer Buying Intentions and Purchase Probability: An Experiment in Survey Design," *Journal of the American Statistical Association*, Vol. 61 (September 1966), pp. 658–96.

To test for the existence of differences among time spans we reestimated both the anticipatory unit purchase equation and the objective model of real automobile expenditures for two subperiods within each of two overlapping major periods. First, we estimated the 1954–59 and 1960–66 subperiods of the 1954–66 span, and the 1960–66 and 1967–71 subperiods of the 1960–71 span. The first two subperiods correspond to differences between measurements of the expected purchase variable with high and low sampling error, while the second two correspond to the purchase plan or intention and the purchase probability versions of the Census Bureau's expected purchase variable. Furthermore, the rate of price inflation was systematically higher during parts of 1954–59 and 1967–71 than during 1960–66.

The anticipatory model unit equations are summarized in Table 2. According to the Chow test for differences in structure between subperiods, the anticipatory unit purchase model does not have a significantly different structure during any of the subperiods, although individual coefficients display very large differences. For example, expected purchases are a less helpful variable during the period prior to 1960, when the variable is derived from SRC data (negative sign, and t ratio of 0.5) than after

Table 2. Changes in Structure of Anticipatory Version of Unit Purchase Rate Equations, Various Subperiods 1954–71[a]

	Regression coefficients[b]				Regression statistics		
Subperiod	*Constant*	A_t^*	$\sum_{i=0}^{3} SZ_{t-i}$	U_t	$\bar{R}^2$	*Standard error*	*Durbin-Watson statistic*
1954: 2–1966: 4	0.45	0.117	0.032	−0.045	0.803	0.079	0.96
		(8.5)	(4.3)	(3.1)			
1954: 2–1959: 4	1.79	−0.040	0.035	−0.085	0.651	0.104	0.68
		(0.5)	(3.0)	(2.3)			
1960: 1–1966: 4	0.44	0.122	0.033	−0.049	0.934	0.039	1.65
		(7.2)	(3.7)	(3.4)			
1960: 1–1971: 2	0.45	0.115	0.033	−0.043	0.883	0.047	1.91
		(8.2)	(6.3)	(4.6)			
1967: 1–1971: 2	1.04	0.051	0.024	−0.044	0.712	0.056	2.19
		(0.6)	(2.2)	(2.4)			

Sources: See Appendix B for sources and explanation of indexes of expected purchases and of consumer sentiment. The unemployment rate is based on total unemployment of all experienced workers over 16 years of age, seasonally adjusted, from the U.S. Bureau of Labor Statistics. Also see discussion in text.

a. The dependent variable, A_t, is the proportion of households purchasing a new automobile, seasonally adjusted at annual rates. When applicable, each equation includes a dummy variable for major automobile strikes.

b. Symbols used in this table are defined as follows:

A_t^* = Index of expected car purchases.

$\sum_{i=0}^{3} SZ_{t-i}$ = Four-quarter first degree Almon lag on the filtered index of consumer sentiment.

U_t = Unemployment rate.

1960 when Census Bureau data become available (t ratio of 7.2). Interestingly enough, although the coefficient of expected purchases is much weaker in 1967–71 than in 1960–66, there is little difference in the residual variance of the anticipatory model in the two spans.[13] However, when the objective model of automobile expenditures is estimated for the same time intervals, the Chow test indicates a significantly different structure for 1960–66 (a period of low inflation) than for 1967–71 (a period of high inflation), although there is no structural difference between 1954–59 and 1960–66.

A plausible explanation for these results is the absence of a price inflation variable in the objective model, since the structural difference shows up in the high-inflation and low-inflation subperiods of the 1960–71 span. The anticipatory model may not show a comparable structural difference because the effect of price inflation on automobile purchase rates is reflected in the behavior of the two anticipatory variables themselves—the index of expected purchases and the index of consumer sentiment. This speculation is consistent with results discussed below, which demonstrate the substantial influence of price inflation variables on both survey measures.

JOINT OBJECTIVE–ANTICIPATORY AUTOMOBILE MODELS

A question that arises naturally is whether the optimal prediction model for real expenditures per household on automobiles should include both objective and anticipatory variables. If the anticipatory variables are viewed as part of the desired stock function in the objective model, they can be introduced simply by adding both expected purchases and the filtered sentiment variable to the objective model; on this view, the anticipatory variables would be part of the Z set in equation (1.2), or could constitute the entire Z set. Alternatively, these variables could replace all those reflecting stock adjustment and formation of expectations in the

13. The reason for this difference may be that purchase rates for automobiles show less total variability over the 1967–71 span, hence there is relatively less *systematic* (and explainable) variability and relatively more *random* variability in purchases during this period. Under these circumstances, the regression coefficients of the independent variables in the unit purchase equation will tend to have large standard errors. And in fact, although the coefficient of A^* in the 1967–71 period is not significantly different from zero, neither is it significantly different from the A^* coefficient during 1960–66. The other variables in the unit purchase equation have coefficients of approximately the same size in either part of the 1960–71 span, although the standard errors are greater in 1967–71.

objective model in addition to serving as proxies for the level of desired stock. In that event they would displace all the economic variables in the objective planned expenditure model (stock, lagged expenditure, income, and relative prices), leaving only the transitory investment part. Since this function is the same in both models, this last situation simply would reduce the objective model to the anticipatory model. The issue comes down to an empirical one, since theory offers little guidance.

The simplest way to examine the question is to add both survey variables to the objective model and examine the resulting structure. Table 3 shows a selection of such results, with equations estimated for time spans that correspond roughly to differences in the precision with which the survey variables are measured.

For the longest available span, 1953–71, both expected purchases, A^*, and the filtered sentiment index, SZ^*, significantly improve the objective model. The mechanisms for stock adjustment and formation of expectations are seriously diluted, and the permanent income coefficient falls below standard significance levels. In addition the transitory part of the objective model loses power almost entirely. For the shorter span, 1960–71, in which the measure of expected purchases has substantially less sampling variability, the results are even stronger. Here, addition of the two survey variables destroys the structure of the original objective model, with the survey variables and the transitory unemployment rate variable being the only significant ones in the equation. Estimates for the still shorter span 1960–67 strengthen this conclusion; here the two survey variables are the only ones close to statistical significance. These results suggest that, for automobile demand models, the survey variable will tend to dominate a joint model provided estimates are restricted to the period beginning with 1960, when the index of expected purchases has reasonably small sampling errors.

The simplest combined model can be interpreted as a reduced form that incorporates the anticipatory model for unit purchases and a supplementary equation for real price per unit. We showed above that the principal variables in the first are the two survey variables and the unemployment rate, and in the second, permanent income. To combine the two into a single expenditure equation in principle requires multiplication of one by the other. The resulting specification contains all independent variables in either equation and all the cross-product terms. Eliminating the latter along with the lag structure in the price equation and the erratic relative

Table 3. Structure of Demand when Anticipatory Variables Are Added to Objective Model of Real Automobile Expenditures, 1953–71 and Subperiods[a]

	Regression coefficients[b]									Regression statistics		
Period	*Constant*	YP'_t	U_t	U_{t-1}	$(PA/PCE)_t$	K_{t-1}	CAR_{t-1}	A_t^*	SZ_t	$\bar{R}^2$	*Standard error*	*Durbin-Watson statistic*
1953:4–1971:2	192	0.031	−13	2	−186	−0.061	0.396	14.3	5.5	0.943	17.5	1.98
	(1.5)	(1.7)	(−1.7)	(0.2)	(−2.1)	(−0.9)	(3.6)	(2.5)	(3.4)			
	54	0.059	−33	26	−101	−0.181	0.654			0.931	19.1	2.11
	(0.4)	(3.2)	(−5.5)	(4.6)	(−1.1)	(−2.6)	(7.2)					
1960:1–1971:2	336	−0.075	−27	−6	−26	0.431	−0.143	39.4	7.3	0.944	16.0	1.90
	(0.5)	(−1.3)	(−2.1)	(−0.4)	(−0.1)	(1.8)	(−0.6)	(3.1)	(2.9)			
	−314	0.065	−39	28	218	−0.067	0.510			0.922	18.9	2.21
	(−0.5)	(1.2)	(−2.7)	(1.9)	(0.5)	(−0.3)	(3.4)					
1960:1–1967:4	1207	−0.061	−9	−26	−737	0.037	−0.310	58.8	7.2	0.944	13.9	2.10
	(1.5)	(−0.6)	(−0.5)	(−1.6)	(−1.3)	(0.1)	(−1.2)	(3.7)	(2.4)			
	62	0.132	−29	15	−119	−0.602	0.642			0.907	18.0	2.46
	(0.1)	(1.2)	−(1.4)	(0.9)	(−0.2)	(−1.3)	(4.0)					

Sources: See Appendix B and the sources for Tables 1 and 2. Also see discussion in text.

a. The dependent variable is CAR_t, expenditures on new cars and net purchases of used cars in 1958 dollars per household. Each equation includes dummy variables for strikes in 1959:4, 1964:4, 1967:4, 1970:4 when applicable.

b. Symbols used in this table are defined as follows:

YP'_t = Real permanent income per household less transfer payments.
U_t = Unemployment rate.
U_{t-1} = Lagged unemployment rate.
$(PA/PCE)_t$ = Price of cars relative to other goods and services.
K_{t-1} = Lagged real depreciated stocks of automobiles.
CAR_{t-1} = Lagged real car expenditures.
A_t^* = Index of expected car purchases.
SZ_t = Filtered index of consumer sentiment.

price variable yields equation (3). The standard error is smaller than that for the objective model by itself shown in Table 3.

$$(3)\qquad CAR_t = 1.14 + \underset{(4.5)}{0.037}\ YP'_t + \underset{(4.5)}{29.9}\ A^*_t + \underset{(2.7)}{4.69}\ SZ_t - \underset{(7.2)}{25.1}\ U_t.$$

Period of fit: 1960:1–1971:2.
$\bar{R}^2 = 0.943$; standard error of estimate = 16.2; Durbin-Watson statistic = 1.70.

Inflation Effects

Whether the rate of price inflation—actual, anticipated, or unanticipated—has an independent influence on expenditures for automobiles is an interesting question that invites examination at some length. Even the direction of any inflation effect is ambiguous on a priori grounds.

Economists have usually taken the view that an expected rise in prices promotes an increase in expenditure: People will tend to substitute goods for money and thus to spend more and save less. The analysis is usually couched in terms of previously unanticipated changes in the rate of price inflation, although that distinction is not always explicit. Thus the "standard" view is that a fully anticipated rise in prices will have no effect on real economic decisions because all the impacts have been fully discounted and embodied in current prices, interest rates, and so forth. But the expectation of a rise in prices, that was previously unanticipated, will make goods, particularly durables, more attractive and money less attractive.

A persuasive alternative view, which probably owes its origin more to psychologists and sociologists than economists, is that a rise in prices (anticipated or not) will tend to increase saving and reduce spending.[14] The argument is often put in terms of the impact of rising prices on consumer confidence or consumer optimism: Rising prices, according to survey data, tend to be associated with unfavorable consumer reactions and weaker confidence.

One interpretation of the survey-based finding that rising prices stir pessimism focuses on the effect they have on consumer expectations about real income. Historically, high inflation rates tend to be associated with a

14. One of the earliest and most consistent proponents of this view was George Katona of the Survey Research Center. See, for example, *The Powerful Consumer: Psychological Studies of the American Economy* (McGraw-Hill, 1960).

relatively high variance in the rate of inflation. If consumers commonly believe that the rate of increase in nominal income will be less variable than the rate of increase in prices, the expectation of rising prices will generate greater dispersion of expectations about real income. A wider dispersion may not have symmetrical effects on behavior, in that the prospect of declining real income may carry more weight on consumer decisions than the prospect of rising real income, even though the two are regarded as equally probable. In short, consumers may be much more concerned that price inflation will erode their real income than pleased that rising nominal incomes will outweigh rising prices. If so, the appropriate reaction to inflationary expectations would be to curtail spending in an attempt to guard against declining real income, thus, as a corollary, raising the saving rate.

The same asymmetry shows up in the effect of price inflation on the real value of assets. Consumers with variable price assets have no reason to suppose that rising prices will erode the real value of their assets. But many have only fixed-price assets whose purchasing power will be eroded by rising prices. If the relation between asset position and expenditures is stronger for those whose assets are mainly fixed-price, the net effect of inflation on expenditures stemming from the assets side will be restrictive.

There seems to be no way to settle this argument on a priori grounds. Probably, steady and moderate rates of price inflation would have quite different effects on consumer expenditures than high or variable rates; moreover, the anticipatory buying effects may not be strong at all unless rates of price inflation are quite high. Evidence from the SRC suggests that, among U.S. consumers, rising prices inhibit real expenditures, although the survey is ambiguous about the exact reasons why rising prices (and wages!) make people feel less optimistic.[15] Ultimately, one is forced back on empirical judgments.

We have experimented extensively with the effects of inflation rates, both anticipated and unanticipated, on spending and saving behavior. As noted earlier, we have compiled a series on expected price changes from SRC data; it is quite unsatisfactory in many respects, however, because of differences in measuring expectations. Prior to 1966, the survey reported only whether consumers expected prices to go up or go down or remain

15. To be precise, the survey finds that consumers commonly associate rising prices with "bad" economic conditions. But it is difficult to identify the precise sets of events that constitute these unsatisfactory conditions.

unchanged; and it was only starting in 1966 that those who expected prices to rise were asked to specify a percentage. While we have constructed a uniform index of price expectations from 1953 to the present, it may not be a wholly satisfactory measure of expected price change. The problem is discussed in Appendix B. In our experiments with alternative measures of actual price change, the consumer price index appears to be more closely associated with actual behavior than the implicit deflator for personal consumption expenditures, and is the variant reported here.

In general, we use two variables to reflect the influence of inflation on consumer behavior: the expected rate of inflation constructed from the SRC data, labeled CPI^*, and the actual rate of inflation, CPI.[16]

The regression coefficients on actual and expected inflation can be interpreted to show the effects of anticipated and unanticipated inflation. A total inflation effect is given by

$$a_1 \, CPI + a_2 \, CPI^*,$$

where a_1 and a_2 are regression coefficients. Inflation is fully anticipated when expected inflation is equal to actual inflation and thus can be substituted for it, as given by

$$a_1 \, CPI^* + a_2 \, CPI^*.$$

The effect of unanticipated inflation is the total effect less the anticipated effect, or

$$a_1 \, (CPI - CPI^*).$$

Thus, the sum of the regression coefficients is interpreted as the effect of anticipated inflation, and the coefficient on actual inflation is interpreted as the effect of unanticipated inflation. That is, the unanticipated inflation effect is the partial derivative with respect to the actual rate of inflation, holding expected inflation constant.[17]

AUTOMOBILE DEMAND MODELS AND INFLATION

The results from introducing the price inflation variable into the anticipatory model of automobile unit sales provide evidence that both the

16. CPI_t^* is the average of the expected rate of inflation from surveys taken in $t - 1$ and $t - 2$. CPI_t is the average of the actual rate of inflation in the same quarters.

17. George Perry suggested this interpretation. Although a different algebraic approach will yield a different interpretation, this one has the most logical appeal.

expected and the actual rate of price inflation have a negative influence on automobile purchase rates. Table 4 contains a collection of such results for the 1960–71 period. The inflation effects are significant and negative when the filtered sentiment variable is used without Almon distributed lags. While either inflation variable has a negative sign in the optimum equation form, which uses the Almon lag, the effects are not significantly different from zero. These results suggest that much of the inflation effect may *already* be contained in the survey variables, a subject examined in greater detail below.

We also examined the effects of inflation on the objective model of automobile demand, and on the supplementary automobile price equation used in the anticipatory model. In the objective model, no strong or systematic effect of any of the inflation variables appeared. In the real price equation, however, the expected rate of price change has a significant negative effect on average real car price, while actual price change had a weaker positive effect. Thus a fully anticipated inflation has a *negative* impact on average price, while any unanticipated price change has a *positive* impact.

The possible influence of special inflation effects in the real car price equation during the period of relatively high inflation rates, 1967:3 through 1971:2, was also explored. The test consists of adding variables, operative

Table 4. Automobile Unit Purchase Equations with Inflation Variables, First Quarter 1960 through Second Quarter 1971[a]

Regression coefficients[b]							*Regression statistics*		
					Inflation variables				
Constant	A_t^*	SZ_t	$\sum_{i=0}^{3} SZ_{t-i}$	U_t	CPI_t	CPI_t^*	$\bar{R}^2$	*Standard error*	*Durbin-Watson statistic*
0.47	0.123 (6.8)	0.014 (2.3)	...	−0.054 (5.1)	−0.016 (2.5)	...	0.865	0.050	1.72
0.57	0.129 (6.8)	0.016 (3.2)	...	−0.059 (5.5)	...	−0.064 (2.6)	0.867	0.050	1.77
0.52	0.130 (6.9)	0.014 (2.4)	...	−0.057 (5.3)	−0.008 (0.8)	−0.041 (1.2)	0.866	0.050	1.79
0.42	0.123 (8.4)	...	0.027 (4.2)	−0.047 (4.9)	−0.010 (1.6)	...	0.887	0.046	2.01
0.47	0.124 (7.8)	...	0.029 (4.7)	−0.047 (4.6)	...	−0.028 (1.1)	0.833	0.046	1.98

Source: See Appendix B and sources for Table 2.

a. The dependent variable is the automobile purchase rate, A. Regressions also include strike dummy variables: A single dummy is used in the Almon lag equations, four separate dummies in the others.

b. Symbols used in this table are defined as follows:

A_t^* = Index of expected car purchases.
SZ_t = Filtered index of consumer sentiment.
$\sum_{i=0}^{3} SZ_{t-i}$ = Almon lag on filtered index of consumer sentiment.
U_t = Unemployment rate.
CPI_t = Actual rate.
CPI_t^* = Expected rate.

only during the 1967–71 period, to an equation that explains average real car price in terms of income, lagged real price, and both actual and expected price change. These "interaction" terms consist of variables defined as Z_1X, where X is an inflation variable and Z_1 has a value of unity during the 1967–71 (high-inflation) period, and of zero at other times. Estimating an equation with both X and Z_1X permits identification of both the general effects of price inflation during the period as a whole, through the coefficient of X by itself, and any special effects associated with the 1967–71 period, through summing the coefficients of X and Z_1X. We have applied the interaction of the high-inflation period to the expected and actual price change variables as well as to the intercept. The interaction terms are designated *CPID* and *CPI*D* for actual and expected inflation, respectively, and *INFD* for the intercept.

With these interaction terms used to isolate any special characteristic of the 1967–71 period, inflation effects appear to have been quite different in those years from the rest of the period; but the standard errors are so high as to limit confidence in this result. The real price equations, with expected and actual price change and with the interaction terms added, are shown below.

$$(4)\qquad \underset{}{V_t} = 95 + \underset{(4.3)}{0.225\ YP'_t} + \underset{(5.3)}{0.531\ V_{t-1}} - \underset{(3.3)}{56.7\ CPI^*_t} + \underset{(1.3)}{8.8\ CPI_t}.$$

Period of fit: 1953:4–1971:2.

$\bar{R}^2 = 0.942$; standard error of estimate = 62.8; Durbin-Watson statistic = 1.93.

$$(4.1)\qquad V_t = 133 + \underset{(4.1)}{0.221\ YP'_t} + \underset{(4.6)}{0.523\ V_{t-1}} - \underset{(3.3)}{58.1\ CPI^*_t} + \underset{(0.5)}{52.5\ CPI^*D_t}$$
$$+ \underset{(1.6)}{12.1\ CPI_t} - \underset{(1.3)}{23.8\ CPID_t} - \underset{(0.2)}{57\ INFD_t}.$$

Period of fit: 1953:4–1971:2.

$\bar{R}^2 = 0.941$; standard error of estimate = 63.3; Durbin-Watson statistic = 1.99.

The net effect of inflation on average real car price in dollars was as follows:

	Fully anticipated inflation	*Unanticipated inflation*
	(n = percentage rise in prices)	
Without interaction	$-47.9n$	$8.8n$
With interaction		
1953–66	$-46.0n$	$12.1n$
1967–71	$-17.3n - 57$	$-11.7n - 57$

Taken at face value, the results indicate that, fully anticipated, inflation usually tends to reduce real expenditures per car substantially, while unanticipated, it tends to increase them slightly. However, during the 1967–71 period, according to our best estimate, inflation had the special characteristic of reducing real expenditure per car, whether it was anticipated or unanticipated, though the effect was somewhat more negative in the former case.

Demand for Nonauto Durables

An objective model for nonauto durables is almost identical to that for lautomobiles; the model includes an income variable, both current and tagged unemployment rates, a stock adjustment mechanism as reflected by the beginning-of-period stocks of other durables, and an adaptive formation-of-expectations mechanism. Equation (5) below contains the optimum version of this model, in which all parameters have the appropriate signs and all but beginning-period stocks have satisfactory significance levels. Other durables (*OD*) are defined as total expenditures on consumer durables (conventional Department of Commerce definition) less gross expenditures on new cars and net purchases of used cars, deflated, per household.

$$
\begin{aligned}
(5) \qquad OD = -232 &+ \underset{(5.5)}{0.072}\, Y_t - \underset{(2.8)}{9.0}\, U_t + \underset{(2.0)}{5.8}\, U_{t-1} \\
&+ \underset{(1.5)}{0.056}\, K_{t-1} + \underset{(4.2)}{0.468}\, OD_{t-1}.
\end{aligned}
$$

Period of fit: 1953:4–1971:2.
$\bar{R}^2 = 0.996$; standard error of estimate $= 9.6$; Durbin-Watson statistic $= 1.60$.

We did not construct a pure anticipatory model for other durables, since the expected purchase variable used in the automobile equation has no good counterpart. Ordinarily, the available measures of expected purchases for the other durables category have little if any net association with actual expenditure, and the difficulties of comparability over time are even more serious here than for automobiles. Nonetheless, it is of interest to test, in the other durables model, the same two anticipatory variables used for automobiles. The filtered sentiment variable is presumably as applicable to expenditures on other durables as it is to those on automobiles, while the variable for expected automobile purchases is not irrelevant if they are representative of expected purchases of durables generally. We

Table 5. Demand Models of Nonautomobile Durables, Fourth Quarter 1953 through Second Quarter 1971

	Regression coefficients[a]										Regression statistics		
									Inflation variables				
Constant	Y_t	U_t	U_{t-1}	K_{t-1}	OD_{t-1}	A_t^*	SZ_t	S_t	CPI_t	CPI_t^*	$\bar{R}^2$	Standard error	Durbin-Watson statistic
−232	0.072 (5.5)	−9.0 (−2.8)	5.8 (2.0)	0.056 (1.5)	0.468 (4.2)	...	...	...	...	...	0.996	9.55	1.60
−230	0.066 (4.6)	−5.8 (−1.4)	2.4 (.07)	0.077 (1.9)	0.441 (3.9)	3.9 (1.3)	0.74 (1.0)	...	...	...	0.996	9.49	1.61
−231	0.064 (4.3)	−7.8 (−2.3)	4.4 (1.4)	0.088 (1.7)	0.426 (3.6)	3.6 (1.1)	...	0.11 (0.3)	...	...	0.996	9.56	1.56
−255	0.073 (5.6)	−6.3 (−2.0)	3.8 (1.3)	0.060 (1.5)	0.502 (4.6)	...	...	...	−2.0 (−1.8)	−3.9 (−2.1)	0.997	8.96	1.79
−255	0.069 (4.9)	−5.4 (−1.4)	2.9 (0.8)	0.070 (1.6)	0.484 (4.4)	2.9 (1.0)	0.12 (0.2)	...	−1.6 (−1.2)	−4.1 (−2.2)	0.997	9.04	1.78

Source: See Appendix B and sources for Table 2. Also see discussion in text.
a. Symbols used in this table are defined as follows:

Y_t = Real disposable income per household.
U_t = Unemployment rate.
U_{t-1} = Lagged unemployment rate.
K_{t-1} = Lagged real depreciated stocks of other durables.
OD_{t-1} = Lagged other durables.
A_t^* = Index of expected car purchases.
SZ_t = Filtered index of consumer sentiment.
S_t = Index of consumer sentiment.
CPI_t = Actual rate of inflation.
CPI_t^* = Expected rate of inflation.

also tested the expected and actual price inflation variables in the other durables regressions.

Table 5 shows the results of these experiments: The first line contains the standard model for other durables; the second and third lines add the two survey variables to the standard model for other durables, and test both the *S* and *SZ* versions of the consumer sentiment index; the last two equations add the two price inflation variables first to the standard model for other durables, and then to the model with the survey variables.

Both survey variables appear to be marginal candidates for improving the specification of a model for other durables: They are significantly weaker than in the comparable automobile expenditure equation. In the third equation, using *S*, the sentiment index itself, in place of the filtered variable *SZ*, *S* had a very weak influence on expenditures.

INFLATION

The two price inflation variables improve the equation significantly: Expected price change has a significant negative impact on expenditures for other durables, while the impact of actual price change is also negative, but smaller and not quite significant at conventional levels. Thus a fully anticipated inflation has a strong negative impact on real expenditures for other durables, while unanticipated inflation has a small negative impact. There is no evidence that the impact of inflation is different in the 1967–71 part of the period from the period as a whole. We tested in the other durables equation the interaction terms used in the equation for real car prices, but the coefficients were generally small and all terms had standard errors well in excess of the coefficients. Finally, the survey variables are weakened when the inflation variables are added; the filtered sentiment index, in particular, apparently is redundant to the price inflation variables.

Predictions of Survey Measures

The evidence seems to bear out that the expected purchase and consumer sentiment variables can improve the explanation of spending on both automobiles and other durable goods. The optimum form of prediction equations for a durable goods demand model seems to involve both survey variables, probably in conjunction with some standard economic and financial variables. The degree to which such models are useful for short-term forecasting depends upon the answers to two questions. First, do the survey variables improve prediction for more than one quarter into the future? Second, how well can the survey variables themselves be predicted? A subsidiary question of considerable interest is, How does price inflation affect the survey variables?

EXPECTED PURCHASES

We have had only moderate success in devising equations to predict the index of expected purchases for automobiles. The A^* variable used in the econometric work above is actually a weighted average of current and past values; hence in this section we use the original variable, A^{**}, rather than the weighted average. The presumption is that it is better to predict A^{**}, and from it calculate the weighted A^*, than to try to predict A^* directly.[18]

We estimate equations for both expected purchases and expected expenditures per household (expected purchases times average car price, $A^{**}V$). The latter variable is suggested by the argument that expected expenditures are a reasonable proxy for the planned investment component of the objective model. We can directly substitute $A^{**}V$ for G^P in the objective model, as the units of measurement are commensurate.

The reduced form equation for G^P is shown in Appendix A as (A5). It specifies a positive coefficient for the lagged dependent variable and a negative coefficient for lagged expenditures, while the stock coefficient can be of either sign.

The results, shown in the top line of Table 6, are consistent with this model except for the sign of CAR_{t-1}, the lagged expenditure variable. That result could easily be due to the strong collinearity that must exist in the equation, since $A^{**}V$, CAR, K, and YP all have strong upward trends. The determinants of planned expenditures on automobiles implied by the equation are permanent and transitory income along with the expected rate of price inflation. The second equation shows the best prediction model for the expected purchase rate variable, A^{**}. It includes the same variables as the first equation except that the lagged stock and expenditure variables are dropped and the inflation interaction terms for the 1967–71 period are added. The third equation reestimates the first model with the inflation

18. A_t^* is defined as $0.6A_t^{**} + 0.3A_{t-1}^{**} + 0.1A_{t-2}^{**}$.

Table 6. Equations Designed to Predict the Index of Expected Purchases for Automobiles, First Quarter 1960 through Second Quarter 1971

	Regression coefficients[a]										*Regression statistics*		
					Lagged dependent								
Dependent variable	*Constant*	YP_{t-1}	YT_{t-1}	CPI^*_{t-1}	A^{**}_{t-1}	$A^{**}V_{t-1}$	K_{t-1}	CAR_{t-1}	CPI^*D_{t-1}	$INFD_{t-1}$	$\bar{R}^2$	*Standard error*	*Durbin-Watson statistic*
Expected real expenditures for cars, $A^{**}V$	−170	0.067 (2.8)	0.031 (1.5)	−13.6 (1.5)	...	0.238 (1.1)	−0.115 (1.0)	0.118 (1.7)	...	...	0.946	10.17	2.35
Expected purchase rate for cars, A^{**}	1.30	0.063[b] (2.2)	0.181[b] (2.6)	−0.672 (2.4)	0.521 (3.2)	...	...	...	0.744 (1.7)	−2.08 (1.5)	0.840	0.28	2.47
Expected real expenditures for cars, $A^{**}V$	−135	0.052 (2.2)	0.039 (1.3)	−14.9 (1.4)	...	0.460 (2.4)	−0.050 (0.4)	...	11.0 (0.7)	−37.1 (0.7)	0.941	10.64	2.33

Sources: See Appendix B and sources for Table 1. Also see discussion in text.

a. Symbols used in this table are defined as follows:

YP_{t-1} = Lagged real permanent income per household.
YT_{t-1} = Lagged real transitory income per household.
CPI^*_{t-1} = Lagged expected inflation rate.
A^{**}_{t-1} = Lagged expected purchase rate for cars
$A^{**}V_{t-1}$ = Lagged expected purchase rate for cars per household.
K_{t-1} = Lagged real depreciated stock of automobiles.
CAR_{t-1} = Lagged real car expenditures.
CPI^*D_{t-1} = Lagged expected inflation including special inflation interaction terms.
$INFD_{t-1}$ = Lagged intercept interaction.

b. In the A^{**} equation, YP_{t-1} and YT_{t-1} coefficients should be divided by 1,000.

interaction terms added and the CAR_{t-1} variable, which had the wrong sign, omitted.

Expected price change, which has a negative coefficient throughout, is the only inflation rate variable with any measurable strength in the expected purchase equations. There is evidence, primarily from the A^{**} prediction model, that the effect of price inflation on expected purchases was not the same during 1967–71 as during 1960–66, as shown by the interaction tests in the second equation. Here, the results imply that anticipated inflation generally has a negative influence on expected purchases, which during the 1967–71 period was independent of variation in inflation rates but more sharply negative than before. This interpretation follows from comparison of the slope and intercept interaction variables in the second row. While the net effect of different anticipated inflation rates during the 1967–71 period is nil (the sum of the CPI^* and CPI^*D coefficients is virtually zero), there is a large negative constant term applicable to the period 1960 as a whole. Thus the level of expected purchases appears to have been depressed during 1967–71 relative to the earlier part of the period, other things equal. A similar but weaker effect shows up in the third equation, where expected expenditures is the dependent variable.

INDEX OF CONSUMER SENTIMENT

Predictions for the consumer sentiment variable[19] are shown in Table 7; basically, we follow the analysis suggested by Hymans, with some modification.[20] Our best results suggest that the stock price level has an influence, although Hymans did not find it useful, and we also find some interesting and different results on the impact of price inflation on the consumer sentiment index. However, our results are extremely sensitive to the definition of a price inflation variable, as regards not only the effect of inflation on S, but also the influence of stock prices.

Because we were interested in comparability, the S predictions are based on the period since 1960. The explanatory variables that proved to be important are stock prices, a variable reflecting the change in stock prices, a price inflation variable, and the lagged dependent variable. The best fits are obtained with the price inflation variable suggested by Hymans, labeled

19. The dependent variable here is S, the level of the index of consumer sentiment. We do not attempt to predict SZ, the filtered index used in the econometric work.

20. Hymans, "Consumer Durable Spending."

Table 7. Prediction Equations for Index of Consumer Sentiment, First Quarter 1960 through Second Quarter 1971[a]

	Regression coefficients[b]										Regression statistics	
				Inflation variables								
							Special inflation interaction terms included					
Constant	SP_t	SPH_t	S_{t-1}	PCH_t	CPI_t	CPI^*_t	$PCHD_t$	$CPID_t$	CPI^*D_t	$INFD_t$	$\bar{R}^2$	Durbin-Watson statistic
36	0.068 (1.2)	14.2 (2.4)	0.367 (2.8)	−5.24 (4.4)	...	4.57 (2.3)	...	...	...	...	0.895	2.06
38	0.059 (1.0)	18.9 (3.1)	0.249 (1.8)	−5.14 (3.2)	...	6.63 (2.5)	−0.71 (0.4)	...	−7.67 (1.9)	+6.5 (0.5)	0.903	2.21
17	0.004 (0.1)	11.6 (1.6)	0.669 (5.7)	...	−1.39 (2.2)	1.84 (0.8)	...	...	...	...	0.860	1.98
25	0.048 (0.9)	14.9 (2.0)	0.545 (4.0)	...	−0.32 (0.4)	...	...	−1.42 (1.6)	...	2.9 (1.0)	0.863	1.87
2	−0.043 (0.7)	20.9 (2.7)	0.710 (5.9)	...	...	2.72 (1.0)	...	...	−5.91 (1.3)	15.9 (1.2)	0.850	1.74

Source: See Appendix B and discussion in text.

a. All independent variables are lagged one quarter before survey.

b. Symbols used in this table are defined as follows:

SP_t = Common stock index, Standard and Poor's index of 500 industrial common stocks.

SPH_t = Stock price change:

$$\frac{SP}{1/8\sum_{i=0}^{7} SP_{t-i}}$$

S_{t-1} = Lagged index of consumer sentiment.

PCH_t = Price change variable used by Hymans, adjusted for scale.

$$\text{Hymans} = \text{H} = \frac{PCE}{1/8\sum_{i=0}^{7} PCE_{t-i}},$$

where PCE is the implicit price deflator for personal consumption expenditures. The Hymans variable is described in Saul H. Hymans, "Consumer Durable Spending: Explanation and Prediction," *Brookings Papers on Economic Activity* (2:1970), p. 177. Our variable, PCH, is defined as (H − 1)100.

CPI_t = Actual rate of inflation.

CPI^*_t = Expected rate of inflation.

$PCHD_t$ = Interaction on PCH_t. $PCHD_t = PCH_t \times D_t$, where $D_t = 1$ from 1967:3 on and 0 otherwise.

$CPID_t$ = Interaction on CPI.

CPI^*D_t = Interaction on CPI^*.

$INFD_t$ = Intercept interaction.

PCH; the *CPI* and *CPI** variables used throughout the analysis not only are less effective in these equations, but also reduce the influence of stock prices virtually to zero. Both measures of actual inflation rates have a negative impact on sentiment while expected inflation has a small positive effect. The first and third equations in Table 7 suggest that fully anticipated inflation has no effect on sentiment, while unanticipated inflation has a noticeable negative effect.

Table 7 also shows equations with 1967–71 interaction terms, designed to test for differences in the effects of price inflation on consumer sentiment before and after 1967. But the equations with a time period interaction on the most effective price inflation variable (*PCH*) proved to be unsuccessful; in general, no significant difference appeared between the effects of *PCH* on sentiment during 1967–71 and the effects over the entire 1960–71 span. For the other inflation variables, however, some differential effects showed up. For expected inflation, *CPI**, as well as actual inflation, *CPI*, the coefficient of the price inflation variable is sizable and negative for the 1967–71 interaction term. On the other hand, the intercept interactions in these equations are positive. The combination of a negative slope interaction and a positive intercept interaction suggests that moderate rates of price inflation had, on balance, a positive influence on sentiment during the 1967–71 period, while high rates had a net negative influence.

The Allocation of Income to Spending and Saving

Earlier sections examined the role of consumer survey data in specifying durables demand models and the influence of inflation in these models. These important and related issues help in forming an understanding of recent consumer behavior. We have argued that the surveys contain economic information not available in an objective model and that the inflationary experience makes recent years unique. If these arguments are valid, the purview of this paper should not be limited to automobiles and other durables. If, at a given level of income, consumer sentiment and the rate of price change have an effect on one sector of consumer expenditure, they must necessarily have an opposite effect on some other aspects of consumer behavior. For example, if, at a given level of income, an increase in consumer sentiment promotes expenditures on durables, some other type of expenditure or saving must fall by a like amount. It is necessary therefore to examine a full model of income allocation and determination in order to understand fully both the effects of inflation and the usefulness of survey data.

A full model is beyond the scope of this paper, but the issues are examined within the context of a simple system of income allocation. A series of equations of the following form are estimated by least squares:

$$E_i = a_i + b_{1i}\,YP + b_{2i}\,YT + \sum_j g_{ij}X_j \quad i = 1, \ldots, n,$$

where the E_i are the allocations of income; YP and YT are permanent and transitory income, respectively; and the X_j are the survey and inflation variables. Systems of expenditure equations of this form are useful for examining the issues at hand because least squares estimates will satisfy all the necessary constraints concerning summation; that is, when

$$\sum_{i=1}^{n} E_i = YP + YT,$$

the least squares estimates will satisfy the constraints that

$$\sum_{i=1}^{n} b_{1i} = \sum_{i=1}^{n} b_{2i} = 1,$$

and that

$$\sum_{i=1} g_{ij} = 0 \text{ for all } j,$$ [21]

where the j subscript denotes separate variables in the X vector.

Four allocations of disposable income are examined: expenditures on durables (*DUR*); expenditures on nondurables and services (*CX*); and personal saving (*PS*) divided into the net increase in consumer installment credit liabilities (*CC*) and other net saving (*ONS*). Since personal saving is equal to other net saving *less* the increase in consumer installment credit liabilities, we define *CC* as having a negative sign. Algebraically, therefore,

21. A simple proof that the constraints hold is found in S. J. Prais and H. S. Houthakker, *The Analysis of Family Budgets* (second impression, abridged; London: Cambridge University Press, 1971). In general, for any system of equations with common independent variables that includes the sum of the dependent variables, the cross-equation coefficient sums will be unity for the dependent variables and zero for the other variables. In the present context it is expected that an increase in the consumer sentiment index, for example, will lead to increased durables expenditures, other things being equal. The constrained system will reveal a negative effect on some other allocation of income. The offsetting effects of the survey and inflation effects revealed by the model indicate the direction and degree of substitutability.

$Y = CX + DUR + PS$, and $Y = CX + DUR + ONS + CC$, where the last term is negative when installment credit increases, and positive when it decreases. The data are all from the national income accounts except for the change in consumer credit, which is obtained from the Federal Reserve Board.

Two specifications of the system are shown in Table 8. In Panel A, each regression includes permanent and transitory income, the survey measure of expected inflation (*CPI**), and the actual inflation variable (*CPI*). Panel B results include the income variables, the index of expected purchases

Table 8. Regression Estimates of Allocation of Income to Spending and Saving, Second Quarter 1954 through Second Quarter 1971[a]

Independent variable and regression statistic	*Regression coefficients*[b]				*Effects*	
	ONS	*CC*	*DUR*	*CX*	*Saving*	*Spending*
			Panel A			
Constant	−383.1 (4.8)	71.1 (1.1)	−931.9 (12.8)	1,243.9 (15.1)	312	−312
Real permanent income per household, *YP*	0.1325 (9.5)	−0.0212 (2.0)	0.2843 (22.5)	0.6044 (42.5)	0.11	0.89
Real transitory income per household, *YT*	0.3758 (5.6)	−0.2078 (4.0)	0.4019 (6.6)	0.4302 (6.3)	0.17	0.83
Expected inflation rate, *CPI**	−27.81 (3.0)	−8.85 (1.2)	−28.24 (3.3)	64.89 (6.8)	−37	+37
Actual inflation rate, *CPI*	12.57 (2.3)	8.94 (2.1)	−1.42 (0.3)	−20.08 (3.6)	+22	−22
$\bar{R}^2$	0.828	0.368	0.962	0.993	...	...
Durbin-Watson statistic	0.79	0.49	0.70	0.66		
			Panel B			
Constant	−307.6 (6.3)	111.8 (3.6)	−809.0 (17.9)	1,004.9 (15.3)	−196	196
Real permanent income per household, *YP*	0.1845 (10.1)	0.0107 (0.9)	0.2238 (13.4)	0.5816 (23.9)	0.20	0.80
Real transitory income per household, *YT*	0.4481 (5.5)	−0.0644 (1.2)	0.2415 (3.2)	0.3748 (3.4)	0.38	0.62
Index of expected car purchases, *A**	−56.24 (3.7)	−31.45 (3.2)	28.82 (2.0)	58.87 (2.9)	−88	+88
Filtered index of consumer sentiment, *SZ*	5.86 (2.0)	−10.38 (1.9)	7.59 (2.8)	−3.07 (0.8)	−5	+5
$\bar{R}^2$	0.836	0.594	0.963	0.988	...	...
Durbin-Watson statistic	0.76	0.72	0.68	0.29		

Sources: Basic data for the dependent variables are from U.S. Office of Business Economics, and, for consumer credit, Board of Governors of the Federal Reserve System. For independent variables, see Appendix B and discussion in text.

a. All monetary variables are in constant dollars per household.

b. Symbols used in this table are defined as follows:

ONS = Other net saving (personal saving minus consumer credit change).
CC = Decrease in consumer installment credit liabilities.
DUR = Expenditures on durables.
CX = Expenditures on nondurables and services.

(A^*), and the filtered index of consumer sentiment (SZ). The impacts of the inflation variables and the survey variables on income allocation are examined separately since the survey variables presumably reflect the influence of inflation.

The expenditure system is, of course, a highly simplified model, designed as a framework for examining inflation and expectational effects on household behavior, and not as a fully specified behavioral model. It will provide estimates of marginal propensities to spend and save out of permanent and transitory income, and of the effects on allocation of changes in the rate of inflation and in buying intentions and sentiment. The effect of the last two is expected to be positive on expenditures, especially for durables. Since these variables measure a general willingness to buy, a tradeoff against saving is expected. The inflation effects are ambiguous. As noted earlier, inflation might prompt a shift into tangible assets in the form of durables and out of financial assets as a form of protection against inflation, or inflation might aggravate consumer uncertainty about the outlook for real income and induce curtailment of spending as a form of precaution. The two hypotheses can be distinguished only empirically.

The coefficients on the inflation variables are small, but the t ratios exceed two in six of eight cases in Panel A. The effects of fully anticipated and unanticipated inflation implied by the results in Table 8 are summarized in Table 9. They suggest that unanticipated inflation does cause the household to reallocate income toward saving and away from spending. The negative effect of unanticipated inflation on consumption of nondurables and services and on total spending including durables, supports the uncertainty hypothesis. Fully anticipated inflation raises con-

Table 9. Summary of Inflation Effects on Household Allocation of Income to Spending and Saving, Second Quarter 1954 through Second Quarter 1971
Constant 1958 dollars of allocation per household per percent of inflation per year

Inflation expectation	*ONS*[a]	*CC*	*DUR*	*CX*	*Effects of inflation*	
					Saving	*Spending*
Fully anticipated	−15.2	+0.1	−29.6	44.8	−15.1	+15.1
Unanticipated	+12.6	+8.9	−1.4	−20.1	+21.5	−21.5

Source: Derived from Table 8, Panel A.
a. Symbols used in this table are defined as follows:
ONS = Other net saving = personal saving minus consumer credit change.
CC = Decrease in consumer installment credit liabilities.
DUR = Expenditures on durables.
CX = Expenditures on nondurables and services.

sumption expenditures on nondurables and services at the expense of both saving and expenditures on durables.

These results are highly tentative. The equations exhibit a great deal of serial correlation, however, and the possibility that the omitted variables have biased the results is therefore great. For example, inflation rates and interest rates are positively correlated; the effects of the former, which is included, could represent those of the latter, which is omitted. The tradeoff effects should be considered with these reservations until a full model of household behavior is analyzed.

The influence of the sentiment and buying plans variables on expenditures is clear and striking. The coefficients on A^* and SZ in Panel B are almost all significant and reveal a definite pattern of substitution. Expected purchases measure a general willingness to spend on both durables and other consumption; the negative effect on saving is strong. Somewhat different results are found for the filtered sentiment index. That variable was designed for the durables models and indicates that greater optimism has a negligible effect on consumption of nondurables and services.

A final point of interest is the relative magnitude in both sets of expenditure equations of the coefficients on permanent and transitory income. The transitory income coefficients are larger than those on permanent income for all equations except consumption of nondurables and services. These results are not inconsistent with the permanent income hypothesis. However, the total propensities to *spend* out of permanent and transitory income are not very different, and the transitory income effect on consumption of nondurables and services is as large as it is on durables.[22]

FORECASTING CONSUMPTION AND SAVING

The results from Panel A of Table 8 were used to generate some forecasts beyond the sample period using actual data for the period up to 1972:1 and hypothesized inflation rates and income growth rates there-

22. The permanent income hypothesis holds that the flow of consumption, defined to include the services from durables but not their purchase, should be unaffected by transitory income. To the extent that they include some changes in inventory rather than pure consumption, expenditures on nondurables and services ought to be related to transitory income, but the coefficient seems much too high to be the result of inventory change alone. See Milton Friedman, *A Theory of the Consumption Function* (Princeton University Press for the National Bureau of Economic Research, 1957).

after. Alternative assumptions for the growth rate of real disposable income were (a) 6 percent for the rest of 1972 and 5.5 percent during 1972; and (b) 7 percent throughout the forecast period. For all the inflation rates examined, the higher level of income growth yielded higher predicted ratios of saving to income and durables expenditures to income, and correspondingly lower ratios of other consumption expenditures to income. The differences generated by the alternative income growth assumptions are small, however, and the discussion below uses assumption (a) above. As both inflation rate variables in the model use lagged data, the actual numbers available through the first quarter of 1972 provide estimates through 1972. For predictions for 1973, alternative inflation assumptions were made: high anticipated inflation ($CPI = CPI^* = 6$ percent); low anticipated inflation ($CPI = CPI^* = 3$ percent); high unanticipated ($CPI = 6$ percent and $CPI^* = 3$ percent), and low unanticipated ($CPI = 3$ percent and $CPI^* = 0$).

Although the model underpredicts the recent high rates of personal saving (8.2 percent in 1971), it accurately predicts the 7.0 percent rate in 1972:1. Under the assumption of high anticipated inflation the rate is predicted to be 7.7 percent in 1973:1 and 7.8 percent in 1973:4, while under the assumption of high unanticipated inflation the saving ratio will be higher: 8.3 percent in 1973:1 and 8.4 percent in 1973:4. The lower inflation rates reduce all the predicted saving rates, but by no more than 0.1 percent. In other words, a given amount of *unanticipated* inflation (actual exceeds expected by 3 percentage points) will increase the personal saving rate substantially (by 0.6 percent), while an equivalent rise in *anticipated* inflation (from 3 percent to 6 percent) will lead to an increase in the saving rate of only 0.05 percent.

The same assumptions about income growth and inflation rates produce a different pattern for expenditures on durables. With high anticipated inflation, the ratio of durables outlays to income is predicted to be 15.8 percent in 1973:1; with low anticipated inflation, 16.8 percent. For unanticipated inflation, both ratios increase substantially: 16.7 percent for the high assumption, and 17.7 percent for the low assumption. A small increase in each of these ratios is predicted during 1973, given the income growth assumptions.

Thus, in general, higher rates of inflation increase saving, reduce durables expenditures, and increase expenditures on nondurables and services; on balance, spending is reduced slightly. But if the inflation is unanticipated, either high or low rates of inflation will increase both saving and expenditures on durables, and will sharply reduce expenditures on nondurables and services; on balance, spending is reduced markedly.

Summary and Conclusions

Two principal conclusions emerge from this paper. The first concerns the usefulness of data on consumer anticipations in demand models, the second the role of anticipated and unanticipated inflation on consumer spending behavior.

ANTICIPATIONS DATA

Our most firmly documented conclusion is that explicitly expectational measures of consumer intentions and attitudes are of considerable importance in models forecasting expenditures on automobiles: The index of expected purchases for automobiles, as well as the filtered version of the consumer sentiment index, contributes significantly to the explanation of purchase behavior. We find that forecast models that involve an appropriate specification of these two survey variables adequately explain all of the aspects of adjustment lag and expectations formation in the models ordinarily used in econometric work, and the only economic variable besides the two survey measures that is relevant is one that captures transitory and unexpected income change, such as the unemployment rate. For nonauto durables, economic variables continue to exert a strong influence and the survey variables appear to be marginally useful in prediction models. Thus, successful predictions of durable goods demand depend on ability to extrapolate the two survey variables some time into the future.

Interestingly enough, it appears that the two survey variables examined here are useful beyond the specific purposes—prediction of consumer durable goods demand—for which they were constructed. Both are generally significant in functions designed to explain personal saving and consumer expenditures on nondurables and services. Although the equation system within which we examine saving and nondurables consumption is a very simple one and is a relatively weak behavioral specification, the strength of the two survey variables in it encourages belief that even a fully specified model of saving or expenditure might have a useful role for survey measures of consumer plans and attitudes. Hence, we find persuasive evidence that these expectational variables will be useful in any fully developed econometric system of short-term demand forecasts, although perhaps more so in automobile demand and saving equations than elsewhere.

INFLATION

We have examined the role of price inflation in the structure of demand for durables, in functional relationships designed to explain the survey variables, and in the simple income allocation system. The results are sometimes hard to interpret, and are sensitive to the selection of an inflation measure. Some results that seem relatively unambiguous, and that are important for policy purposes, can, however, be identified.

The price inflation variables have a moderate influence in fully developed demand models for automobiles and other durable goods as well as in equations designed to predict the survey variables that play an important role in the models. The strongest effects of inflation show up in equations that seek to explain average real expenditures per car and real expenditures on nonauto durables. There is some inflation effect in equations designed to explain unit purchases of automobiles, but they are relatively weak. In general, the most consistent effect in these demand models is a negative influence of expected price change on real expenditures, for both automobiles and nonauto durables. As a result, a fully anticipated inflation appears to have a negative impact on real expenditures for durables; however, unanticipated inflation has very little impact.

Second, unanticipated price inflation appears to have a negative influence on both purchasing plans and attitudes of consumers, as reflected, respectively, in the index of expected purchases, A^*, and the index of consumer sentiment, S. Even when anticipated, inflation has an influence on expected purchases, but has no identifiable effect on consumer sentiment. There is some evidence that the effects of inflation on these variables were not the same during 1967–71 as they were for the 1960–71 period as a whole, and that the more rapid inflation during the later part of this period tended to depress the purchase and sentiment indexes relative to predictions made on the basis of the earlier part of the period.

Our third and most tentative conclusion relates to the way inflation, as measured in the income allocation equations of Table 8, affects total expenditures and saving. Unanticipated inflation appears to have a negative influence on consumer expenditures for nondurables and services, while a fully anticipated inflation has a stronger positive influence. For durable goods, unanticipated inflation has almost no impact, while a fully anticipated inflation has a negative one. For saving, the first has a positive influence, while the second has a somewhat weaker negative effect.

In general terms, the results suggest that a fully anticipated inflation will increase consumer expenditures on nondurables and services and reduce both spending on durables and personal saving. On the other hand, a totally unanticipated inflation has the opposite effect: Here, consumer expenditures, mainly for nondurables and services, are reduced substantially, while saving rises commensurately. These results support the view that a primary effect of unanticipated inflation is to reduce spending and increase saving, possibly because inflation deepens uncertainty about real income expectations.

APPENDIX A

Reduced Form of Objective Model

The reduced form of the model is derived by writing (1.3), with the lag operator, solving for Z^e, and substituting in (1.2)[1] to yield

$$K_t^* = \frac{\rho Z_t}{1-(1-\rho)L_t}. \tag{A1}$$

Substituting for K^* in (1.1) yields

$$G_t^P = \beta\left(\frac{\rho Z_t}{1-(1-\rho)L_t} - (1-\delta)K_{t-1}\right). \tag{A2}$$

Combining (A2) with (1.0) and (1.4) yields

$$G_t = \beta\left(\frac{\rho Z_t}{1-(1-\rho)L_t} - (1-\delta)K_{t-1}\right) + f(T_t). \tag{A3}$$

Multiplying out by the lag operator yields

$$\begin{aligned} G_t = {} & \beta\rho Z_t - \beta(1-\delta)K_{t-1} + \beta(1-\delta)(1-\rho)K_{t-2} \\ & + f(T_t) - (1-\rho)f(T_{t-1}). \end{aligned} \tag{A4}$$

1. The functional notation is dropped from (1.2) for simplicity. The lag operator, L, is defined as $Lx_t = x_{t-1}$. The other variables are defined on pp. 73–74.

Equation (A4) shows that the model includes two lagged stock variables because there are two lag processes (adjustment and expectations). Also, a lagged transitory term appears because the transitory variables are not part of the lagged formation-of-expectations component of the model. The reduced form in the text, equation (1.5), is derived from (A4) by substitution from the identity

$$G_{t-1} = K_{t-1} - (1 - \delta)K_{t-2}.$$

A reduced form for the planned component of expenditure alone can be derived in the same way:

$$\text{(A5)} \quad G_t^P = \beta\rho Z_t + (1 - \rho)G_{t-1}^P + \beta(-\rho + \delta)S_{t-1} - \beta(1 - \rho)G_{t-1}.$$

APPENDIX B

Data Estimation and Sources

Permanent Income

Permanent income was estimated from the following basic equation:

$$YP_t = \eta Y_t - (1 - \eta)(1 + \gamma)\, YP_{t-1},$$

where Y is current real income per household,[1] η is the coefficient of adjustment, and γ the trend rate of growth. The adaptive formation of expectations of real permanent income, YP, follows Friedman's approach and the estimation procedure was suggested by Darby.[2]

The growth rate, γ, is generated from the quadratic trend function,

$$\ln Y = a + bt + ct^2.$$

The quadratic term is used because the t^2 term is highly significant, and,

1. Current real income per household was derived by dividing disposable real income, published in *Survey of Current Business*, by an estimate of the number of households, based on annual data published in Bureau of the Census, *Statistical Abstract of the United States*.

2. See Milton Friedman, *A Theory of the Consumption Function* (Princeton University Press for the National Bureau of Economic Research, 1957), and Michael Darby, "The Allocation of Transitory Income Among Consumers' Assets," *American Economic Review* (1972, forthcoming).

although it implies an increasing trend, it yields a better fit during the sample period. The growth rate is given by

$$\gamma = \frac{d \ln Y}{dt} = b + 2ct.$$

The initial value for permanent income (when $t = 0$) is also derived from the trend function,

$$YP_0 = e^a.$$

The value of η is assumed to be 0.19. This figure is derived from Friedman's estimate of $\eta = 0.4$ from an annual model. Mundlak[3] shows that when adjustments are truly made quarterly and the model is estimated from annual data, the annual adjustment coefficient (η_A) and the true quarterly adjustment coefficient (η_Q) are related as follows:

$$(1 - \eta_A) = \frac{1 - \eta_Q}{4\eta_Q} [1 - (1 - \eta_Q)^4].$$

Two permanent income series, YP and YP', are used in the paper. The series for YP is based on disposable income. The trend equation is

$$\ln Y = \underset{}{8.6805} + \underset{(4.6)}{0.00234}\, t + \underset{(6.5)}{0.0000426}\, t^2.$$

$\bar{R}^2 = 0.965$; standard error of estimate $= 0.023$; Durbin-Watson statistic $= 0.12$.

The series for YP' is based on disposable income less transfer payments. This variable is used in the objective models of automobile demand, where nontransfer income is more relevant. The trend equation for calculating permanent nontransfer income is

$$\ln Y = 8.6799 + \underset{(4.6)}{0.00234}\, t + \underset{(6.5)}{0.0000425}\, t^2.$$

$\bar{R}^2 = 0.964$; standard error of estimate $= 0.023$; Durbin-Watson statistic $= 0.12$.

Automobile and Other Durable Stocks

The stock existing at the end of the quarter is the sum of depreciated past expenditures in real terms. That is, the stock is given by

$$K_t = \sum_{i=0}^{n} (1 - \delta)^i X_{t-i},$$

where K is the stock; X, quarterly real expenditures; n, the life of the good;

3. See Yair Mundlak, "Aggregation Over Time in Distributed Lag Models," *International Economic Review*, Vol. 2 (May 1961), pp. 154–63.

and δ, the depreciation rate. It is assumed that the goods depreciate at a constant rate, δ, for n quarters, at which point they are scrapped.

For automobile stocks, the assumptions about depreciation and length of life used by Hymans are adopted: $\delta = 0.078$ and $n = 40$ quarters.[4] The expenditure series is the U.S. Department of Commerce personal consumption expenditure component of gross auto product, published in *Survey of Current Business.*

For other durables (personal consumption expenditures on durables less auto expenditures, as above) the assumptions are $n = 40$ and $\delta = 0.098$. The depreciation rate is the average rate over 1954–68 implied by Hymans' procedure for other durables.[5] The stock series are deflated by the number of households at mid-quarter.

Index of Expected Purchases

The index of expected purchases of automobiles, A^*, is a weighted variable defined by

$$A_t^* = 0.6\, A_t^{**} + 0.3\, A_{t-1}^{**} + 0.1\, A_{t-2}^{**},$$

where A^{**} is constituted from data from the Survey Research Center (SRC), the *Quarterly Survey of Intentions* (QSI), and *Consumer Buying Expectations* (CBE), described below.

From 1953 through 1959 the only source of information on buying intentions is data from the Survey Research Center of the University of Michigan. Since the data are taken from several sources and are not available in a consistent form nor for every quarter, some processing is necessary to put them into useful form. This was done for earlier years by Arthur M. Okun, in "The Value of Anticipations Data in Forecasting National Product," in *The Quality and Economic Significance of Anticipations Data,* A Conference of the Universities-National Bureau Committee for Economic Research (Princeton University Press for the National Bureau of Economic Research, 1960), p. 446; later data are taken from various issues of the *Survey of Consumer Finances,* published annually by the Survey Research Center of the University of Michigan.

4. Saul H. Hymans, "Consumer Durable Spending: Explanation and Prediction," *Brookings Papers on Economic Activity* (2:1970), p. 196.

5. *Ibid.*, p. 199.

From first quarter 1953 to first quarter 1956 Okun provides data for nine periods of the thirteen quarters in the form of intentions (measured by the sum of "will buy," "will probably buy," and one-half the "may buy" responses) for new and used cars. The new and used car intentions are assigned weights of 0.6 and 0.3, respectively. From 1956 on, second and fourth quarter surveys are available with the data classified by "will buy," "will probably buy," and "may buy" new autos. Weights of 0.7, 0.5, and 0.3, respectively, were assigned as well as a 0.3 weight for used car purchase plans and a 0.4 weight for "don't know" responses. The first quarter data are available in a new-used classification with "don't know" responses allocated. Consistent weights for these classifications based on the mean size of each category were calculated (0.32 for used cars, 0.54 for new cars). The two sections of the SRC data were then linked on the basis of an overlap period.

Data for missing quarters were interpolated and the series seasonally adjusted with the X-11 moving seasonal program. After adjustment, the missing quarters were corrected to be interpolations of the seasonally adjusted data. The SRC portion (1953–60) of the basic intentions series was then linked to the level of the QSI-CBE portion based on an overlap period. The derivation of the QSI-CBE portion follows.

For 1960 through 1966, the Census Bureau's *Quarterly Survey of Intentions* is used; for 1967 on, purchase probability data from the bureau's *Consumer Buying Expectations* are used. First we construct a weighted measure of the basic QSI intentions data: Six-month definite, probable, or possible plans to buy new cars are assigned weights of 0.7, 0.5, and 0.3, respectively; twelve-month plans are assigned a weight of 0.3; used-car plans a weight of 0.2; and "don't know" responses a weight of 0.3. For CBE data, six- and twelve-month car purchase probabilities were given equal weights in constructing the series. The constructed index used in the equations is given in Table B-1.

Index of Consumer Sentiment

The Survey Research Center's quarterly index of consumer sentiment is published in *Business Conditions Digest*. The variable S is the survey lagged one quarter and with missing quarters (all prior to 1962) interpolated linearly.

The filtered sentiment index, SZ (Table B-2), reflects the notion that the

Table B-1. Index of Expected Purchases, A*, 1953–71

	Quarter			
Year	*First*	*Second*	*Third*	*Fourth*
1953	...	...	6.26	5.66
1954	6.17	6.89	7.56	8.13
1955	7.79	7.60	7.50	7.47
1956	7.32	7.42	7.64	7.91
1957	7.78	7.74	7.45	7.03
1958	6.79	6.56	6.52	6.53
1959	7.07	7.37	7.37	7.20
1960	7.75	7.74	7.60	7.53
1961	7.63	7.60	7.86	7.97
1962	8.04	8.30	8.21	8.35
1963	8.40	8.64	8.84	8.82
1964	8.97	9.16	9.05	9.41
1965	9.55	9.58	9.62	9.61
1966	9.58	9.46	9.47	9.58
1967	9.28	8.93	9.24	9.12
1968	9.23	9.37	9.42	9.57
1969	9.55	9.57	9.54	9.44
1970	9.41	9.36	9.41	9.44
1971	9.74	9.54	...	...

Sources: Derived from data in the following publications: 1953–56—Arthur M. Okun, "The Value of Anticipations Data in Forecasting National Product," in *The Quality and Economic Significance of Anticipations Data*, A Conference of the Universities-National Bureau Committee for Economic Research (Princeton University Press for the National Bureau of Economic Research, 1960), p. 446; 1957–59—University of Michigan, Survey Research Center, *Survey of Consumer Finances*, relevant issues; 1960–66—U.S. Bureau of the Census, *Quarterly Survey of Intentions*, relevant issues; 1967–71—Bureau of the Census, *Consumer Buying Indicators*, relevant issues.

change in S is relevant when it is either large or persistent, hence when uncertainty is unmistakably increasing or decreasing. The rule for determining whether a change in S is systematic is arbitrary, but reasonable: It holds that a move is persistent when it proceeds in the same direction for at least three consecutive quarters. Interpolated quarters are counted; and three more quarterly movements are not necessary to reintroduce the series after a break in a series of upward or downward movements. The criterion is whether the next quarter after the break reinforces the previous pattern by registering a new local high (or low) value; if so, the series will be interrupted only by the quarter break, and if not the basic decision rule applies, and the series must restart. The rule is relaxed in the case of two consecutive changes that are quantitatively large (defined to be at least seven percentage points on the SRC index, which has a base of 1963 = 100).

Table B-2. Filtered Index of Consumer Sentiment, SZ, 1953–72

	Quarter			
Year	*First*	*Second*	*Third*	*Fourth*
1953	...	...	0.00	0.00
1954	−1.65	−1.65	0.00	1.00
1955	2.05	4.10	6.05	3.15
1956	0.30	0.15	0.00	0.00
1957	0.00	0.00	−1.85	−4.00
1958	−4.60	−5.05	−2.60	2.50
1959	4.95	3.60	2.25	1.10
1960	0.00	0.00	0.00	−0.70
1961	−1.40	−0.70	0.00	0.50
1962	1.05	1.95	1.40	0.00
1963	0.00	0.00	0.00	0.00
1964	0.00	1.05	1.05	1.05
1965	1.05	1.05	1.40	0.85
1966	0.50	0.00	−2.15	−4.40
1967	−3.70	−1.45	0.00	0.80
1968	0.80	0.00	0.00	0.00
1969	0.00	0.00	0.00	−2.60
1970	−5.95	−4.15	−2.15	−1.35
1971	0.00	0.00	1.70	2.10
1972	0.40	...	...	...

Sources: Derived from index of consumer sentiment in *Business Conditions Digest*, relevant issues.

Formally, the filtered variable is

$$SZ_t = 0.5\, z_t\, (\Delta S_t) + 0.5\, z_{t-1}\, (\Delta S_{t-1}),$$

where

$$\Delta S_t = S_t - S_{t-1},$$

and where $z_t = 1$

if

$$\Delta S_{t-i} \text{ for } i = 0, 1, 2 \text{ are of the same sign,}$$

or if

$$|\Delta S_t + \Delta S_{t-1}| \geq 7,$$

or if

$$z_{t-2} = 1 \text{ and } z_{t-1} = 0 \text{ and } |\Delta S_t| > |\Delta S_{t-1}|;$$

otherwise, $z_t = 0$.

Index of Expected Price Change

The expected rate of inflation, *CPI**, is constructed from SRC data on expected price changes, which have been gathered since 1952. However, prior to 1966:2, the survey ascertained only whether prices were expected to rise, fall, or remain the same. Since 1966, those who expected a price increase have been asked, "How large a price increase do you expect?" Except in the last few years, the surveys were not taken regularly and missing quarters are interpolated (see Table B-3).

The basic survey series for post-1966 years reports the mean expected price increase in the next twelve months. The calculation uses the class mid-points of the four classes expecting prices to go up less than 10 percent; 10 percent for the classes expecting a greater than or equal to 10 percent rise; the mean of positive responses for the "don't know how much" class; and 0 for the "will not go up" responses. For the earlier period, an index of expected inflation is constructed by assigning weights of +1 to "will go up" responses, 0 to "stay the same" and "don't know" responses, and −1 to "will go down" responses. This index is linked to the post-1966 data by an overlap period. Prior to 1960, the survey question refers to expected price changes for household goods, appliances, and clothing in the

Table B-3. Basic Index of Expected Price Change, *CPI*, 1953–72**

	Quarter			
Year	*First*	*Second*	*Third*	*Fourth*
1953	...	...	−0.61	−0.71
1954	−0.80	−0.90	−0.87	−0.85
1955	0.13	0.42	0.73	1.04
1956	1.25	1.46	1.65	1.84
1957	1.58	1.32	1.39	1.46
1958	0.94	0.42	1.01	1.60
1959	2.04	2.16	2.28	2.41
1960	2.53	2.39	2.25	2.11
1961	1.97	1.97	2.00	2.04
1962	2.27	2.04	1.85	2.01
1963	2.53	2.30	2.34	2.23
1964	2.41	2.60	2.62	2.63
1965	2.64	2.66	2.68	2.60
1966	2.67	2.74	3.33	3.12
1967	2.91	3.01	3.12	3.44
1968	3.38	3.32	3.47	2.99
1969	3.07	3.73	3.74	2.80
1970	3.29	3.73	3.06	3.47
1971	3.50	3.25	2.39	2.41
1972	3.04	...	...	...

Sources: Derived from University of Michigan, Survey Research Center, *Survey of Consumer Finances*, various issues, table on price expectations for the next year.

next year. The index of expected inflation was constructed with the same weights and linked to the price inflation index by another overlap period.

The main apparent deficiency in the data is the persistent tendency of consumers to expect almost as much price inflation in the early and middle 1960s as in the late 1960s. Similarly surprising are the expectations of deflation in the period after the Korean War. On the other hand, these data may very well reflect consumer expectations and accurately indicate that the current inflation is largely unanticipated.

The variable used in the econometric work is the index of expected inflation, CPI^*, an average of the basic survey series, CPI^{**}, over two quarters, as shown by

$$CPI_t^* = 0.5\ CPI_{t-1}^{**} + 0.5\ CPI_{t-2}^{**}.$$

The data are lagged because the SRC surveys are taken at various times during the quarter and do not become available for some time. The surveys are averaged in order to smooth random variation.

Comments and Discussion

Saul Hymans: The Juster-Wachtel paper attempts to interrelate the entire range of stock adjustment processes, sentiment-expectation data, and analysis of inflation effects in models predicting consumer expenditures. Some of the data employed are notoriously imperfect. And although the paper seeks to be as hard on these data as possible, their quality remains one reason why I feel the results should be considered little more than suggestive of fruitful avenues to pursue in further investigations. I also have some technical questions to raise about the analysis and the specification of some of the empirical models.

There are at least three troublesome technical points. First, Z is the function containing the determinants of desired stock. The adaptive expectations model alleges that changes in expectations about Z are proportional to the difference between the current value of Z and the previous expectation of Z. However, if the current value of Z is available, an expectation value would be unnecessary. It is the lagged value of Z that should appear in the adaptive expectations equation, in the subsequent reduced form equation that is fitted to the data, and in all the other equations involving the objective model.

Second, the combination of adaptive expectations and partial adjustment can play real tricks with the structural error term in the model. This possibility is neglected by the authors in making regression estimates and, I believe, works to the relative disadvantage of the objective model when it is compared with the anticipatory model. The objective model is subjected to both of these mechanisms—partial adjustment and adaptive expectations. The anticipatory model is subjected to neither.

Third, the authors attempt to predict the index of expected auto purchases, the A^{**} variable, and the value of those purchases, the $A^{**}V$ variable, which resulted in the three equations in Table 6. In this model the lagged auto stock and lagged expenditures on autos should be included as explanatory variables. But when they are, in the first equation of the table, they are not statistically significant and lagged expenditures has the wrong sign. The variables are apparently too highly correlated to appear as regressors in the same equation. It might be possible to construct a statistical technique that would use an a priori theoretical specification about the variables to get around this problem. But when the problem is avoided by using equations such as the second and third equations in Table 6, which omit the lagged expenditures variable, the structural meaning of the results is unclear, including the results in the inflation variables.

Turning to empirical problems, Table 2 compares the anticipatory model over different time periods. Prior to 1960, the expected purchase variable, A^*, is simply constructed from bad data. That is probably reason enough to explain the 1954–59 equation. But what about the 1967–71 equations, when the coefficient of A^* is again neither significantly nor even probably measurably different from zero? Apparently that variable is useful only for the 1960–66 period. The authors concluded that the residual variation in the anticipatory model is not much higher in 1967–71 than in 1960–66, but in fact the standard error of estimate is 44 percent higher in the former period than in the latter. The same comparison with the objective model shows only a 21 percent increase in the standard error of estimate despite the fact that the Chow test seems to like one and not the other.

It is apparent that, whatever their type, all of the models go bad in the late 1960s. That fact seems to me of far greater significance than any nitpicking over the two bits' worth of explanatory power by which the objective and the anticipatory models differ.

The material on the income allocation system is potentially interesting but subject to too many problems for me to be impressed with the results. The specifications for the expenditure system are too simplistic to be in the same paper with the equations discussed earlier. As the Durbin-Watson statistics demonstrate, the timing patterns are so inadequate as to vitiate the results. I suspect the authors would have been better off putting all the lagged dependent variables in each equation, or putting lagged durable stocks in each equation, or, as I think best, fitting the simple expenditure system to annual data, where the timing relationships are far less crucial. This method would still let them deal with the issue that interests them most—the way inflation affects the allocation of income among various saving and spending categories. In short, I would have been happier with a far more carefully considered job on a proper subset of the topics that the authors took up.

James Duesenberry: I thought the Juster-Wachtel paper was very interesting and suggestive of a number of possibilities for further research. In places it moves us ahead a significant distance. But I also had some problems with it. First of all, I was surprised at the initial discussion of the basic model because they used a standard stock adjustment model that deals with automobiles but not with any substantive theory of the behavior of the public. I would have thought someone as interested as Juster is in surveys of consumer attitudes would look more closely at the specific decision making that is involved. We are dealing with a situation in which people are faced with a set of long-run choices: how often they trade their cars; whether they buy second cars; and what kind of car they buy and with what degree of luxury. Presumably, much of the basic pattern of their choices is accounted for by the slow response to permanent income, to relative prices, and, possibly, to the relative repair costs of used cars, which ought to be somewhere in this sytem. Then, in addition, there are transient factors, such as changes in actual income or expectations, that lead people to postpone purchases or to decide to trade down or up and thus cause variations around the basic pattern of purchases. More attention should have been paid to the bolts and nuts of the decision-making process in specifying the basic model. The authors went in this direction when they separated the problem of predicting auto expenditures into how many cars would be bought and at what average price.

An integrated argument arises from looking at the paper as a whole. The evidence seems to show that there is something different about the last five years in comparison with the earlier years. The paper argues, first, that some of that difference appears to be picked up by the survey variables, although that conclusion is called into question by the observations that Hymans made, and remains problematic. And it argues, second, that inflation may account for the difference about the last five years.

Both of these arguments, but especially the first one, are weakened by the way the authors compromised in using the many variables from the objective model together with the survey variables. They ended up with a weak specification of the objective model, particularly in its transitory elements. If an objective model were built from scratch to include the survey variables, it would be more complicated than this one. In dealing with transitory factors the unemployment rate is not enough to link the basic model to the survey variables. More detail about the car stock might have been useful in coping with this problem. Because the combined model is inadequate, it weakens the conclusion that some structural change in the later years is picked up by the survey variables and not by the objective ones.

I thought the inflation analysis made some real progress; separating the inflation into anticipated and unanticipated elements makes the whole argument more sensible. On the whole there is some positive evidence in favor of the proposition that inflation was a significant variable in the latter part of the period and not earlier. But I was not overwhelmed by the evidence that the survey variables picked that up.

Table 3, in which the anticipatory variables are added to the objective variables, poses another problem. Unfortunately, adding the anticipatory variables causes big changes, in both the size of the other coefficients and their significance, at least in the 1960–71 and 1960–67 periods. Given the weaknesses in the specification of the objective model, the importance of the explanatory power of the anticipatory variables is questionable. Particularly in this situation, adding a new variable that knocks another one out does not mean the new one is the right one. It tells you only that, because of collinearity problems, the result is ambiguous.

The paper does move us ahead on a complicated subject. But a good deal of ambiguity remains. To reduce it calls for working the survey data into a model that makes use of more detail about consumer buying—whether people are buying new or old cars, trading up or trading down, and that sort of thing—as a way of providing more certainty about what motivates people and what the surveys can tell us.

Tom Juster and Paul Wachtel: Regarding Hymans' first point, in a life cycle approach to a demand model, expectations are relevant whether or not current information is available. It might be argued that current information that may not be available should not be used to predict, if the objective model is viewed as a predictive one. In that case, the only change necessary is to lag the objective variables, income and prices, one quarter. We have looked at equations of that sort and nothing is fundamentally changed from those reported in our paper. In general, expectations are a very important part of the model. They are relevant even when current information is available, and that is how we justify our formulation.

We tried to give the objective model a fair shake in comparing it with the anticipatory model, although both Hymans and Duesenberry felt we should have done better by it. In any sort of objective model with a lag structure, a complete specification would be complicated and we were forced to some simplifications. Scanning possible serial correlation parameters for first, second, or higher order serial correlations would improve the fit and give the objective model a better chance in these comparisons. But without an a priori reason to expect a particular form of the error term, the improved fit may not genuinely reflect an improved model.

We entirely agree with Duesenberry's notion that one wants to get more micro about the determinants of auto purchases. Many of his suggestions would apply to the design of an equation to explain A^{**}, the index of expected purchases. That variable is supposed to represent a net judgment on the part of consumers as to what they will do in the next three, six, or twelve months, which they presumably make on the basis of their past income, expected income, car stock relative to income, and developments in used and new car prices. All of those ingredients go into the determination of the index of expected purchases. Therefore it is not surprising to find that, when that variable is introduced into an equation including other, objective, variables, the others become redundant. That is exactly what happened in the 1960–71 period when an accurate measure was available for the index of expected purchases.

General Discussion

Several discussants commented on how the survey variables should be interpreted and what the most useful way to study them would be. Saul Hymans argued for sharply differentiating between the buying intentions and consumer sentiment variables. He noted that when the sentiment and buying intentions variables were used together with objective variables, as they have been in this and other research, the sentiment variable did not displace objective variables while buying intentions did. He cautioned against a casual inference that both types of surveys reflect "attitudes." James Duesenberry pointed out that if buying intentions were treated like the data on plant and equipment spending plans, it would be natural to use one set of objective variables to explain buying intentions and another set of variables, including the consumer sentiment data, to explain the deviation of the intentions from actual consumer expenditures. Part of the sentiment variable presumably would be explained by objective variables, and it would be the remaining, unexplained, part of the sentiment variable that would be useful new information about consumer behavior.

Lawrence Klein also argued the importance of going as far as possible with objective variables rather than seeing how far they could be replaced by survey data. He preferred using a carefully structured model of objective variables to explain consumer behavior and supplementing this with some function of the sentiment variable that represented the part of consumer behavior that could not be explained by objective variables. He reported being able to predict the sentiment variable fairly well using price changes and unemployment rates. In a similar vein, R. J. Gordon said that the real need is for consumption functions in an econometric model that would predict the result of alternative monetary and fiscal policies. This required more research on explaining the determinants of the survey variables. Starting with objective functions like the ones in this paper, and with improvements to them from survey data, good explanations of the survey data are the basic requirement. The ultimate consumption function would then include all the determinants of the survey variables as well as the objective variables.

While Arthur Okun agreed that one important use of survey data was to improve our understanding of consumer response to objective variables, he noted that survey information on inflationary expectations itself provided objective measures of that important determinant of consumer behavior. The present paper was the first study he had seen that used survey responses on expected inflation to help explain consumption. He and Alan Greenspan both noted that consumers could be expected to cut back on spending in the face of higher inflation rates, whether anticipated or not, because more inflation would be associated with greater uncertainty about individual real incomes, even if real incomes were unchanged on average. The results in the paper were consistent with this view.

Robert Solow found it hard to take seriously results based on the survey of inflationary expectations because the survey data seemed so implausible a priori. He noted that individual responses to the survey were wildly out of line with actual price experience and suspected respondents did not understand the questions they were being asked and would not in fact behave in a way that was consistent with their answers. William Nordhaus, George Perry, and others were inclined to reserve judgment on this, since it was hard to distinguish whether Solow's reservations were correct or whether, on average, the surveys were correctly telling us that consumers actually held and acted on uninformed and implausible expectations about inflation.

Several discussants offered observations about consumer behavior in recent years. Hendrik Houthakker reported that the saving functions he developed with Lester Taylor continued to predict quite well in this period of historically high saving rates. He found no need to look for structural changes or special effects in consumer behavior over this period. Their equations view saving as an attempt to reach target levels of assets, with target levels growing with income. With nominal income growing rapidly, partly as the result of inflation, the model predicted high saving rates. R. J. Gordon was not convinced by the paper's emphasis on inflation as the cause of high saving in the 1969–71 period. He noted that individuals who had become used to rapid increases in their real incomes during the previous five years saw them begin to drop, and he conjectured that this change converted them from optimists to pessimists. Presumably such conversion would have taken place even if the rate of inflation had been steady. Okun noted that the rising unemployment and persistent inflation that, in combination, characterized recent years offered a unique opportunity to study their impact on consumer behavior. While the paper had stressed the influence of inflation in this period, it was possible that the prolonged rise in unemployment was important or that the separate effects of inflation and unemployment were not simply additive in this period.