3 Consumption

3.1 Introduction

In this chapter the three consumption equations of the model will be discussed. The emphasis in the chapter is on examining the role that consumers' general feelings and attitudes play in influencing their short-run behavior. An attempt has also been made to examine what effect consumer buying expectations have on consumer expenditures. In the next section the theory behind the present model will be briefly discussed and the data on consumer sentiment and consumer buying expectations that have been used will be described. The three consumption categories—durable goods, nondurable goods, and services—will then be examined in Sections 3.3, 3.4, and 3.5 respectively. Section 3.6 concludes with a summary of the major results of the chapter.

3.2 Consumer Sentiment, Consumer Buying Expectations, and Short-Run Consumption Functions

An adequate explanation of short-run consumer behavior is essential in a short-run forecasting model, and yet it is one of the most difficult to achieve. There has been an enormous amount of work in the area of consumer behavior, but unfortunately no very accurate equations for explaining short-run changes in consumption appear to have been developed.[1] The work in this chapter is based on the theory that general feelings of optimism or pessimism on the part of consumers are likely to be important determinants of their short-run behavior. The average consumer in the United States has considerable discretion in how much he purchases in any given quarter (i.e., the average consumer in the United States is far above the level of subsistence), and if he is worried about the future, he is likely to spend less and save more than he would if he were more sanguine about the future. The main attempt in this chapter has thus been to examine how useful the available data on consumer sentiment are in explaining short-run changes in consumption.

[1] See, for example, Suits and Sparks [41], p. 217, for a discussion of the poor short-run explanatory power of the consumption equations of the Brookings model.

The main series on consumer sentiment is compiled by the Michigan Survey Research Center.[2] In 1952 the Research Center began to conduct surveys on consumer attitudes. From 1954 through 1961 the surveys were taken approximately three times a year, and from 1962 to the present the surveys have been taken quarterly. The sample size has varied from 1000 to 3000 observations. Questions are asked regarding attitudes about personal financial conditions, business conditions, and market conditions.[3] The series used in this study is an index of consumer sentiment that is based on five questions about consumer attitudes.[4] The index will be denoted as $MOOD_t$ in the discussion that follows.

While the main attempt in this study has been to see how the $MOOD_t$ index affects consumer expenditures, an attempt has also been made to see how consumer buying expectations affect consumer expenditures. To the extent that buying expectations are realized, they should be significant in explaining actual expenditures. The main series on consumer buying expectations is compiled by the Bureau of the Census.[5] The data are compiled from a quarterly household survey of approximately 11,500 households. The survey is designed to measure consumer buying expectations rather than general feelings or attitudes: each respondent is asked to select his chances of purchasing certain items during a specified time period (usually 12 months) from an answer sheet that is scaled from 0 to 100. The survey was considerably changed in 1967, and the data before 1967 are not strictly comparable with the more recent data. The questionnaire of the old survey was less detailed regarding the probability breakdown and was thus more qualitative in nature.[6]

The index of consumer buying expectations that has been considered in this study is the index of expected new car purchases. This index is available from the old survey from the first quarter of 1959 through the third quarter of 1967 and from the new survey from the first quarter of 1967 to the present.[7] Although the old and new survey indices are not strictly comparable, they

[2] See, for example, Katona et al. [32].
[3] See Katona et al. [30], p. 175.
[4] See Katona et al. [32], Table II–1, pp. 243–244, for a tabulation of this series through 1966. The series was revised slightly in 1968, but the revisions were quite small. For the work in this study the prerevised figures were used before 1967. Before 1962, quarterly observations were obtained for this study by interpolating (when necessary) between the given observations. From 1955 through 1961 ten observations had to be constructed in this way. The data and the interpolation figures are presented in Appendix A.
[5] See, for example, U.S. Bureau of the Census [46].
[6] U.S. Bureau of the Census [44], p. 2.
[7] See U.S. Bureau of the Census [45], p. 25, for a tabulation of the data from the old survey and U.S. Bureau of the Census [46], p. 2, for a tabulation of the data from the new survey (through the fourth quarter of 1969).

were treated as one continuous series in this study. Data from the old survey were used for the series from the first quarter of 1959 through the fourth quarter of 1966, and data from the new survey were used for the series from the first quarter of 1967 on. This series on expected new car purchases will be denoted as $ECAR_t$. Data on $ECAR_t$ are presented in Appendix A.

In addition to consumer sentiment and buying expectations, consumption is likely to be influenced by present and lagged values of income. Indeed, much of the previous work in the area of consumer behavior, including the work relating to the permanent income hypothesis, can be incorporated into the general problem of determining the lag structure of consumption on income. As discussed in Chapter 1, one tenet of this study is that it is too much to expect that the highly aggregated data used here can distinguish among various complicated lag structures. Consequently, only two simple lag structures were estimated for each of the consumption equations. In the first case consumption was assumed to be a linear function of current income and income lagged one quarter, and in the second case consumption was assumed to be a linear function of current income and consumption lagged one quarter. The second case can be interpreted as implying that consumption is a geometrically declining function of current and all past values of income, or that desired consumption is a linear function of current income, with actual consumption being subject to a simple lagged adjustment process. Again, due to the aggregative nature of the model, no strict interpretation will be placed on the results regarding the "true" lag structure or adjustment process. The results are only approximate at best.

In the work that follows consumption has been disagregated into consumption of durables, consumption of nondurables, and consumption of services. Due to the postponeable nature of consumption of durables, changes in consumer feelings and attitudes are likely to have more influence on changing the consumption of durables than on changing the consumption of nondurables and services. Unlike the other two, consumption of services is subject to very little short-run variation. Treating these three kinds of consumption separately is thus likely to improve the explanatory power and forecasting ability of the model.

3.3 Consumption of Durables

Various equations explaining the consumption of durables were estimated using current and lagged values of the consumer sentiment variable, MOOD, and the consumer buying expectations variable, ECAR. When ECAR was used in the equations, the shorter sample period beginning in 602 had to be used since data on ECAR were not available before 1959. Of the many equations estimated, two equations emerged as candidates for further consideration.

The first equation, estimated over the longer sample period, was

$$\begin{aligned} CD_t = &-25.43 + .103\,\widehat{GNP_t} + .110\,MOOD_{t-1} + .092\,MOOD_{t-2} \\ &\ (4.22)\quad (39.78)\qquad\quad (1.88)\qquad\qquad\quad (1.54) \\ &\hat{r} = .648 \\ &\quad\ (6.01) \\ &\mathrm{SE} = 1.125 \qquad\qquad\qquad\qquad (3.1) \\ &R\Delta^2 = .554 \\ &50 \text{ observ.} \end{aligned}$$

$$[1, GNP_{t-1}, CD_{t-1}, CD_{t-2}, CN_{t-1}, CN_{t-2}, CS_{t-1}, CS_{t-2}, V_{t-1}, V_{t-2}, G_t, MOOD_{t-1}, MOOD_{t-2}, MOOD_{t-3}, PE2_t, PE2_{t-1}].$$

CD_t denotes expenditures on durable consumption goods during quarter t seasonally adjusted at annual rates in billions of current dollars, GNP_t denotes gross national product during quarter t seasonally adjusted at annual rates in billions of current dollars, and $MOOD_{t-i}$ denotes the Michigan Survey Research Center index of consumer sentiment during quarter $t-i$. The variables in brackets are the variables that were used as instruments for the endogenous GNP_t variable in the first stage regression. The variables are defined in Table 2–1, and the ones that have not yet been discussed will be discussed in the relevant sections or chapters below. The "hat" over the GNP_t variable denotes the fact that it was treated as endogenous in the estimation of equation (3.1).

The meaning of the results that are presented in (3.1) was discussed in Chapter 2. The absolute values of the t-statistics are given in parentheses. $R\Delta^2$ is the R-squared that has been calculated taking the dependent variable to be in first differenced form, and so it is a measure of the percent of the variance of the *change* in CD_t explained by the equation. $\hat{r}$ is the estimate of the first order serial correlation coefficient of the error terms.

The income variable, GNP_t, is highly significant in equation (3.1).[8] Neither of the lagged values of the consumer sentiment variable is significant

[8] Remember from Chapter 2 that a coefficient estimate is said to be significant if its t-statistic is greater than two in absolute value, and that a variable is said to be significant if its coefficient estimate is significant.

in the equation, due to the collinearity between the two values, but including them both in the equation resulted in a better fit, even after adjusting for degrees of freedom, than including either of them separately. When included separately, both $MOOD_{t-1}$ and $MOOD_{t-2}$ were significant. The estimate of the serial correlation coefficient is fairly high, which perhaps indicates that the lag structure is not well specified or that relevant variables have been omitted from the equation. The fit is reasonably good for this series, with 55.4 percent of the variance of the change in CD_t being explained.

The second equation that seemed worthy of further consideration, this time estimated over the shorter sample period, was

$$\begin{aligned} CD_t = \underset{(4.38)}{-32.09} + \underset{(35.33)}{.105}\ \widehat{GNP_t} + \underset{(2.35)}{.164}\ MOOD_{t-1} + \underset{(1.64)}{.084}\ ECAR_{t-2} \\ \underset{(3.08)}{\hat{\rho} = .456} \\ SE = 1.155 \qquad (3.2) \\ R\Delta^2 = .527 \\ \text{36 observ.} \end{aligned}$$

$[1, GNP_{t-1}, CD_{t-1}, CD_{t-2}, CN_{t-1}, CN_{t-2}, CS_{t-1}, CS_{t-2}, V_{t-1}, V_{t-2}, G_t, MOOD_{t-1}, MOOD_{t-2}, ECAR_{t-2}, ECAR_{t-3}, PE2_t, PE2_{t-1}]$.

$ECAR_{t-2}$ denotes the Bureau of the Census index of expected new car purchases during quarter $t-2$. The serial correlation is reduced in equation (3.2) from equation (3.1); the coefficient estimate of $MOOD_{t-1}$ is somewhat larger; and the $ECAR_{t-2}$ variable is nearly significant.

A number of equations were estimated in arriving at equations (3.1) and (3.2). In particular, various combinations of current and lagged values of MOOD and ECAR were tried in the equations. Neither the current value of MOOD nor the current value of ECAR was significant in the equations estimated, even when included separately. With respect to the lagged values of MOOD and ECAR, $MOOD_{t-1}$ appeared to be more significant that $MOOD_{t-2}$ in the various equations estimated, and $ECAR_{t-2}$ appeared to be more significant than $ECAR_{t-1}$. Because of collinearity problems, adding $MOOD_{t-2}$ or $ECAR_{t-1}$ (or both) to equation (3.2) resulted in insignificant coefficient estimates for these variables, as well as for $MOOD_{t-1}$ and $ECAR_{t-2}$. When included separately, each of the four lagged variables was significant. $MOOD_{t-3}$ and $ECAR_{t-3}$ were not significant, even when included separately. Both indices thus appear to have a lagged effect on durable consumption of between one and two quarters. It should be pointed out that both indices are based on surveys that are conducted near the beginning of the quarter.

Equation (3.2) has less serial correlation than equation (3.1) and has a larger estimate of the coefficient of $MOOD_{t-1}$. This is not due to the fact that $ECAR_{t-2}$ has replaced $MOOD_{t-2}$ in equation (3.2), however, but to the fact that different sample periods have been used. When equation (3.1) was estimated for the shorter period, the results were:

$$
\begin{array}{l}
CD_t = \underset{(4.33)}{-34.72} + \underset{(47.73)}{.107}\ \widehat{GNP_t} + \underset{(2.17)}{.160}\ MOOD_{t-1} + \underset{(1.31)}{.100}\ MOOD_{t-2} \\
\hat{\rho} = \underset{(2.68)}{.408} \\
\mathrm{SE} = 1.170 \qquad (3.3) \\
R\Delta^2 = .515 \\
36 \text{ observ.} \\
\text{[variables same as for (3.1)].}
\end{array}
$$

Equation (3.3) is similar to equation (3.2) with respect to the size of the coefficient estimate of $MOOD_{t-1}$ and the size of the estimate of the serial correlation coefficient. The fits of (3.3) and (3.2) are nearly the same, with the use of $ECAR_{t-2}$ instead of $MOOD_{t-2}$ in (3.2) resulting in a slightly better fit.

Since MOOD and ECAR are in approximately the same units (index numbers to the base 100), the larger coefficient estimate for $MOOD_{t-1}$ than for $ECAR_{t-2}$ in equation (3.2) implies that $MOOD_{t-1}$ has a larger influence on CD_t than does $ECAR_{t-2}$. In general, for all of the equations estimated in this study the MOOD variable appeared to be more significant than the ECAR variable in explaining CD_t. This result is consistent with the results of Adams [1] and Katona et al [31], who seem to find that consumer attitudes are more important in the explanation of consumption over time than are consumer buying expectations.

Equations (3.1) and (3.2) were chosen to be tested within the context of the overall model. The result of these tests are described in Chapter 11. There is little to choose between the two equations on the basis of the results for the individual equations, and fortunately the present model is small enough so that the different equations can be easily tested within the context of the overall model to see which one gives the best results. It turned out that equation (3.1) gave slightly better results on this basis, and so it was chosen as the basic equation explaining the consumption of durables. In other words, the Bureau of the Census index of expected new car purchases was not included among the final predetermined variables of the model. This is not to say that the index is not significant in explaining consumption of durables, but only that it does not appear to add new information from that already contained in the index of consumer sentiment variable.

Two other issues were involved in the choice of equation (3.1) as the basic equation explaining the consumption of durables. The first relates to the question of the lag structure of consumption on income. As mentioned in Section 3.2, two basic lag structures were estimated for each of the consumption equations—one in which lagged income was added to the equation and one in which lagged consumption was added. It turned out for durable consumption that neither lagged income nor lagged consumption was significant. For example, when lagged income and then lagged consumption were added to equation (3.1), the results were:

$$\begin{aligned} CD_t = \underset{(4.17)}{-26.43} + \underset{(1.08)}{.060}\,\widehat{GNP_t} + \underset{(1.97)}{.124}\,MOOD_{t-1} + \underset{(1.39)}{.086}\,MOOD_{t-2} \\ + \underset{(.78)}{.044}\,GNP_{t-1} \end{aligned}$$

$$\begin{gathered} \hat{\rho} = \underset{(5.91)}{.641} \\ \mathrm{SE} = 1.163 \\ R\Delta^2 = .533 \\ 50 \text{ observ.} \\ [\text{variables same as for (3.1) plus } GNP_{t-2}]. \end{gathered} \tag{3.4}$$

$$\begin{aligned} CD_t = \underset{(4.12)}{-28.70} + \underset{(8.44)}{.118}\,\widehat{GNP_t} + \underset{(1.98)}{.115}\,MOOD_{t-1} + \underset{(1.76)}{.108}\,MOOD_{t-2} \\ - \underset{(1.10)}{.147}\,CD_{t-1} \end{aligned}$$

$$\begin{gathered} \hat{\rho} = \underset{(7.34)}{.720} \\ \mathrm{SE} = 1.120 \\ R\Delta^2 = .567 \\ 50 \text{ observ.} \\ [\text{variables same as for (3.1)}]. \end{gathered} \tag{3.5}$$

Neither the lagged income term in equation (3.4) nor the lagged consumption term in equation (3.5) is significant, and the fit has not been noticeably improved in either equation from that in equation (3.1). These two lag structures were thus rejected in favor of the simpler specification in equation (3.1).

The other issue involved in the choice of equation (3.1) as the equation explaining durable consumption relates to the use of GNP as the income variable. In equation (3.1), as well as in the equations explaining nondurable and service consumption, GNP has been used as the income variable instead of disposable personal income (DPI). One reason this has been done is that it is difficult to explain or predict disposable personal income, even given knowledge of GNP. The relationship between the change in DPI and the change in GNP appears to be far from stable in the short run. The relationship is in part a function of tax rate changes, which could perhaps be incorporated into the model.[9] but in part it is also a function of the dividend policies of corporations. When GNP levels off or turns down, corporate profits are much more affected than are dividend payments, and much of the decrease in corporate profits is absorbed by undistributed corporate profits. A similar conclusion holds when GNP increases rapidly: undistributed corporate profits increase with little short-run change in dividend payments. The short-run relationship between DPI and GNP, in other words, does not appear capable of being explained in any simple way.

In order to explain DPI it thus appears that it would be necessary to develop an income side of the model. Because of a desire to keep the model as simple as possible, an income side was not developed, and no attempt was made to explain or include disposable personal income within the model. In order to see the consequences of using GNP as the income variable, however, equation (3.1) was estimated using DPI in place of GNP. The results were:

$$\begin{aligned} CD_t = \underset{(4.93)}{-33.26} + \underset{(35.04)}{.161}\,\widehat{DPI_t} + \underset{(2.08)}{.133}\,MOOD_{t-1} + \underset{(1.70)}{.111}\,MOOD_{t-2} \\ \hat{r} = \underset{(6.21)}{.660} \\ SE = 1.237 \qquad\qquad (3.6) \\ R\Delta^2 = .460 \\ 50 \text{ observ.} \end{aligned}$$

$$[1, DPI_{t-1}, CD_{t-1}, CD_{t-2}, CN_{t-1}, CN_{t-2}, V_{t-1}, V_{t-2}, G_t, MOOD_{t-1}, MOOD_{t-2}, MOOD_{t-3}, PE2_t, PE2_{t-2}].$$

DPI_t denotes disposable personal income (personal consumption plus personal saving) during quarter t seasonally adjusted at annual rates in billions of current dollars. The estimate of the coefficient of DPI_t is larger in equation (3.6) than the estimate of the coefficient of GNP_t in equation

[9] See Crockett and Friend [6] for an attempt to do this.

(3.1), as expected, but surprisingly the fit of equation (3.6), which uses DPI, is worse than the fit of equation (3.1), which uses GNP. No explanatory power has been gained using DPI in place of GNP.

Although no definitive reason can be given why the fit of the equation worsens when DPI is used, it may be related to the effect of corporate profits on consumption. When corporate profits are high, confidence and business optimism are likely to be high, and this general optimism may have an effect on consumption that is not picked up in the values of the consumer sentiment variable. (As mentioned above, higher corporate profits are not necessarily turned into higher dividend payments in the short run, and thus disposable personal income does not necessarily increase in the short run when corporate profits increase. GNP, of course, does increase.) Likewise, when profits are low, feelings of doubt and pessimism are likely to prevail, and this may have an independent negative effect on consumption. This is not to say that consumption is directly influenced by undistributed corporate profits, but that general conditions that cause undistributed corporate profits to be high or low may also influence consumption in the same direction.

This argument, that GNP is in part acting as a proxy for consumer confidence, is really no more than a conjecture, but what can be concluded from the above results is that at least for the type of durable consumption equations considered in this study, the use of GNP instead of DPI as the income variable does not result in any loss of explanatory power. Equation (3.1) is certainly not a structural equation in the strict sense of the word, but for short-run forecasting purposes the equation does appear to give an adequate explanation of durable consumption. A more complete examination of the question of whether DPI should be included in the model could have been undertaken by developing an income side and testing it (along with the consumption equations that use DPI as the income variable) within the context of the overall model in the manner done for other versions of the model below. Given the rather positive results achieved below in explaining consumption, however, the benefits that might have resulted from examining this question were not considered to be worth the cost.

3.4 Consumption of Nondurables

Equations similar to those for the consumption of durables were estimated for the consumption of nondurables. The lag structure appeared to be different for nondurables than for durables in that the one-quarter-lagged value of nondurable consumption was highly significant in all of the nondurable equations. With respect to the consumer sentiment variable and the consumer buying expectations variable, the consumer sentiment variable emerged as the most significant of the two. In particular, $MOOD_{t-2}$ emerged as the most significant variable, and the two best equations for the two different sample periods were:

$$\begin{aligned} CN_t = \underset{(5.40)}{.081}\, \widehat{GNP}_t + \underset{(9.30)}{.646}\, CN_{t-1} + \underset{(4.67)}{.147}\, MOOD_{t-2} \\ \hat{r} = \underset{(2.47)}{-.381} \\ SE = 1.383 \\ R\Delta^2 = .550 \\ 36 \text{ observ.} \end{aligned} \tag{3.7}$$

$[1, GNP_{t-1}, CD_{t-1}, CD_{t-2}, CN_{t-1}, CN_{t-2}, CS_{t-1}, CS_{t-2}, V_{t-1}, V_{t-2}, G_t, MOOD_{t-2}, MOOD_{t-3}, PE2_t, PE2_{t-1}]$.

$$\begin{aligned} CN_t = \underset{(3.50)}{.034}\, \widehat{GNP}_t + \underset{(19.71)}{.866}\, CN_{t-1} + \underset{(2.56)}{.049}\, MOOD_{t-2} \\ \hat{r} = \underset{(2.47)}{-.330} \\ SE = 1.436 \\ R\Delta^2 = .402 \\ 50 \text{ observ.} \end{aligned} \tag{3.8}$$

[variables same as for (3.7)].

CN_t denotes expenditures on nondurable consumption goods during quarter t seasonally adjusted at annual rates in billions of current dollars.

Although equations (3.7) and (3.8) are the same except for the different sample periods, the coefficient estimates are quite different. For the shorter period of estimation the estimates of the coefficients of GNP_t and $MOOD_{t-2}$ are much larger and the estimate of the coefficient of CN_{t-1} somewhat smaller. There is negative first order serial correlation of the error terms in both equations. When both equations were tested in Chapter 11 within the context of the overall model, equation (3.7), which is estimated over the shorter sample period, gave decidedly better results. There definitely seems to have been a shift in the nondurable consumption relationship between the beginning of the longer sample period (561) and the beginning of the shorter sample period (602). Equation (3.7) was thus chosen as the basic equation explaining nondurable consumption.

A number of equations were estimated in arriving at equation (3.7) as the basic equation explaining nondurable consumption. With respect to the MOOD and ECAR indices, the MOOD index gave better results. This is not too surprising, since ECAR, the buying expectations variable, relates only to expectations of new car purchases. $ECAR_{t-1}$ and $ECAR_{t-2}$ were significant when each was included in place of $MOOD_{t-2}$ in equation (3.7), however, which indicates that expected new car purchases are positively correlated with nondurable purchases as well. Neither $ECAR_{t-1}$ nor $ECAR_{t-2}$ was significant when included with $MOOD_{t-2}$ in equation (3.7) (although $MOOD_{t-2}$ remained significant), and the fits of the equations that included $ECAR_{t-1}$ or $ECAR_{t-2}$ in place of $MOOD_{t-2}$ were worse than the fit of equation (3.7). $MOOD_{t-2}$, in other words, clearly dominated $ECAR_{t-1}$ and $ECAR_{t-2}$ in the explanation of nondurable consumption.

With respect to the lagged values of MOOD, $MOOD_{t-1}$ was significant when included in place of $MOOD_{t-2}$ in equation (3.7), but when both $MOOD_{t-1}$ and $MOOD_{t-2}$ were included in the equation, $MOOD_{t-1}$ became highly insignificant, while $MOOD_{t-2}$ retained its significance. Contrary to the case for durable consumption, $MOOD_{t-1}$ and $MOOD_{t-2}$ did not appear to have independent explanatory power in the nondurable equation.

The constant term was not significant in equation (3.7) (as well as in almost all of the other nondurable equations estimated), and so the constant term was not included in the final equation estimated. Excluding the constant term had very little effect on the other coefficient estimates.

With respect to the lag structure of nondurable consumption on income, the choice in favor of using the lagged consumption variable was quite clear. When, for example, an equation like (3.7) was estimated using lagged income in place of lagged consumption, the results were not as good:

$$
\begin{array}{l}
CN_t = \underset{(3.02)}{29.74} + \underset{(1.00)}{.079}\, \widehat{GNP}_t + \underset{(1.75)}{.142}\, GNP_{t-1} + \underset{(1.20)}{.118}\, MOOD_{t-2} \\
\hat{r} = \underset{(3.11)}{.460} \qquad\qquad (3.9) \\
\text{SE} = 1.544 \\
R\Delta^2 = .456 \\
\text{36 observ.} \\
\text{[variables same as for (3.7) plus } GNP_{t-2}\text{].}
\end{array}
$$

Only the constant term and the serial correlation coefficient are significant in equation (3.9), and the fit is worse than that in equation (3.7). Note that dropping CN_{t-1} from equation (3.7) increased the estimate of the serial correlation coefficient from $-.381$ to .460.

Finally, with respect to the possible use of DPI instead of GNP as the income variable, an equation like (3.7) was estimated using DPI in place of GNP to see how the results compared. The results were:

$$
\begin{aligned}
CN_t = \; & \underset{(7.00)}{.144}\, \widehat{DPI_t} + \underset{(9.73)}{.594}\, CN_{t-1} + \underset{(5.90)}{.137}\, MOOD_{t-2} \\
& \hat{\rho} = \underset{(3.31)}{-\ .483} \\
& \mathrm{SE} = 1.216 \qquad (3.10) \\
& R\Delta^2 = .652 \\
& 36 \text{ observ.}
\end{aligned}
$$

$$[1, DPI_{t-1}, CD_{t-1}, CD_{t-2}, CN_{t-1}, CN_{t-2}, CS_{t-1}, CS_{t-2}, V_{t-1}, V_{t-2}, G_t, MOOD_{t-2}, MOOD_{t-3}, PE2_t, PE2_{t-1}].$$

Contrary to the results achieved for durable consumption, the fit of equation (3.10), which uses DPI, is better than the fit of equation (3.7), which uses GNP. The coefficient estimates are all significant in equation (3.10), and as expected, the estimate of the coefficient of DPI_t in (3.10) is larger than the estimate of the coefficient of GNP_t in (3.7).

The results in this chapter thus indicate that nondurable consumption is more closely tied in the short run to disposable income and previous consumption behavior than is durable consumption. Durable consumption, in other words, appears to be more influenced by consumer feelings and attitudes in the short run than is nondurable consumption. This is not unexpected, of course, since durable purchases are in general more postponable than nondurable purchases. Despite the better fit obtained in equation (3.10) by using DPI, the equation was not included in the model for the reasons presented above.

3.5 Consumption of Services

Consumption of services has very little short-run variability and is easier to forecast than the other two components of aggregate consumption. The equation that was finally chosen to be used as the equation explaining consumption of services is

$$CS_t = \underset{(4.15)}{.022}\,\widehat{GNP_t} + \underset{(47.77)}{.945}\,CS_{t-1} - \underset{(7.37)}{.023}\,MOOD_{t-2}$$

$$\hat{r} = -\underset{(0.55)}{.077} \qquad (3.11)$$

$$\text{SE} = .431$$

$$R\Delta^2 = .891$$

50 observ.

[variables same as for (3.6)].

CS_t denotes the consumption of services during quarter t seasonally adjusted at annual rates in billions of current dollars. Except for the estimate of r (which is effectively zero), the coefficient estimates in equation (3.11) are significant and the fit is quite good. Equation (3.11) explains 89.1 percent of the variance of the change in CS_t. The estimate of the constant term was not significant, and the constant term was omitted in the final estimate. Excluding the constant term had very little effect on the other coefficient estimates. The estimate of the coefficient of GNP_t is quite small and the estimate of the coefficient of CS_{t-1} quite large: consumption of services appears to be only slightly affected by current income changes.

The estimate of the coefficients of the consumer sentiment variable in equation (3.11) is significant but negative, which is contrary to what might be expected. There is one reason, however, why the coefficient of $MOOD_{t-2}$ might be expected to be negative. It was seen above that $MOOD_{t-2}$ had a positive effect on the consumption of durables and nondurables: periods of consumer optimism correspond, other things being equal, to large durable and nondurable purchases. Now it may be that these periods also correspond to slightly smaller expenditures for services. A family that has just purchased a large durable item, for example, may be inclined, other things being equal, to spend a little less on entertainment activities for a few months.[10] If there are any of these kinds of substitution effects between the consumption of services and the consumption of durables and nondurables in the short run, there are, of course, more sophisticated ways of specifying them. These more complicated specifications are beyond the scope of this study, however, and for present purposes the results in equation (3.11) appear to be adequate.

Again, a number of equations were estimated in arriving at equation

[10] Depressed consumers, on the other hand, may not feel like buying a large durable item, but may be inclined to engage in more entertainment activities in an attempt to cheer themselves up.

(3.11) as the basic equation explaining the consumption of services. With respect to the lagged values of MOOD, $MOOD_{t-1}$ was tried in place of $MOOD_{t-2}$ in equation (3.11), and while its coefficient estimate was significant (and negative), the fit was slightly worse. When $MOOD_{t-1}$ and $MOOD_{t-2}$ were included together in the equation, neither was significant and the fit was not improved. With respect to the ECAR index, equation (3.11) was reestimated for the shorter period of estimation, and the results of this equation were compared with the results achieved by replacing $MOOD_{t-2}$ with $ECAR_{t-1}$ or $ECAR_{t-2}$ in the equation. The coefficient estimates of $ECAR_{t-1}$ or $ECAR_{t-2}$ were significant (and negative), but the fits were not as good. Again, the index of consumer sentiment appeared to have more explanatory power than did the index of expected new car purchases. The services equation was quite stable in the sense that estimating equation (3.11) for the shorter period of estimation resulted in little change in the coefficient estimates.

With respect to the lag structure of service consumption on income, the choice in favor of using the lagged consumption variable was clear. When an equation like (3.11) was estimated using lagged income in place of lagged consumption, the results were much worse:

$$\begin{aligned} CS_t = \underset{(1.58)}{13.23} + \underset{(4.38)}{.196}\, \widehat{GNP_t} &+ \underset{(1.52)}{.067}\, GNP_{t-1} - \underset{(3.12)}{.166}\, MOOD_{t-2} \\ \hat{r} &= \underset{(18.59)}{.935} \\ \text{SE} &= 1.066 \\ R\Delta^2 &= .349 \\ &\text{50 observ.} \end{aligned} \tag{3.12}$$

$$[1, GNP_{t-1}, GNP_{t-2}, CD_{t-1}, CD_{t-2}, CN_{t-1}, CN_{t-2}, CS_{t-1}, V_{t-1}, V_{t-2}, G_t, MOOD_{t-2}, MOOD_{t-3}, PE2_t, PE2_{t-1}].$$

The results in (3.12) are quite poor, as might have been expected from the significance of CS_{t-1} in equation (3.11). The $R\Delta^2$ has dropped from .891 in equation (3.11) to .349 in equation (3.12).[11] Serial correlation is extremely pronounced in (3.12), reflecting in this case the omission of the lagged dependent variable.

Finally, with respect to the possible use of DPI as the income variable,

[11] When the R-squared was computed in terms of levels rather than changes, it only dropped from .9999 in (3.11) to .9995 in (3.12), which indicates the conceptual advantage of computing the R-squared in terms of changes.

an equation like (3.11) was estimated using DPI in place of GNP as the income variable. The results were:

$$
\begin{gathered}
CS_t = \underset{(4.05)}{.034}\ \widehat{DPI_t} + \underset{(47.14)}{.946}\ SC_{t-1} - \underset{(6.50)}{.030}\ MOOD_{t-2} \\
\hat{r} = \underset{(.38)}{-.054} \\
\text{SE} = .441 \qquad\qquad (3.13) \\
R\Delta^2 = .886 \\
\text{50 observ.} \\
[1, DPI_{t-1}, CD_{t-1}, CD_{t-2}, CN_{t-1}, CN_{t-2}, CS_{t-1}, CS_{t-2}, V_{t-1}, \\
V_{t-2}, G_t, MOOD_{t-2}, MOOD_{t-3}, PE2_t, PE2_{t-1}].
\end{gathered}
$$

The fit of equation (3.13), which uses DPI, is slightly worse than the fit of equation (3.11), which uses GNP. No explanatory power has been lost by using GNP in place of DPI in the equation explaining the consumption of services.

3.6 Summary

The emphasis in this chapter has been on examining the role that consumer sentiment and buying expectations play in influencing short-run changes in consumption. This role appears to be an important one, since both the Michigan Survey Research Center index of consumer sentiment and the Bureau of the Census index of expected new car purchases were significant in the consumption equations when considered separately. When considered together, the consumer sentiment index dominated the buying expectations index, and the latter was not used in the final versions of the equations. The buying expectations index did not appear to contain information not already contained in the consumer sentiment index.

In addition to the use of the consumer sentiment index, consumption has been explained by income and, in two of the three cases, by lagged consumption. GNP was used as the income variable in the equations instead of disposable personal income. No loss of explanatory power in the durable consumption and service consumption equations resulted from this procedure, but some loss of explanatory power did occur in the nondurable consumption equation. It was conjectured that GNP may be in part serving as a proxy for consumer confidence in the short run and that this may be why no explanatory power was lost in the durable equation by using GNP as the income variable. Because of the desire to keep the model as simple as possible, an income side was not developed to explain disposable personal income, and thus disposable personal income was not included in any of the final equations of the model.

There was some slight evidence that durable and nondurable consumption and service consumption are substitutes in the short run, since the consumer sentiment variable had a negative influence in the services equation and a positive influence in the other two equations. Consumption of services was also less influenced by current income changes than were the other two consumption categories, and it was clearly the easiest to explain of the three.

The results in this chapter actually have a bearing on the specification of large-scale structural models. The results indicate that some measure of consumer attitudes should be included in short-run consumption functions. In large-scale structural models, consumer attitude variables should probably not be treated as exogenous, but this does not mean that they should be excluded from the analysis altogether. What needs to be done is to discover the factors that determine consumer attitudes and then to incorporate these factors directly into the models.