Illiquidity, Consumer Durable Expenditure, and Monetary Policy

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In the literature on consumer durable expenditure,[1] monetary policy has a major impact either through interest rate[2] or liquid asset (real balance) effects. The theoretical justification for the inclusion of liquid assets as an important determinant of consumer durable expenditures is not particularly strong,[3] and results with this variable have been mixed.[4] Yet, even though there is a solid theoretical basis for monetary policy effects through interest rates, empirical econometric work has rarely found these effects to be substantial.[5]

One possible conclusion from research in this area is that monetary policy has only a marginal effect on consumer durable expenditures. Another possibility, however, is that channels of monetary policy as yet unexplored might be a crucial determinant of this type of expenditure.

This paper studies the neglected illiquid aspect of the consumer durable asset. It finds that increased consumer liabilities are a major deterrent to consumer durable purchases and increased financial asset holdings a powerful encouragement. The results show that monetary policy has a strong impact on consumer durable expenditure through two additional channels of monetary influence: 1) Monetary policy affects the price of assets in the economy. Consumer financial asset holdings, thereby affected, influence expenditure on durables. 2) Past monetary policy will have affected the cost and availability of credit, thus influencing the size of consumers' debt holdings and hence consumer durable expenditure.

The paper proceeds in the following way: the next section develops a model which determines the effects of consumer durable illiquidity on the desirability of this asset; the second section contains aggregate time-series tests of this model; and the final section discusses the implications for monetary policy and contains concluding remarks.

I. Illiquidity of the Consumer Durable Asset

One aspect of the consumer durable asset that distinguishes it from financial assets is its illiquidity. Well-developed capital markets exist for most financial assets,

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[1] See Franco Modigliani; Michael Hamburger; F. Thomas Juster and Paul Wachtel (1972a); Michael McCarthy; Albert Hirsch, Maurice Liebenberg, and George Green; Ta-Chung Liu and Erh-Cheng Hwa; and Otto Eckstein, Edward Green, and Allen Sinai.

[2] Classified with interest rate effects are the effects of installment credit terms.

[3] One justification for the inclusion of liquid assets in consumer expenditure equations is found in Arnold Zellner, David Huang, and L. C. Chau.

[4] In none of the models mentioned in fn. 1 does the liquid asset variable enter significantly and with the right sign—indeed it often enters with the wrong sign—in both equations for the autos and parts and nonauto components of consumer durable expenditure.

[5] Hamburger's study seems to be the only piece of empirical work where these effects are substantial. Yet, he only finds these powerful effects when interest rates enter his equations with very long lags.

and cash can be generated with a minimum of cost in time, money, and effort by selling them in their near perfect markets. Capital markets for used consumer durables are, on the other hand, highly imperfect. Durable goods are very heterogeneous, and much information which is costly to obtain is needed to determine their value.[6] Also the bulk and difficulty in handling of durables leads to high transaction costs in their purchase or sale. These transaction and information problems lead to a wide spread between the price the consumer receives from selling his used consumer durable and its value in use.[7,8]

A simple two-period model of the effects of consumer durable illiquidity on the desirability of this asset is developed below. It is shown that the nature of markets for consumer durables forces the consumer to take account of his balance sheet status, i.e., his debt and financial asset position, as well as the riskiness of his income stream, in determining the desired level of his consumer durables stock.

Assume that a consumer buys a unit of durables with price equal to unity at the beginning of period one. The durable's in-use value at the end of the period would be $1-d$, where d is the depreciation rate.[9] Yet, if the consumer suffers a shortfall in income so that the durable good has to be sold in a distress manner, its full value cannot be realized. Its illiquidity stems from the imperfect nature of the used consumer durable capital market. The degree of this illiquidity will be described by the variable q ($q<1$), which is the fraction of in-use value that can be realized from a distress sale. This formulation is quite general: it is not dependent on any specific type of illiquidity loss; it includes the loss from a low sales price as well as from transaction costs. If, as a result of an income shortfall, a distress sale of the durable at the end of the period is required to raise cash, then the realized value of the durable at the end of the period will be $q(1-d)$, where q is less than one.

If there is no distress sale, the one-period opportunity cost C_0 of holding a durable rather than a financial asset will be:

$$(1) \quad C_0 = 1 - (1 - d) + r = r + d$$

But if there is a distress sale as a result of an income shortfall, then:

$$(2) \quad C_0 = 1 - q(1 - d) + r = r + d + (1 - q)(1 - d)$$

where [10] C_0 = one-period opportunity cost

[6] For example, how well has the owner treated his durable, has it been damaged, how frequently has it been used, was it a lemon to start with, etc.

[7] The value-in-use is the present discounted value of the durable's flow of services.

[8] To see why costly information would lead to a spread between selling price and in-use value, see George Akerlof. In an extreme case no organized market might exist as a result of information problems. The absence of organized markets for many types of used consumer durable goods is quite common.

[9] In the case of a durable where there is a planned trade-in, the expected costs incurred in the trade-in—transactions and otherwise—are included in depreciation. The value of the durable at the end of the period reflects these costs.

[10] The opportunity cost in equation (2) assumes that a consumer cannot borrow to cover his income shortfall or that the cost of borrowing over and above the yield on financial assets is more than $(1-q)(1-d)$. It is well known that financial intermediaries are more than happy to make loans to consumers when they least need it and are extremely reluctant to make loans to consumers when they are in financial trouble. If the financial intermediary does make a loan at all to a consumer with an income shortfall, it charges a very substantial premium to compensate for the increased risk. Thus the assumption inherent in equation (2) is quite reasonable. If the difference between the borrowing cost and the yield on financial assets is less than $(1-q)(1-d)$, the consumer will borrow instead of selling his consumer durables. This can be incorporated into the above model by replacing $(1-q)(1-d)$ with the spread between the distress borrowing rate and the yield on financial assets. This leads to the same results as found in the text.

The reluctance of financial intermediaries to lend to consumers in financial trouble explains why most consumers hold debt and financial assets at the same time, even if borrowing costs for the consumer not suffering financial distress are somewhat higher than the yield on

of holding a durable, and r = one-period return on financial assets (which is assumed certain).

We can now view the opportunity cost of holding durable goods in an uncertain world with a Tobin-Markowitz mean-variance framework. If the probability of making a distress sale is p and not making a distress sale is $1-p$, then

$$(3) \quad E(C_0) = p[r + d + (1 - q)(1 - d)] + (1 - p)(r + d) = r + d + p(1 - q)(1 - d)$$

$$(4) \quad Var\,(C_0) = p(1 - p)[(1 - q)(1 - d)]^2$$

where E and Var are the expectation and variance operators, respectively.

A distress sale occurs whenever consumption[11] plus debt service (interest plus amortization) is larger than income, plus readily available financial assets; i.e., when

$$(5) \quad DS + CON - Y - FIN > 0$$

where DS = debt service
CON = consumption
Y = disposable income
FIN = holdings of financial assets

The permanent income hypothesis implies that

$$(6) \quad CON = k\overline{Y}$$

where k = the propensity to consume out of permanent income, and $\overline{Y}$ = expected average (permanent) income. If income is a normally distributed random variable, then using the standard normal distribution formula we may write:

$$(7) \quad p = f[(DS - FIN - (1 - k)\overline{Y})/\sigma_Y]$$

where σ_Y = the square root of the income variance, with

$$\frac{\partial p}{\partial DS} > 0, \quad \frac{\partial p}{\partial FIN} < 0$$

$$\frac{\partial p}{\partial \sigma_Y} > 0, \quad \text{and} \quad \frac{\partial p}{\partial \overline{Y}} < 0$$

since k is usually assumed to be less than one.

Debt service is a positive function of the consumer's liabilities at the beginning of the period, hence

$$(8) \quad \frac{\partial DS}{\partial DEBT} > 0$$

where $DEBT$ = liabilities at the beginning of the period. Now:

$$(9) \quad \frac{\partial E(C_0)}{\partial DEBT} = (1 - q)(1 - d) \cdot \left[\frac{\partial p}{\partial DS}\,\frac{\partial DS}{\partial DEBT}\right] > 0$$

$$(10) \quad \frac{\partial E(C_0)}{\partial FIN} = (1 - q)(1 - d)\left[\frac{\partial p}{\partial FIN}\right] < 0$$

$$(11) \quad \frac{\partial E(C_0)}{\partial \sigma_Y} = (1 - q)(1 - d)\left[\frac{\partial p}{\partial \sigma_Y}\right] > 0$$

$$(12) \quad \frac{\partial E(C_0)}{\partial \overline{Y}} = (1 - q)(1 - d)\left[\frac{\partial p}{\partial \overline{Y}}\right] < 0$$

and

$$(13) \quad \frac{\partial\, Var\,(C_0)}{\partial DEBT} = [(1 - q)(1 - d)]^2 \cdot [1 - 2p]\left[\frac{\partial p}{\partial DS}\,\frac{\partial DS}{\partial DEBT}\right]$$

$$(14) \quad \frac{\partial\, Var\,(C_0)}{\partial FIN} = [(1 - q)(1 - d)]^2 \cdot [1 - 2p]\left[\frac{\partial p}{\partial FIN}\right]$$

financial assets. When a consumer suffers a drop in income, financial assets are a buffer that help prevent the consumer from taking losses either by selling his durables or borrowing at inflated rates to raise cash; thus the consumer will not try to minimize his borrowings by holding no financial assets as he would in a world of absolute certainty and perfect capital markets.

[11] Since a distress sale can be avoided at a relatively low cost by a reduction in consumer durable expenditure, consumption, not consumer expenditure, is the relevant variable for the necessity of a distress sale.

$$(15)\quad \frac{\partial\, Var\,(C_0)}{\partial \sigma_Y} = [(1-q)(1-d)]^2 \cdot [1-2p]\left[\frac{\partial p}{\partial \sigma_Y}\right]$$

$$(16)\quad \frac{\partial\, Var\,(C_0)}{\partial \overline{Y}} = [(1-q)(1-d)]^2 \cdot [1-2p]\left[\frac{\partial p}{\partial \overline{Y}}\right]$$

If the probability of a distress sale is less than one-half ($p<1/2$) for consumer durables, which would certainly seem to be the case for most individuals in our economy, then[12]

$$(17)\quad \frac{\partial\, Var\,(C_0)}{\partial DEBT} > 0, \qquad \frac{\partial\, Var\,(C_0)}{\partial FIN} < 0,$$
$$\frac{\partial\, Var\,(C_0)}{\partial \sigma_Y} > 0, \qquad \frac{\partial\, Var\,(C_0)}{\partial \overline{Y}} < 0$$

In a Tobin-Markowitz mean-variance model, both a lower expected opportunity cost and a lower variance are preferred.[13] Therefore, a consumer durable is a more desirable asset: the lower the debt holdings, the higher the financial asset holdings, the lower the variance of income, and the higher is expected income in this period.[14]

[12] As can be seen in an appendix available from the author, the assumption that p is less than one-half is certainly not needed for the debt and financial asset results obtained here.

[13] If the consumer has a diversified portfolio, then the capital asset pricing model applies; he prefers a lower mean opportunity cost and a lower covariance with the market return. If the correlation of the opportunity cost of holding a durable and the market return is positive and reasonably constant, then a lower variance of the opportunity cost is preferred as in the simple mean-variance model used above. Richard Bower and Donald Lessard indicate that for most situations the simple mean-variance model usually leads to the same decisions as the capital asset pricing model.

[14] The model above is quite simple and gives a nice neat result, yet it does make the unrealistic assumption that consumption cannot be lowered below its desired level to meet the problem of an income shortfall, or that it would be more costly to do so than to incur a loss from distress selling a consumer durable. Furthermore, the mean-variance model used here requires special assumptions which have been objected to in the literature. A more general model, found in an appendix available from the author, has been developed which does not rely on the special assumptions of the mean-variance model and allows the consumer to meet an income shortfall by lowering his consumption below its desired level. The results for the effects of debt and financial asset holdings on the desirability of the consumer durable asset are the same in this model as in the mean-variance model presented above. The more general model is not used here because its exposition is not as simple, and because the role of income stream riskiness is not as clear.

II. Time-Series Tests of the Liquidity Model

A stock adjustment model incorporating the results of the "liquidity" model of the previous section is developed here. It is tested on quarterly aggregate time-series data for consumer durables expenditure and its two component parts: autos and parts expenditure, and nonauto consumer durables expenditure. The models are estimated over the period 1954-I through 1972-IV, with the exclusion of quarters in which there were auto strikes, i.e., 1964-IV to 1965-II and 1970-IV to 1971-II.[15] All quantities are in real per capita terms (thousands of 1958 dollars per capita) with flows as seasonally adjusted annual rates.[16]

A. *The Model*

The literature views a consumer durable as an asset in the portfolio which yields a return of consumption services; the consumer derives benefits from the services of the stock, not from the flow of durable purchases.[17] The consumer thus desires a

[15] Strong strike effects are felt in both the quarter of the strike and the quarter following. Use of first-order serial correlation corrections necessitates excluding the second quarter following the strike from the sample period as well as the two previous quarters in the consumer durables and autos and parts estimations. These quarters were also excluded for the nonauto consumer durables estimations because aberrations in the auto sector might have an impact on nonauto durable purchases. In fact, model estimates for the nonauto consumer durable sector were not appreciably affected when the excluded quarters were included in estimating the models.

[16] The sources of these data are described in another appendix available from the author.

[17] See Arnold Harberger, Gregory Chow, Modigliani, Richard Stone and D. A. Rowe, and Juster and Wachtel (1972a).

certain stock of durables which is a function of permanent income and the user rental cost of capital. The liquidity model developed in the previous section indicates that, in addition, the desired durables stock is a function of the value of the consumer's debt and financial asset holdings at the beginning of the period. Therefore:

$$(18)\quad K^* = f(Y_P, CAPC, DEBT, FIN) + E_A$$

where K^* = real per capita desired stock of durables,
Y_p = real per capita expected average (permanent) income,
$CAPC$ = user rental cost of consumer durable capital[18] $(RCB+D)(PCD/PCON)$,
RCB = Moody's AAA corporate bond rate,
D = annual depreciation rate,[19]
PCD = consumer durables implicit price deflator,
$PCON$ = consumption implicit price deflator,
$DEBT$ = real per capita debt holdings of households—beginning of quarter,
FIN = real per capita gross financial asset holdings of households (includes demand deposits plus currency, time and savings deposits, bonds, corporate equity, life insurance and pension funds, and other miscellaneous assets)—beginning of quarter,
E_A = additive error term.

When expected income is high, and the desired durables stock is high, a change in the user capital cost should cause a larger dollar change in the desired stock of durables. Thus, equation (18) is linearized with the coefficient of permanent income a linear function of the user rental capital cost,[20] i.e.,

$$(19)\quad K^* = a + (b + c\,CAPC)\,Y_P + d\,DEBT + e\,FIN + E_A$$

Consumer durable expenditure is modeled with the stock-adjustment or so-called flexible-accelerator model which views consumers as adjusting only slowly to their desired stock of durables. The change in the stock, i.e., net investment, is only a fraction, λ, of the gap between the desired and actual stock at the beginning of the period. Net investment is also viewed as a function of transitory income because: 1) some portion of transitory income and hence saving should be reflected in consumer durable purchases; and 2) transitory income is a proxy to some extent for perceptions of income variance[21,22] which

[18] The user rental cost of consumer durable capital used here is completely analogous to the user rental cost of capital in the investment studies of Robert Hall and Dale Jorgenson and of Charles Bischoff. The interest rate in the formula above is a nominal interest rate, not a real interest rate as would be appropriate in the Hall-Jorgenson formulation; thus the effect of inflation on consumer durable expenditure is not incorporated into this model. Attempts were made to estimate the effect of inflation on consumer durable expenditure and include it in the model, yet experiments with varied distributed lags of past inflation rates proved fruitless; no significant effects could be obtained. This is not surprising for the effect of inflation is by no means clear. On one hand, with constant nominal interest rates inflation lowers the user rental cost of capital and encourages durable expenditures. Yet evidence from consumer surveys indicates that inflation increases consumers' perceptions of uncertainty (see Juster and Wachtel, 1972b), and this has a depressing effect on consumer durable expenditures.

[19] The assumed depreciation rate used in calculating the capital cost measure for all consumer durables is .20, while it is .25 for autos and parts, and .15 for nonauto consumer durables.

[20] This assumption is not critical to our argument. If K^* is alternatively assumed to be a linear function of the right-hand side variables in (18), i.e.,

$$(19a)\quad K^* = a + bY_P + cCAPC + d\,DEBT + e\,FIN + E_A$$

the fit of the estimated model and the asymptotic t-statistics of the coefficients (except for the constant term) change hardly at all, and the important empirical results of this paper still hold.

[21] Transitory income is a cyclical variable which is related to the probability of a worker losing his job and suffering an interruption of his normal income stream.

the liquidity model indicates affects the desired stock of durables and hence net investment.[23] Therefore:

$$(20) \quad (K - K_{-1}) = \lambda(K^* - K_{-1}) + fY_T + E_B$$

where

K = real per capita stock of durables at the end of quarter,
λ = the quarterly adjustment rate,
Y_T = real transitory income per capita,
E_B = additive error term,

and subscripts refer to the time period of the K variable.

Consumer durable expenditures, or equivalently, gross investment in consumer durable goods, equals the sum of net investment and replacement. Assuming a quarterly replacement rate of δ:

$$(21) \quad EXP/4 = \delta K_{-1} + (K - K_{-1})$$

where EXP = real per capita consumer durable expenditures at an annual rate. Combining equations (18) through (21) we derive the model to be estimated:

$$(22) \quad EXP = 4\lambda a + [4\lambda b + 4\lambda c\, CAPC]Y_P + 4\lambda d\, DEBT + 4\lambda e\, FIN + 4fY_T + 4[\delta - \lambda]K_{-1} + u$$

where u = additive error term $= 4(\lambda E_A + E_B)$.

The signs of all the coefficients of equation (22) are easily determined. The coefficients on permanent and transitory income should both be positive because increased permanent or transitory income encourages consumer durable purchases.[24] Increased user capital costs should discourage purchase of consumer durables; this implies that $4\lambda c$ is less than zero. The lagged stock coefficient will be negative if the speed of adjustment is higher than the replacement rate—the usual case.

The results of the previous section indicate that illiquidity of the consumer durable asset should lead to a positive FIN coefficient and a negative $DEBT$ coefficient in the above model. Changes in the value of financial assets for the wealthy, for whom liquidity is not a problem, might have a smaller impact on consumer durable expenditure than for the middle or lower income groups. For this reason, the

When transitory income is low, workers have a high probabilty of being laid off and have a larger income variance, and when it is high, workers have a low probability of being laid off and have a correspondingly lower income variance.

[22] The unemployment rate is also a cyclical variable that reflects the probability of losing one's job and is related to income stream variance. If transitory income is excluded from the expenditure model and the unemployment rate is used as a proxy for income variance in its place, it enters with the appropriate negative sign (indicating that higher income variance depresses consumer durable demand). It is statistically significant at the 5 percent level or higher in regression models for all consumer durables and its two component parts: nonauto consumer durables and autos and parts. The debt and financial asset variables results are not qualitatively different when unemployment is used in the expenditure models instead of transitory income.

[23] Attempts to find further measures of perceived income variance were unsuccessful. The unemployment rate, the Survey Research Center (*SRC*) consumer sentiment index, a filtered version of this index (see Juster and Wachtel, 1972b), a crude measure of perceived risk in the financial markets using yield spreads between low grade corporate bonds and comparable government securities, and calculated income variance from past data, were all tested in the equation (22) model shown here. Only the unemployment rate and the filtered *SRC* index proved to be statistically significant in any regression equation. Both of these variables were significant in the autos and parts regressions, yet the transitory income and adjustment speed coefficient took on unreasonable values. Furthermore, both variables had the wrong sign in the nonautos regression. The failure to find further measures of consumers' perceptions of income variance is not a severe problem. The estimated effect of financial asset holdings on the desired consumer durables stock should in any case reflect perceived income variance effects because of high correlation of the perceived variance and asset measures. When perceived income variance increases, a higher risk premium would probably be used in discounting the earning streams of equity. This causes a lower valuation of equity; thus the value of financial assets falls. A strong negative correlation between the gross financial assets measure and perceived income variance is thus expected.

[24] The transitory income coefficient should be positive not only because transitory income might be saved in the form of consumer durables, but also because a rise in transitory income indicates that consumers' income variance may have declined, thus increasing the desired stock of durables and durable purchases.

unequal and highly skewed distribution of financial asset holdings in this country would tend to sharply lower the aggregate financial assets coefficient in a model estimated on aggregate time-series data. On the other hand, consumer liabilities are distributed far more equally than financial assets; thus the coefficient on consumer liabilities should still retain a high value in time-series estimations. Even though the liquidity model does not imply that for an individual the debt coefficient should be markedly larger in absolute value than the financial assets coefficient, this result might be expected in time-series estimates of these coefficients which reflect the distribution effects described above.

B. *Empirical Estimates*

Equation (22)—whether it be estimated for expenditures on all consumer durables, or for autos and parts and nonauto consumer durables expenditures—is just one equation in a simultaneous system; thus simultaneous equation bias will result from ordinary least squares estimation. In the above model this bias would be especially severe for the debt coefficient.[25] To avoid least squares bias, an instrumental variable technique has been used.[26] Strong serial correlation is evident in all the regression equations, and to achieve efficient estimates a first-order serial correlation correction has been made using Ray Fair's method and the appropriate additional instruments.[27,28] The results for each sector are denoted by superscripts: D for all consumer durables; A for autos and parts; and NA for nonauto consumer durables.

The estimates for consumer durables are as follows, with asymptotic t-statistics in parentheses. The coefficient on u_{-1} is the first-order serial correlation coefficient.

$$
\begin{aligned}
(23)\quad EXP^D = {} & -.3378 + .2693\,Y_T \\
& (-2.45) \quad (3.89) \\
& + (.4295 - .4527\,CAPC^D)\,Y_P \\
& \quad (2.40) \quad (-2.41) \\
& - .0014\,K^D_{-1} - .2167\,DEBT \\
& (-.01) \qquad (-4.63) \\
& + .0453\,FIN + .5527\,u_{-1} \\
& \quad (4.08)
\end{aligned}
$$

$R^2 = .9932$; Durbin-Watson = 1.90; Standard Error = .007529.

The results are good. The coefficients of the debt and financial asset variables have the signs hypothesized by the liquidity model and are highly significant; the coefficients are over four times their respective asymptotic standard errors. The depressing effect of debt holdings on consumer durable purchases is quite substantial; for every $1 of debt held at the beginning of the quarter, durable purchases at an annual rate will be decreased by 22¢. The value of financial asset holdings has a

[25] Ordinary least squares estimates of the debt coefficient would be severely biased upward if the error term is positively serially correlated—the usual case. A positive error last period would imply a positive error in the current period, while increased durable purchases last period—a result of the positive error term—would lead to increased debt holdings at the beginning of the current period. The debt variable and the error term would thus be positively correlated, and this would lead to an upwardly biased ordinary least squares coefficient estimate. A comparison of the ordinary least squares and instrumental variables estimates of equation (22) indicates that the bias in ordinary least squares estimates is of the predicted direction and is quite strong.

[26] The list of instruments includes unborrowed reserves at member banks plus currency outside of banks, the discount rate, exports, federal government expenditures, the effective rate of personal income tax, these five variables lagged one period, the constant term, and population.

[27] Except for the lagged stock coefficients, regression estimates where there was no correction for serial correlation were not appreciably different from the corrected regression estimates. The serial correlation corrected regressions exhibited a higher adjustment speed of desired to actual stocks.

[28] Ordinary least squares estimates using a Cochrane-Orcutt technique for autocorrelation correction are provided in an appendix available from the author. Qualitatively the results are similar to those in the text (i.e., signs and t-statistics), though coefficient estimates sometimes differ by as much as 30 percent.

significant positive effect on the demand for durables, though, as might be expected, it is not as strong as the depressing effect of debt; an extra dollar of financial assets held at the beginning of the quarter leads to $4\frac{1}{2}¢$ of increased durables purchases.

In addition, the Y_T, Y_P, and $CAPC^D$ coefficients are all significant and of the expected sign in the estimated equation above. The magnitudes of these coefficients are also quite reasonable; 27¢ of a $1 increase in transitory income is spent on consumer durables, while a $1 increase in permanent income leads to somewhere in the neighborhood of 34¢ of increased durables expenditures. At the means of the sample data the interest rate elasticity of consumer durables expenditure is −.14, while the price elasticity is −.71. The lagged stock coefficient implies that approximately 6 percent[29] of the discrepancy between desired and actual stocks of durables is made up within the quarter; this is an annual adjustment rate of 22 percent.

The consumer durables demand model presented so far only allows for lags in the adjustment of actual to desired consumer durable stocks; i.e., no decision lags are allowed in the consumer's determination of his desired stock. This assumption seems rather naive. The consumer may acquire information on his user rental cost of durables slowly, and thus his decision on his desired stock of durables may be influenced by past as well as present user rental costs. Capital gains or losses may not be considered fully part of financial assets until they are realized. Movements in common stock prices, which lead to unrealized capital gains or losses in the short run, should not have their full impact immediately; instead, the valuation of common stock would affect the desired consumer durables stock with a distributed lag.

To test for the possibility of the lags described above, experimentation with polynomial distributed lags of the user rental cost variable and stock market financial assets have been pursued. There is no improvement in the standard error of the regression or asymptotic t-statistics from a lag on the capital cost variable. It seems that the consumer does not take long to acquire information on his cost of capital. On the other hand, a substantial improvement in fit is obtained when the value of stock market assets affects the desired stock of durables with a distributed lag. The liquidity model implies that there should be no differences in the effect of stock market and non-stock market assets on consumer durable desirability; thus the sum of the lagged stock market asset coefficients should be equal to the coefficient of unlagged non-stock market financial assets. Applying this a priori equality as a constraint,[30] experiments with polynomial distributed lags constrained to be zero at the tail resulted in an endpoint constrained, second degree polynomial with a four-quarter lag having the best fit (lowest standard error of the regression). The result using instrumental variables and Fair's method is:

$$
\begin{aligned}
(24)\quad EXP^D = {} & -.5239 + .2167\,Y_T \\
& \quad (-3.30) \quad (2.94) \\
& + (.7026 - .6409\,CAPC^D)Y_P \\
& \quad (3.39) \quad (-3.25) \\
& - .2630\,K^D_{-1} - .3118\,DEBT \\
& (-1.18) \qquad (-4.43) \\
& + .0632\,NSFIN \\
& + .0231\,STK + .0173\,STK_{-1} \\
& \quad (3.50) \qquad (4.61)
\end{aligned}
$$

[29] This assumes a quarterly replacement rate of .05625, which is the depreciation rate used in computing the consumer durables stock.

[30] The null hypothesis that this constraint is valid cannot be rejected at the 5 percent level. This hypothesis was tested with a two-tailed asymptotic t-test. The asymptotic t-statistic equals .3276 while the critical t at the 5 percent level is approximately two.

$$+ .0121\,STK_{-2} \quad (2.75)$$

$$+ .0074\,STK_{-3} \quad (1.58)$$

$$+ .0034\,STK_{-4} + .6383\,u_{-1} \quad (1.03)$$

$$\sum_{L=0}^{4} \text{coefficients of } STK_{-L} = .0632 \quad (4.10)$$

$R^2 = .9940$; Durbin-Watson = 2.01; Standard Error = .007104.

STK = real per capita value of households' stock market asset holdings—beginning of quarter.

$NSFIN$ = real per capita non-stock market financial asset holdings of households—beginning of quarter = $FIN - STK$.

The lag pattern of equation (24) has a desirable shape, with a stronger impact on durables expenditure from more recent movements of stock market asset holdings. Furthermore, the overall impact of gross financial consumer assets on durables expenditures is larger in the lagged equation (24), than in the unlagged version (23): the overall financial assets coefficient is .0632 in (24) vs .0453 in (23). The debt coefficient also increases in absolute value in (24); $1 of increased debt holdings now leads to a 31¢ decrease in durables purchases. The Y_T and Y_P coefficients still have reasonable magnitudes in this regression and are significant at the 1 percent level, while the lagged stock coefficient now implies that over 12 percent of the discrepancy between desired and actual stocks is made up within the quarter—an annual adjustment rate of approximately 40 percent. This speed of adjustment is quite plausible and is in the middle of the range of estimated adjustment speeds in other consumer durable studies.[31]

[31] See Harberger.

A striking result of allowing a distributed lag on stock market financial assets is the increase in absolute value of the capital cost coefficient and the rise of its asymptotic t-statistic to a value over three. In this model, the user rental cost of capital, and hence interest rates, has a strong and significant effect on consumer durable purchases. At the sample means the interest rate elasticity of consumer durable purchases is −.20.

To put the regression results of (23) and (24) in perspective, it would be worthwhile to compare them to results from a regression which does not include the debt and financial asset terms which are implications of the liquidity model. Instrumental variable estimates using Fair's method for this "standard" stock-adjustment consumer durables model are as follows:

$$(25)\quad EXP^D = -.2205 + .1954\,Y_T \quad (-1.52)\ (2.01)$$

$$+ (.4611 - .7982\,CAPC^D)\,Y_P \quad (2.39)\ (-3.10)$$

$$- .0535\,K^D_{-1} + .7846\,u_{-1} \quad (-.23)$$

$R^2 = .9919$; Durbin-Watson = 1.75; Standard Error = .008111.

The regression results of equation (23) and especially (24), which incorporate the liquidity model, are much superior to the results of the standard regression (25). The fit is better and the autocorrelation coefficient—an indicator of specification error—is far lower. The Y_T and Y_P coefficients are not as statistically significant in the standard regression, and the speed of adjustment—a quarterly rate of 7 percent—is somewhat low.

The model of equation (22) has also been estimated for the autos and parts, and the nonauto consumer durables sectors separately. Regression estimates using instrumental variables and Fair's method

TABLE 1—AUTO AND PARTS REGRESSIONS

Instrumental Variables Estimates Using Fair's Method
Dependent Variable: EXP^A

Coefficient of	Equations (26)	(27)	(28)
Constant Term	−.1920	−.2591	−.1570
	(−2.89)	(−3.33)	(−2.14)
Y_T	.1002	.0777	.0306
	(1.42)	(1.08)	(.34)
Y_P	.2142	.3133	.3432
	(2.74)	(3.42)	(3.25)
$CAPC^A \cdot Y_P$	−.1834	−.2458	−.4578
	(−1.61)	(−2.09)	(−2.82)
K^A_{-1}	−.0194	−.2819	−.4453
	(−.08)	(−1.10)	(−1.40)
$DEBT$	−.1731	−.2149	
	(−4.24)	(−3.63)	
FIN	.0398		
	(4.09)		
$NSFIN$		.0486	
STK		.0209	
		(3.53)	
STK_{-1}		.0139	
		(4.05)	
STK_{-2}		.0083	
		(2.09)	
STK_{-3}		.0041	
		(.97)	
STK_{-4}		.0014	
		(.45)	
$\sum_{L=0}^{4} STK_{-L}$		.0486	
		(3.44)	
ρ	.5163	.6045	.7630
R^2	.9703	.9738	.9661
Durbin-Watson	1.84	1.91	1.63
Standard Error	.007138	.006759	.007513

Note: ρ = First-order serial correlation coefficient. All other variables are as defined in the text. Asymptotic t-statistics in parentheses.

TABLE 2—NONAUTO CONSUMER DURABLE REGRESSIONS

Instrumental Variables Estimates Using Fair's Method
Dependent Variable: EXP^{NA}

Coefficient of	Equation (29)	(30)	(31)
Constant Term	−.2697	−.3220	−.0753
	(−3.31)	(−3.77)	(−1.51)
Y_T	.1511	.1327	.1607
	(6.26)	(5.16)	(5.90)
Y_P	.3558	.4291	.1210
	(3.32)	(3.83)	(1.99)
$CAPC^{NA} \cdot Y_P$	−.2421	−.3149	−.2513
	(−2.94)	(−3.58)	(−2.90)
K^{NA}_{-1}	−.2633	−.3644	.1389
	(−1.38)	(−1.85)	(1.08)
$DEBT$	−.0672	−.1021	
	(−3.47)	(−3.74)	
FIN	.0089		
	(2.52)		
$NSFIN$		.0161	
STK		.0046	
		(2.10)	
STK_{-1}		.0041	
		(3.17)	
STK_{-2}		.0034	
		(2.23)	
STK_{-3}		.0025	
		(1.55)	
STK_{-4}		.0014	
		(1.20)	
$\sum_{L=0}^{4} STK_{-L}$		.0161	
		(2.96)	
ρ	.5758	.5912	.6325
R^2	.9974	.9975	.9970
Durbin-Watson	2.09	2.17	1.99
Standard Error	.002574	.002540	.002724

appear in Tables 1 and 2. Experiments with endpoint constrained, polynomial distributed lags were also carried out for these sectors, and, as in the case for all consumer durable expenditures, the best fits were obtained with a four-quarter endpoint constrained, polynomial distributed lag on stock market assets. The constraint that the sum of the STK coefficients should equal the coefficient on $NSFIN$ was imposed.[32] The estimates incorporating lags on stock market asset holdings also appear in Tables 1 and 2.

The results for both the autos and parts and nonauto consumer durable sectors are excellent. The debt and financial asset variables are of the right sign and are significant in all cases. The lag pattern of stock market assets in the lagged versions of the model is very similar in both sectors and has a sensible shape; more recent movements in the value of stock

[32] The null hypothesis that this constraint is valid cannot be rejected at the 5 percent level for either sector. The asymptotic t-statistic for the auto and parts and nonauto consumer durables regressions were .4294 and 1.1728, respectively. The critical t at the 5 percent level is approximately two.

market asset holdings have greater impact on purchases, as in the estimates for all consumer durables. The Y_T, Y_P, capital cost, and lagged stock terms are all of the expected sign and are usually significant. The magnitudes of these coefficients are also reasonable. The lagged versions of the estimated model for the two sectors, equations (27) and (30), do have a superior fit to the unlagged models, (26) and (29); and the quarterly speed of adjustment implied by these lagged models is over 12 percent for autos and parts, and over 13 percent[33] for nonauto consumer durables; at annual rates these are both over 40 percent.

It is interesting to note that the estimated debt and financial assets coefficients are so much larger in the autos and parts regressions than in the nonauto regressions, in spite of the fact that autos and parts make up not quite half of total consumer durable purchases. The consumer's financial position seems to have more impact on his decision to purchase an automobile than it does on his decision to purchase a household consumer durable.[34] This is a worthwhile subject for further research.

Standard regression equations for both sectors where the debt and financial assets variables have been excluded have been estimated and appear as equations (28) and (31) in Tables 1 and 2. For both sectors, regression equations which incorporate the results of the liquidity model are superior to the standard regressions. They have a better fit, a lower standard error, and a smaller autocorrelation coefficient. Furthermore, in the nonauto consumer durables case the standard regression has an impossibly low speed of adjustment; only .5 percent of the discrepancy between desired and actual stocks is made up within the quarter—an annual rate of 2 percent.

Disaggregation of the consumer durable sector into its autos and parts and nonauto consumer durables components has resulted in further tests of the liquidity model. The results are still strongly supportive of this hypothesis.

III. Implications for Monetary Policy and Concluding Remarks

The consumer durable expenditure model which incorporates the results of the liquidity model developed in this paper leaves monetary policy with a strong role to play in the demand for one of the most volatile components of gross national product. Three routes for monetary policy effects on consumer durable expenditures can now be envisioned.

1) Monetary policy affects interest rates and hence the user rental cost of capital. Tight monetary policy which raises interest rates will be a strong deterrent to consumer durable purchases because of the high interest elasticity of consumer durable demand indicated by empirical results in this paper.

2) In a Tobin, Foley-Sidrauski theoretical framework, monetary policy has a strong influence on asset prices in the economy. Tight monetary policy will lead to a fall in stock and bond prices and will thus result in a smaller valuation of the gross financial assets in the community. This will lead to decreased purchases of durables because consumers' financial positions have deteriorated; they are now left with a high probability of income shortfalls that would have to be met by the distress sale of consumer durables or a drop in consumption.

3) Past monetary policy will have affected the cost and availability of credit

[33] These adjustment rates assume a quarterly replacement rate of .07 for autos and parts and .045 for nonauto consumer durables.

[34] As a result of indivisibilities in the consumer's portfolio, the absolute size of the loss from selling a durable, and not just the loss per unit of the durable, could be important to consumer behavior. High priced durables such as automobiles would have a greater potential absolute loss from a forced sale than low priced durables, and this might explain the result found above.

to the consumer and will have thus affected the size of consumers' liabilities. Easy past monetary policy which has encouraged the buildup of consumer debt holdings will eventually prove a deterrent to future consumer durable purchases. The increased debt holdings force the consumer to desire more liquid assets.[35]

Viewing the consumer durable as an illiquid asset which must be traded in imperfect capital markets has led to a consumer durables demand model where perceived risk, and consumer liabilities and gross financial asset holdings influence consumer durables expenditure. In contrast to other work on macro-economic financial asset effects where net wealth influences consumer behavior,[36] this approach finds that the composition of the consumer balance sheet is critical to spending decisions.[37] The empirical estimates of this model have proved very encouraging, and several new and apparently potent channels of monetary policy that affect aggregate demand have been proposed. Furthermore, a traditional path for monetary policy effects on consumer durable expenditure has proved to be quite powerful in the model estimated here.

The liquidity model developed in this paper should also have applications in such areas as residential housing demand, and this will be the subject of further research. Many producer's goods, such as inventories and producer's durables are also illiquid assets; incorporating this feature into investment models might throw light on other possible channels of monetary policy effects in our economy. This avenue of monetary research should prove very fruitful.

[35] Simulations with a macro-econometric model (see the author) indicate that the two liquidity channels discussed in (2) and (3) far outweigh the interest rate effects discussed in (1), and are indeed extremely important in the determination of aggregate demand.

[36] For example, see Modigliani.

[37] An important implication of the analysis of this paper is that changes in the composition of the household balance sheet which leave net wealth unchanged can affect the expenditure behavior of households. An increase in indebtedness matched by an increase in holdings of nonfinancial assets which leaves net wealth constant would still lead to a future decline in consumer durable expenditure; a decrease in the value of financial asset holdings matched by an increase in nonfinancial asset holdings that left net wealth constant would also lead to a decline in consumer durable demand.

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