ILLIQUIDITY, THE DEMAND FOR CONSUMER DURABLES, AND MONETARY POLICY

by

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ABSTRACT

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In this thesis, the neglected illiquid aspect of the consumer durable asset is studied and the following results are derived from a mean-variance model: the consumer durable is a less desirable portfolio asset if (a) the consumer's debt holdings are high, (b) gross financial asset holdings are low, (c) income variance is high, or (d) expected income is low. The implications of this model are tested on post-war, quarterly, aggregate time-series data and annual data for nine categories of durables from 1929-1958. The results show that monetary policy can have a strong impact on consumer durable expenditure by affecting the buildup of consumer liabilities and the valuation of consumer's financial assets. Simulation experiments with the MPS model are used to explore the full impact of these effects, and there are important implications for the potency of monetary vs fiscal policy, the crowding out phenomenon, and the size of possible stock market effects on the economy.

DEDICATION

To the old man

ACKNOWLEDGEMENTS

I would like to give special thanks to my thesis advisor, Stan Fischer. Not only has he been open-minded and helpful, but he has also given me the appropriate amount of zetz. I would also like to thank the other members of my thesis committee, Rudi Dornbusch and Franco Modigliani, who provided me with their insights. Jim Kearl helped familiarize me with the simulation programs for the MPS model, while Jeff Perloff gave service beyond the call of duty by sitting through and commenting on my innumerable workshop appearances. I wish to thank them, as well as Paul Joskow, Peter Temin and the participants in the Money Workshop at MIT. This research was completed while I was the recipient of a NSF graduate fellowship. Further research support has been provided by the Federal Reserve Bank of Boston. The evidence and conclusions set forth here are solely those of the author and do not indicate concurrence by those mentioned above or by the Federal Reserve System.

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CHAPTER ONE

INTRODUCTION

Understanding the routes through which monetary policy affects aggregate demand is an important topic of macroeconomic research. Not only will information on monetary policy transmission channels increase our knowledge of the magnitude of monetary policy effects and promote our understanding of the macroeconomic system, but it will also prove extremely useful to the policy maker. This thesis is an attempt to develop several new channels of monetary policy and to explore the impact of these channels on aggregate demand.

Keynesian thought has concentrated on the investment expenditure of business firms in studying monetary policy effects. As is evidenced by many of the macro-economic models in existence,[1] investment expenditure channels have never left monetary policy with a primary role in the determination of aggregate demand; fiscal policy and exogenous shocks to the economic system have been delegated as the major source of business cycle fluctuations.

The monetarist analysis of Milton Friedman and his disciples has presented some impressive evidence that monetary policy is the critical determinant of aggregate demand and the business cycle. Historical

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1 For example, the Wharton model [McCarthy (1972)], the DRI model [Eckstein, Green & Sinai (1974)], the BEA model [Hirsch, Liebenberg & Green (1973)], and the Fair (1970) model.

analysis,[2] timing evidence,[3] and reduced form empirical estimation[4] appear to indicate that monetary policy has far stronger effects on the economy than is indicated by the investment oriented empirical work of the Keynesians.[5] Furthermore, in spite of the serious problems with reduced form estimation,[6] the work of Friedman and Meiselman (1963) hints that monetary policy has strong effects on consumer expenditure; this is a sector of aggregate demand which as a source of important monetary policy transmission mechanisms has been ignored by many of the structural macroeconomic model builders -- with the notable exception of those economists associated with the Federal Reserve Board, M.I.T, University of Pennsylvania (FRB-MIT-PENN or FMP) macroeconomic modelling project (now the MIT-PENN-SSRC (MPS) modelling project).[7]

In contrast to much of the work in the literature which concentrates on the expenditure behavior of business firms in studying monetary policy effects, this thesis explores the expenditure behavior of consumers, and in particular their expenditure for consumer durables.

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2 Friedman and Schwartz (1963a).

3 Friedman and Schwartz (1963b).

4 Friedman and Meiselman (1963) and the St. Louis Model of Anderson and Carlson (1969).

5 As Tobin (1970) has shown, the monetarist timing and historical evidence cited above does not give incontrovertible support to the position that monetary policy has strong effects on aggregate demand. Evidence from reduced form estimation is also suspect (see Modigliani (1971), for example). Nevertheless, the monetarist evidence does give strong indications that monetary policy effects are far stronger than the Keynesian macro model builders have supposed.

6 See Ando & Modigliani (1965), Deprano & Meyer (1965), Hester (1965) and Modigliani (1971).

7 See Modigliani (1971).

In the literature on consumer durable expenditure[8] monetary policy has a major impact either through interest rates[9] or liquid asset (real balance) effects.[10] The theoretical justification for the inclusion of liquid assets as an important determinant of consumer durable expenditure is not particularly strong[11] and results with this variable have been mixed.[12] 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.[13]

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 thesis studies the neglected illiquid aspect of the consumer durable asset and finds that increased consumer liabilites are a major deterrent to consumer durable purchases and increased financial asset

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8 See Modigliani (1971); Hamburger (1967); Juster and Wachtel (1972a); McCarthy (1972); Hirsch, Liebenberg and Green (1973); Liu and Hwa (1974); and Eckstein, Green and Sinai (1974).

9 Classified with interest rate effects are the effects of installment credit terms.

10 Liquid asset (real balance) effects do not include effects from the changing valuation of common stock prices.

11 One justification for the inclusion of liquid assets in consumer expenditure equations is found in Zellner, Huang and Chau (1965).

12 In none of the models mentioned in footnote 8 does the liquid asset variable enter significantly and of the right sign -- indeed it often enters with the wrong sign -- in both equations for the autos and parts and non-auto components of consumer durable expenditure.

13 Michael Hamburger's (1967) 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.

holdings a powerful encouragement.[14] 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 assets holdings, thereby affected, influence expenditure on durables.[15] 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.[16]

Chapter Two of this thesis develops a model which determines the effects of consumer durable illiquidity on the desirability of this asset. The illiquidity of the consumer durable asset causes a rise in the effective opportunity cost of holding this asset as the probability of encountering financial distress increases for the consumer. The decision to purchase a durable is thus dependent on factors which affect the probability of the consumer encountering financial distress: these include his income stream risk and his balance sheet status -- i.e., his debt and financial asset position. The analysis has been formalized with a mean-variance model where the illiquidity of the consumer durable asset leads to the following results: a consumer durable is a less desirable portfolio asset if (a) the consumer's debt holdings are high, (b) gross financial asset

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14 The generalized stock-adjustment model of Watts & Tobin (1960) and Zellner (1960) also stresses the effects of household balance-sheet changes on consumer durable expenditure. The approach found here is consistent with the generalized stock-adjustment approach in that it explains why discrepancies between desired and actual stocks of the liabilities and financial assets balance-sheet items should affect the demand for consumer durables.

15 Financial asset effects on aggregate demand have been an important feature of the MPS model [see Modigliani (1971)]. In that model financial asset effects operate directly only on consumption, while here the financial assets effect is found to be important for consumer durable expenditure as well.

holdings are low, (c) income variance is high, or (d) expected income is low.

In Chapter Three, the implications of the "liquidity hypothesis" developed in Chapter Two are tested in a standard stock-adjustment model of consumer durable expenditure with postwar, aggregate quarterly time-series data. The evidence supporting the theoretical results is quite strong. The debt and financial asset terms enter significantly with the hypothesized signs in regressions for the consumer durables category and its two components, autos and parts, and non-auto consumer durables; and the magnitudes of the other coefficients are quite reasonable with this specification. Comparisons with expenditure models which do not reflect the influence of consumer durable illiquidity indicated the superiority of specifications that include this effect.

The fourth chapter contains further tests of the liquidity hypothesis of Chapter Two. A consumer durables demand model is tested on annual data from 1929 to 1958 for nine different categories of consumer durable goods. Again, as in Chapter Three, the results are favorable to the liquidity hypothesis.

The fifth chapter conducts dynamic simulation experiments with the MPS macro-econometric model to obtain quantitative information on the importance of the newly discovered monetary policy transmission channels which are implications of the work in earlier chapters. The experiments do indicate that these channels are indeed very critical in the

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16 Past monetary policy which affects the buildup of consumer durable capital would also have affects on consumer durable purchases in the flexible accelerator framework of most consumer durable expenditure models. This type of effect is quite similar to the liabilities channel discussed above.

operation of the macroeconomic system. In addition, these channels do have pronounced impact on our perception of the strength of monetary policy effects and such issues as the "crowding out" phenomenon.

The sixth and final chapter of this thesis contains a summary and concluding remarks.

CHAPTER TWO

ILLIQUIDITY OF THE CONSUMER DURABLE ASSET AND THE "LIQUIDITY HYPOTHESIS"

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, 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.[1] 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.[2,3]

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.

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1 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.

2 The value in use is the present discounted value of the durable's flow of services.

3 To see why costly information would lead to a spread between selling price and in-use value, see Akerloff (1970). 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.

Assume that a consumer buys a unit of consumer 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.[4] 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) $$C_0 = 1 - (1-d) + r = r + d$$

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

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

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4 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. Thus the value of the durable at the end of the period reflects these costs.

where,[5]

C_0 = one period opportunity cost of holding a durable,

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

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

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5 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 even 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 are 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 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.

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

A distress sale occurs whenever consumption[6] plus debt service (interest plus amortization) is larger than income plus readily available financial assets; i.e., when

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

DS = debt service,

CON = consumption,

Y = disposible income,

FIN = holdings of financial assets.

The permanent income hypothesis implies that

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

where,

k = the propensity to consume out of permanent income,

$\overline{Y}$ = expected average (permanent) income.

If income is a normally distributed random variable, then using the stan-

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6 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.

dard normal distribution formula we may write:

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

σ_Y = the square root of the income variance

with

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

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) $$\frac{\partial DS}{\partial DEBT} > 0$$

where,

DEBT = liabilities at the beginning of the period.

Now:

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

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

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

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

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

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

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

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

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[7]

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7 As can be seen in an appendix to this chapter, the assumption that p is less than one-half is certainly not needed for the debt and financial asset results obtained here.

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

In a Tobin-Markowitz mean-variance model, both a lower expected opportunity cost and a lower variance are preferred.[8] 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.[9,10]

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8 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. Bower and Lessard (1973) indicate that for most situations the simple mean-variance model usually leads to the same decisions as the capital asset pricing model.

9 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 to this chapter 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.

10 In the long-run, the balance-sheet position of the individual is endogenous to his decision making process, and it might seem inappropriate to study balance-sheet effects on consumer durables demand without analysing

10 (continued) the consumer's overall balance-sheet decisions. Yet, in the short-run, many changes in the consumer's balance-sheet are exogenous, in that the consumer does not have control over certain surprise events (movements in common stock prices, changes in the price level, etc.) which affect the balance-sheet. Therefore, it does make sense to ask the question analysed here: how does the desirability of the consumer durable asset change with changes in the consumer's balance-sheet?

APPENDIX TO CHAPTER TWO

A MORE GENERAL ILLIQUIDITY MODEL

All variables not defined in this appendix have been defined in the body of the chapter.

If the consumer has a shortfall so that he cannot cover his debt payments and desired consumption expenditures, i.e.:

(A1) $SF = \text{shortfall} = DS + CON^* - Y - FIN > 0$

where

CON^* = desired consumption.

He must incur some loss due to financial distress as a result of holding the very illiquid consumer durables asset which can only be sold at a fraction $q (q<1)$ of its true worth.

The maximum relative (we are only concerned with consumer durables as an alternative to a more liquid financial asset) loss that can be incurred per unit of consumer durables as a result of holding the illiquid consumer durables asset is $(1-q)(1-d)$: this is the loss taken when the durable is sold at the end of the period to raise cash. Smaller losses can possibly be incurred if the shortfall is met by a drop in consumption below its desired level rather than a distress sale of consumer durables.

Utility is a function of consumption in period 1, C1, and consumption in period 2, C2, i.e.

(A2) $U = U(C1,C2)$

where there is diminishing marginal utility from consumption, i.e.

(A3) $U_{C1} > 0$ $U_{C1,C1} < 0$

(A4) $U_{C2} > 0$ $U_{C2,C2} < 0$

(where the subscripts refer to partial partial derivatives).

As a result of holding the last unit of consumer durables at the margin, in the case of a shortfall situation, the drop in the current period consumption, C1, will be $\frac{-1}{P_C}$ (where P_C = price of consumption goods and price of durables =1), while the second period consumption, C2, will be higher by $\frac{(1+r)}{P_C}$ (where r is the interest rate).

The loss per unit of consumer durables at the margin, L, is the change in utility, i.e.:

(A5) $$L = -dU = (-U_{C1}dC1 + U_{C2}dC2) = \frac{U_{C1}}{P_C} - \frac{U_{C2}}{P_C}(1+r)$$

As the shortfall increases, C1 will fall; A3 and A4 then indicate that U_{C1} rises while U_{C2} falls. Therefore, the loss per unit of consumer durables given in A5 must rise as the shortfall increases, i.e.

(A6) $L = L(SF)$

(A7) $L'(SF) > 0, \text{ if } SF \geq 0$

where

L = loss per unit of consumer durables as a result of holding the illiquid consumer durable asset.

Obviously if SF < 0 then there is no loss in the period from holding an illiquid asset, thus

(A8) if $SF < 0$ then $L = 0$ and $L' = 0$; hence

$$0 \leq L \leq (1-q)(1-d)$$

From equations A1 and A7

(A9) $$\frac{\partial L}{\partial FIN} = L'(SF)\frac{\partial SF}{\partial FIN} = -L'(SF) < 0, \text{ if } SF \geq 0$$

$$= 0 \text{ if } SF < 0$$

(A10) $$\frac{\partial L}{\partial DEBT} = L'(SF)\frac{\partial SF}{\partial DS}\frac{\partial DS}{\partial DEBT} = L'(SF)\frac{\partial DS}{\partial DEBT} > 0, \text{ if } SF \geq 0$$

$$= 0 \text{ if } SF < 0$$

The one period opportunity cost of holding a unit of consumer durables, C_0, conditional on income is:

(A11) $$C_0 = 1 - (1-d) + r + L(SF) = r + d + L(SF)$$

For any resulting value of income in this period:

(A12) $$\frac{\partial C_0}{\partial FIN} = \frac{\partial L}{\partial FIN} < 0, \text{ if } SF \geq 0$$

$$= 0 \text{ if } SF < 0$$

(A13) $$\frac{\partial C_0}{\partial DEBT} = \frac{\partial L}{\partial DEBT} > 0, \text{ if } SF \geq 0$$

$$= 0 \text{ if } SF < 0 \quad .$$

We can now get the results obtained earlier with the mean-variance model that increased financial asset holdings and decreased debt holdings make a consumer durable asset more desirable. Increased financial asset holdings lower or at worst leave unchanged the one-period opportunity cost of holding a durable no matter what the realized income level is. Thus increased asset holdings make the consumer durable a more attractive asset relative to financial assets. Analogously lower debt holdings lower or at worst leave unchanged the one-period opportunity cost of holding a durable, and this again makes the consumer durable a more desirable asset.

CHAPTER THREE

TIME-SERIES TESTS OF THE "LIQUIDITY HYPOTHESIS"

A stock adjustment model incorporating the results of the "liquidity hypothesis" of the previous chapter is developed here. It is tested on quarterly aggregate time-series data for consumer durables enpenditure and its two component parts: autos and parts expenditure, and non-auto consumer durables expenditure. The models are estimated over the period 1954-I through 1972-IV, with the quarters 1964-IV to 1965-II and 1970-IV to 1971-II excluded because effects of the 1964 and 1970 auto strikes make the model presented here inapplicable for the excluded quarters.[1] All quantities are in real per capita terms (thousands of 1958$ per capita) with flows as seasonally adjusted annual rates.[2]

I. THE MODEL

The modern literature views a consumer durable as an asset in the consumer's portfolio which yields a return of consumption services; the consumer derives benefits from the services of the stock, not from the

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1 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 non-auto consumer durables estimations because aberrations in the auto sector might have an impact on non-auto durable purchases. In fact, model estimates for the non-auto consumer durable sector were not appreciably affected when the excluded quarters were included in estimating the models.

2 The sources of this data are described in an appendix to this chapter.

flow of durable purchases.[3] The consumer thus desires a certain stock of durables which is a function of the usual variables found in the literature: permanent income and a Hall-Jorgenson 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:

(1) $K^{*} = f(Y_P, \text{CAPC}, \text{DEBT}, \text{FIN}) + E_A$

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[4]

= (RCB + D)(PCD/PCON),

RCB = Moody's AAA corporate bond rate,

D = annual depreciation rate,[5]

PCD = consumer durables implicit price deflator,

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3 See Harberger (1960); Chow (1957); Modigliani (1971); Stone and Rowe (1957); and Juster and Wachtel (1972a).

4 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 Hall and Jorgenson (1967) and of Bischoff (1971). 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 incldue 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 durables 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.

5 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 non-auto consumer durables.

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.

If we assume that the coefficient of expected average income is a linear function of the user rental capital cost[6] and further linearize (1), we have:

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

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 proxies to some extent for perceptions of

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6 This assumption is not crucial to our argument. It seems that when expected income is high, and thus the desired durables stock is high, a change in the user capital cost should have a larger effect on the desired stock of durables. In fact, when K^* is assumed to be a linear function of the right-hand-side variables in (18) -- i.e.

(2a) $$K^* = a + bY_P + c\ CAPC + d\ DEBT + e\ FIN + E_A$$

the fit of the estimated model and the asymptotic t-statistics of the coefficients (except for the constant term) change hardly at all.

income variance[7,8] which the liquidity model indicates affect the desired stock of durables and hence net investment.[9] Therefore:

$$(3) \qquad (K - K_{-1}) = \lambda(K^* - K_{-1}) + f\, Y_T + E_B$$

where

K = real per capita stock of durables -- 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:

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

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7 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. When transitory income is low, workers have a high probability 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.

8 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) and is statistically significant at the five percent level or higher in regression models for all consumer durables

where,

EXP = real per capita consumer durable expenditures at an annual rate.

Combining equations 1 through 4 we derive the model to be estimated:

(5) $$EXP = 4\lambda a + [4\lambda b + 4\lambda c\ CAPC]Y_P + 4\lambda d\ DEBT + 4\lambda e\ FIN + 4f\ Y_T + 4[\delta - \lambda]K_{-1} + u$$

where,

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

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8 (continued) and its two component parts: non-auto 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.

9 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 non-autos 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, and thus the value of financial assets falls. A strong negative correlation between the gross financial assets measure and perceived income variance is thus expected.

The signs of all the coefficients of equation 5 are easily determined. The coefficients on permanent and transitory income should both be positive because increased permanent or transitory income encourages consumer durable purchases.[10] 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 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.

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10 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.

II. EMPIRICAL ESTIMATES

Equation 5 -- whether it be estimated for expenditures on all consumer durables, or for autos and parts and non-auto 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.[11] To avoid least squares bias an instrumental variable technique has been used to estimate equation 5.[12] 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.[13, 14] The results for each sector are denoted by superscripts: D for all consumer durables; A for autos and parts; and NA for non-auto consumer durables.

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11 Ordinary least squares estimates of the debt coefficient would be severly 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 durables 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 5 indicates that the bias in ordinary least squares estimates is of the predicted direction and is quite strong.

12 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.

13 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.

14 Ordinary least squares estimates using a Corchrane-Orcutt technique for

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.

$$
\text{(6)} \quad EXP^D = \underset{(-2.45)}{-.3378} + \underset{(3.89)}{.2693} + (\underset{(2.40)}{.4295} - \underset{(-2.41)}{.4527}\ CAPC^D)Y_P
$$

$$
\underset{(-.01)}{-.0014}\ K^D_{-1} - \underset{(-4.63)}{.2167}\ DEBT + \underset{(4.08)}{.0453}\ FIN
$$

$$
+ \ .5527\ u_{-1}
$$

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 dollar of debt held at the beginning of the quarter, durable purchases at an annual rate will be decreased by twenty-two cents. The value of financial asset holdings has a significant positive effect on the demand for durables,

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14 (continued) autocorrelation correction are provided in a second appendix to this chapter. 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 thirty percent.

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 four and a half cents 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; twenty-seven cents of a one dollar increase in transitory income is spent on consumer durables, while a one dollar increase in permanent income leads to somewhere in the neighborhood of thirty-four cents 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 six percent[15] of the discrepancy between desired and actual stocks of durables is made up within the quarter; this is an annual adjustment rate of twenty-two 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

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

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,[16] 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:

16 The null hypothesis that this constraint is valid cannot be rejected at the five 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 five percent level is approximately two.

The procedure used here is analogous to that used in the consumption function of the 1973 MPS model.

$$(7)\qquad EXP^D = \underset{(-3.30)}{-.5239} + \underset{(2.94)}{.2167}\, Y_T + (\underset{(3.39)}{.7026} - \underset{(-3.25)}{.6409}\, CAPC^D)Y_P - \underset{(-1.18)}{.2630}\, K^D_{-1}$$

$$\underset{(-4.43)}{-.3118}\, DEBT + .0632\, NSFIN + \underset{(3.50)}{.0231}\, STK$$

$$+ \underset{(4.61)}{.0173}\, STK_{-1} + \underset{(2.75)}{.0121}\, STK_{-2} + \underset{(1.58)}{.0074}\, STK_{-3}$$

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

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

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 7 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, 7, than in the unlagged version, 6: the overall financial assets coefficient is .0632 in (7) vs .0453 in (6). The debt coefficient also increases in absolute value in 7; a dollar of increased debt holdings now leads to a thirty-one cent decrease in durables purchases. The Y_T and Y_P coefficients still have reasonable magnitudes in this regression and are significant at the one percent level, while the lagged stock coefficient now implies that over twelve percent of the discrepancy between desired and actual stocks is made up within the quarter -- an annual adjustment rate of approximately forty 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.[17]

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 regressions results of 6 and 7 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:

$$(8) \qquad EXP^D = \underset{(-1.52)}{-.2205} + \underset{(2.01)}{.1954}\, Y_T + (\underset{(2.39)}{.4611} - \underset{(-3.10)}{.7982}\, CAPC^D) Y_P$$

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

17 See Harberger (1960).

R^2 = .9919

Durbin-Watson = 1.75

Standard Error = .008111

The regression results of equation 6 and especially 7 which incorporate the liquidity model are much superior to the results of the standard regression, 8. The fit is better and the autocorrelation coefficient -- an indicator of specification error -- is far lower. In addition the Y_T and Y_P coefficients are not as statistically significant in the "standard" regression.

The model of equation 5 has also been estimated for the autos and parts and the non-auto consumer durables sectors separately. Regression estimates using instrumental variables and Fair's method 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.[18] 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 non-auto 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

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

Table 1

AUTO AND PARTS REGRESSION

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

Coefficient of / Equation #	9	10	11
Constant Term	-.1920 (-2.98)	-.2591 (-3.33)	-.1570 (-2.14)
Y_T	.1002 (1.42)	.0777 (1.08)	.0306 (.34)
Y_P	.2142 (2174)	.3133 (3.42)	.3432 (3.25)
$CAPC^A \cdot Y_P$	-.1834 (-1.61)	-.2458 (-2.09)	-.4578 (-2.82)
K^A_{-1}	-.0194 (-.08)	-.2819 (-1.10)	-.4453 (-1.40)
DEBT	-.1731 (-4.24)	-.2149 (-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	.6730
R^2	.9703	.9738	.9661
Durbin-Watson	1.84	1.91	1.63
Standard Error	.007138	.006759	.007513

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

Table 2

NON-AUTO CONSUMER DURABLE REGRESSIONS

Instrumental Variables Estimates Using Fair's Method

Dependent Variable -- EXP^{NA}

Equation #	12	13	14
Coefficient of			
Constant Term	-.2697 (-3.31)	-.3220 (-3.77)	-.0753 (-1.51)
Y_T	.1511 (6.26)	.1327 (5.16)	.1607 (5.90)
Y_P	.3558 (3.32)	.4291 (3.83)	.1210 (1.99)
$CAPC^{NA} \cdot Y_P$	-.2421 (-2.94)	-.3149 (-3.58)	-.2513 (-2.90)
K^{NA}_{-1}	-.2633 (-1.38)	-.3644 (-1.85)	.1389 (1.08)
DEBT	-.0672 (-3.47)	-.1021 (-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

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 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 10 and 13, do have a superior fit to the unlagged models, 9 and 12; and the quarterly speed of adjustment implied by these lagged models is over twelve percent for autos and parts and over thirteen percent[19] for non-auto consumer durables -- at annual rates these are both over forty 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 non-auto 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 his decision to purchase a household durable.[20] 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 11 and 14 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

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19 These adjustment rates assume a quarterly replacement rate of .07 for autos and parts and .045 for non-auto consumer durables.

20 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 durable, could be important to consumer behavior. High priced

standard error, and a smaller autocorrelation coefficient. Furthermore, in the non-auto consumer durables case the standard regression has an impossibly low speed of adjustment; only one-half percent of the discrepancy be-between desired and actual stocks is made up within the quarter -- an annual rate of two percent.

Disaggregation of the consumer durable sector into its autos and parts and non-auto 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 of this paper.

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20 (continued) 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.

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 the 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 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.

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 macroeconomic financial asset effects where net wealth influences consumer behavior,[21] this approach finds that the composition of the consumer balance sheet is critical to spending decisions.[22] The empirical estimates of this model have proved very encouraging, and two new and apparently potent channels of monetary policy that affect aggregate demand (described in [2] and [3] above) have been proposed. Furthermore, the traditional interest role channel for monetary policy effects on consumer durable expenditure has proved to be quite powerful in the model estimated here.

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21 For example, see Modigliani (1971) and Ando-Modigliani (1963).

22 An important point is that an increase in indebtedness matched by an increase in holdings of non-financial assets which leaves net wealth constant would still lead to a future decline in consumer durable expenditure in the liquidity model estimated here. A decrease in the value of financial asset holdings matched by an increase in the value of non-financial assets that left net wealth constant would also lead to a decline in consumer durable demand. Hence, the fact that net wealth is unchanged is no guarantee that changes in the composition of the household balance sheet have no effect on consumer durable expenditure.

APPENDIX A-1 TO CHAPTER THREE

THE DATA

The data from household financial wealth and liabilities was obtained from the Federal Reserve Board, while the data on autos and parts and non-auto consumer durable expenditure was kindly supplied by the Wharton Econometric Forecasting Unit. Data used in constructing all the other varialbes was obtained from the databank of the MIT-PENN-SSRC (MPS) model. Details of the MPS data and the financial wealth and liabilities data are found in MIT-PENN-SSRC Model, Quarterly Econometric Model Data Directory, January 1973.

The permanent income series used in estimation was constructed using the procedure outlined in Darby. As in Darby the quarterly adjustment coefficient was assumed to be .1. Transitory income was computed as the difference between real disposable income per capita and permanent income. The stock series for autos and parts was constructed using a perpetual inventory method with a quarterly depreciation rate of .07 -- this is approximately a twenty-five percent annual rate. It was also assumed, as in construction of the MPS consumer durable stock, that a consumer durable depreciates twice as fast in the quarter in which it is purchased. The non-auto consumer durable stock series was computed as the difference between the auto and parts stock and the consumer durables stock found in the MPS databank. The model estimates were not particularly sensitive to the assumptions used in constructing the stock data, or the assumptions used in constructing the permanent and transitory income series.

APPENDIX A-2 TO CHAPTER THREE

ORDINARY LEAST SQUARES ESTIMATES

Table A-1

Consumer Durables Expenditure Regressions

Ordinary Least Squares

Dependent Variable -- EXP^D

Equation #	15	16	17
Coefficient of			
Constant Term	-.3164 (-2.47)	-.4170 (-3.06)	-.2577 (-1.78)
Y_T	.2947 (5.64)	.2759 (5.30)	.2895 (4.27)
Y_P	.4372 (2.59)	.5502 (3.16)	.4225 (2.21)
$CAPC^D \cdot Y_P$	-.4625 (-2.93)	-.5040 (-3.27)	-.4967 (-2.31)
K^D_{-1}	-.0222 (- .12)	-.1340 (- .70)	-.0802 (- .34)
DEBT	-.1580 (-4.26)	-.2397 (-3.89)	
FIN	.0292 (3.99)		
NSFIN		.0485	
STK		.0208 (4.24)	
STK_{-1}		.0139 (4.26)	
STK_{-2}		.0083 (2.13)	
STK_{-3}		.0042 (1.03)	
STK_{-4}		.0014 (.50)	
$\sum_{L=0}^{4} STK_{-L}$		.0485 (3.49)	
ρ	.5638	.5763	.8012
R^2	.9937	.9943	.9923
Durbin-Watson	1.95	2.02	1.92
Standard Error	.007240	.006976	.007877

Table A-2

Autos and Parts Regressions
Ordinary Least Squares:
Dependent Variable -- EXP^A

Equation #	18	19	20
Coefficient of			
Constant Term	-.1967 (-3.20)	-.2433 (-3.42)	-.1807 (-2.49)
Y_T	.1462 (2.84)	.1401 (2.74)	.1579 (2.62)
Y_P	.2635 (3.38)	.3039 (3.64)	.3121 (3.18)
$CAPC^A \cdot Y_P$	-.2090 (-2.32)	-.2118 (-2.36)	-.2822 (-2.33)
K^A_{-1}	-.1900 (- .84)	-.2977 (-1.26)	-.4766 (-1.55)
DEBT	-.1175 (-3.68)	-.1710 (-3.10)	
FIN	.0226 (3.32)		
NSFIN		.0362	
STK		.0165 (3.52)	
STK_{-1}		.0105 (3.40)	
STK_{-2}		.0059 (1.59)	
STK_{-3}		.0026 (.68)	
STK_{-4}		.0006 (.24)	
$\sum_{L=0}^{4} STK_{-L}$		.0362 (2.74)	
ρ	.5658	.5861	.7834
R^2	.9731	.9748	.9692
Durbin-Watson	1.92	1.96	1.86
Standard Error	.006796	.006628	.007162

Table A-3

Non-Auto Consumer Durables Regressions

Ordinary Least Squares:

Dependent Variable -- EXP^{NA}

Equation #	21	22	23
Coefficient of			
Constant Term	-.2391 (-3.14)	-2747 (-3.55)	-.0949 (-1.94)
Y_T	.1469 (7.51)	.1383 (6.92)	.1553 (7.24)
Y_P	.3053 (3.03)	.3506 (3.45)	.1305 (2.16)
$CAPC^{NA} \cdot Y_P$	-.1774 (-2.51)	-.2169 (-3.06)	-.1769 (-2.39)
K^{NA}_{-1}	-.2001 (-1.11)	-.2629 (-1.47)	.0942 (.74)
DEBT	-.0531 (-3.24)	-.0815 (-3.35)	
FIN	.0072 (2.77)		
NSFIN		.0135	
STK		.0047 (2.63)	
STK_{-1}		.0036 (3.12)	
STK_{-2}		.0027 (1.92)	
STK_{-3}		.0017 (1.21)	
STK_{-4}		.0008 (.85)	
$\sum_{L=0}^{4} STK_{-L}$		.0135 (2.74)	
ρ	.5606	.5559	.6374
R^2	.9975	.9976	.9971
Durbin-Watson	2.07	2.14	1.96
Standard Error	.002532	.002499	.002700

CHAPTER FOUR

ILLIQUIDITY AND THE DEMAND FOR CONSUMER DURABLES: FURTHER TESTS

In this chapter, annual data from 1929 to 1958 for nine different categories of durable goods are used to further study the liquidity hypothesis. This chapter proceeds as follows: in the next section the model used to test this hypothesis is developed; empirical results follow; and in the final section are concluding remarks.

I. THE ESTIMATION MODEL

The modern literature views a consumer durable as an asset in the consumer's 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.[1] The consumer thus desires a certain stock of durables which is assumed to be a function of permanent income and a Hall-Jorgenson (1967) user rental cost of capital. The liquidity hypothesis indicates that in addition the desired stock of durables is a function of consumers' liabilities, gross financial asset holdings and perceptions of income variance. Therefore:

(1) $$K^* = f(Y_p, \text{CAPC}, \text{DEBT}, \text{FIN}, \sigma^2)$$

---

1 See Harberger (1960), Chow (1957), Modigliani (1971), Stone and Rowe (1957), and Juster and Wachtel (1972a).

where K^* = real per capita desired stock of consumer durables

Y_p = real per capita permanent income

CAPC = user rental cost of capital = $PD_i(r+d_i)/PPCE$ for section i = 1, 2, ... 9

r = AAA corporate bond rate

d_i = depreciation rate for sector i

PPCE = price deflator for personal consumption expenditures

PD_i = price deflator for sector i

DEBT = real per capita consumer liabilities[2] -- beginning of period

FIN = real per capita average value of consumer gross financial assets

σ^2 = perceived income variance

If we assume a specification linear in the natural logarithms, then,

(2) $$\log(K^*) = a + b\log(Y_p) + c\log(CAPC) + d\log(DEBT) + e\log(FIN) + f\log(\sigma^2) + \varepsilon_A$$

ε_A = additive error term

As in the familiar stock-adjustment model, the consumer will not adjust the actual stock to its desired level immediately. Instead, we assume that the consumer closes only a percentage of the gap between the log of the

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2 This measure includes loans on securities. Securities loans might be felt to have a different impact on consumer durable demand than other debt, so experiments with a consumer debt measure that excludes securities loans were tried. No appreciable differences with the results using the more inclusive liabilities measure were found.

desired stock and the log of the actual stock in each time period. That is,

$$\text{(3)} \qquad \log(K) - \log(K_{-1}) = \lambda[\log(K^{*}) - \log(K_{-1})] + \varepsilon_B$$

where K = actual real per capita stock -- end of year

K_{-1} = actual real per capita stock -- beginning of year

λ = speed of adjustment per period

ε_B = additive error term

Combining equations 2 and 3 we derive the model to be estimated.

$$\text{(4)} \qquad \log(K) = a + \lambda b \log(Y_p) + \lambda c \log(CAPC) + \lambda d \log(DEBT) + \lambda e \log(FIN) + \lambda f \log(\sigma^2) + u$$

where u = additive error term = $\lambda\varepsilon_A + \varepsilon_B$

The liquidity hypothesis indicates that the sign of the debt coefficient should be negative, the gross financial assets coefficient positive and the perceived income variance coefficient negative. In addition, the permanent income coefficient should be positive and the user capital cost coefficient negative.

II. EMPIRICAL RESULTS

Pooled Regressions: 1929-1941, 1947-1958

Equation 4 and its variants are estimated with ordinary least squares on a pooled sample of the nine consumer durable sectors[3] for the years 1929-1941 and 1947-1958. Unfortunately the quality of this data is not high; this is an especially serious problem for the household balance-sheet items, DEBT and FIN, which have been interpolated between benchmarks using the Chow and Lin (1971) best linear unbiased procedure. The data is discussed in detail in the appendix to this chapter. The war years 1942-1946 have been excluded from the sample as in other consumer durables studies[4] because aberrations in that period make the equation 4 model inapplicable. The adjustment speed, debt elasticity, wealth elasticity and perceived income variance elasticity are assumed to be constant for all nine sectors,[5] while the income and rental capital cost elasticities

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3 The sectors are: furniture, automobiles, automobile accessories (tires and parts, etc.), kitchen appliances, entertainment durables (radios, musical instruments, t.v., etc.), opthalmic and medical appliances, pleasure craft and wheel goods, books and jewelry.

4 See Harberger (1960).

5 F-tests do reject the constraint that the adjustment speed and asset, debt and perceived variance elasticities are the same for all sectors. For example, when unemployment is used as a measure of perceived income variance, the above constraint is rejected at the one percent level: $F(36,162) = 2.03$ while the critical F at one percent is approximately 1.8. The F-test may well be inappropriate for the estimated model of Tables 1 and 2. If there is serial correlation of the residuals in any sector -- this does indeed seem to be the case for most of the sectors as can be seen from the estimates of Table 5 -- then the calculated statistic will not be distributed as F, and the test statistic will often reject the null hypothesis too frequently. The assumed constraint may thus be valid in spite of the F-test results. The F-test results do indicate that it is

and constant term have been allowed to vary for each sector. The resulting estimates appear in Tables 1 and 2.

Unfortunately, there is no clear-cut, pure measure of consumers' perceived income variance, and thus equation 4 is first estimated excluding the perceived income variance variable.[6] The income and capital cost elasticities for this regression appear in Table 2.[7] In the resulting regression 2, the debt and financial asset coefficients are of the sign hypothesized by the liquidity model and are highly significant; both t-statistics are near six. The income elasticities are very reasonable, with automobiles, entertainment durables, and pleasure craft and wheel goods -- all of which are considered luxuries -- having the highest income elasticities. The household durables, furniture and china, have the lowest income

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5 (continued) dangerous to rely solely on pooled regressions to explore the illiquidty hypothesis' validity. As a result, this constraint is abandoned later in the chapter and tests of the liquidity hypothesis are reported for individual sectors.

6 In some sense, changes in perceived income variance are still reflected in a model which does not explicily include this variable. The estimated effect of gross financial asset holdings on the desired consumer durable stock includes income variance effects because of high correlation of the perceived income 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 will cause a lower valuation of equity, and thus the value of financial assets will fall. A strong negative correlation between the wealth measure and perceived income variance is thus expected.

7 The income and capital cost (when appropriate) elasticities, both short and long run, are very similar for all the estimated pooled regressions in Table 1; thus only the results for one regression need be listed.

elasticities, and neither is significantly different from zero.[8] Although the adjustment speed is somewhat low -- only slightly more than twenty percent of the gap between desired and actual stock is made up within the year, as can be seen from the first regression in Table 1, this is not the result of the inclusion of the liquidity variables, debt and financial asset holdings, in the model specification.[9]

The estimated capital cost elasticities of regression 2 are not always satisfactory: only slightly more than half of the estimates have the correct negative sign. The failure of this capital cost variable to appropriately enter the regression model in many cases might be due to the inadequacies of the data used in constructing this variables. Market interest rates may not accurately reflect the consumer's opportunity cost of capital, especially in the abnormal times of the Great Depression. The durable goods' relative price data was obtained from Commerce Department implicit deflators[10] that do not adequately reflect the impact of quality and technological change in the goods categories. The relative price data used here may thus be badly biased.[11] Estimates where the

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8 Houthakker and Taylor (1966) have estimated expenditure models for the nine consumer durables categories used here. Their long-run expenditure elasticities are comparable to the long run income elasticities in Table 2. They also find that the furniture and china categories have low income elasticities and that the entertainment and pleasure craft and wheel goods categories have high income elasticities.

9 With the lagged dependent variable in the estimation model, if there is positive serial correlation of the residuals in some of the sectors, the ordinary least squares estimate of the adjustment speed coefficient will be biased downward. The low estimate of the adjustment speed may thus be the result of this bias.

10 See the Data Appendix to this chapter.

11 This problem is discussed in Griliches (1961).

TABLE 1

ORDINARY LEAST SQUARES ESTIMATES
POOLED REGRESSIONS: 1929-1941, 1947-1958
Dependent Variable: Log(K)

Regression #	Coefficients of: Log(K_{-1})	Log(DEBT)	Log(FIN)	Log(UN)	R^2	SE
Estimates with rental capital cost variable included						
1)	.7890 (54.53)				.9992	.03418
2)	.8023 (46.24)	-.0896 (-5.97)	.2125 (5.94)		.9994	.03102
3)	.7780 (44.59)	-.0451 (-2.58)	.1276 (3.26)	-.0272 (-4.45)	.9994	.02962
Estimates with rental capital cost variables excluded						
4)	.7790 (54.60)				.9991	.03567
5)	.7979 (48.22)	-.0927 (-6.79)	.2125 (6.28)		.9993	.03182
6)	.7812 (46.90)	-0.0558 (-3.38)	.1369 (3.56)	-.0215 (-3.74)	.9993	.03086

UN = Unemployment rate

SE = Standard error of regression

T-statistics in parentheses

TABLE 2

ESTIMATED INCOME AND CAPITAL COST ELASTICITIES FROM REGRESSION 2

SECTOR	INCOME ELASTICITIES		CAPITAL COST ELASTICITIES	
	Short-run	Long-run	Short-run	Long-run
Furniture	.0269 (.46)	.1361	-.1441 (-1.13)	-.7289
Automobiles	.4843 (9.37)	2.4497	-.4667 (-3.33)	-2.3606
Automobile Accessories	.0783 (.56)	.3960	-.1654 (-.81)	-.8366
Kitchen Appliances	.2860 (3.98)	1.4466	-.1260 (-1.22)	-.6373
Entertainment Durables	.4306 (7.77)	2.1780	.0454 (1.34)	.2296
Medical Appliances	.2857 (2.84)	1.4451	.0217 (.20)	.1098
Pleasure Craft & Wheel goods	.4638 (4.90)	2.3460	.1029 (.86)	.5205
China	.0191 (.54)	.0966	-.2020 (-1.11)	-1.0217
Books & Jewelry	.1662 (2.75)	.8407	.1115 (.83)	.5640

T-statistics in parentheses

rental capital cost variables have been excluded are reported in Table 1, and the results are just as favorable to the liquidity hypothesis.

One possible proxy for perceived income variance is the unemployment rate (UN);[12] it reflects the probability of unemployment and hence to some extent the riskiness of the consumer's income stream. Results including this variable appear in Table 1 as regressions 3 and 6 and are quite good. The coefficients of the debt, financial assets and unemployment variables all have the signs hypothesized by the liquidity model and are significant at the one percent level.

The pooled regression estimates of Table 1 do indeed seem to lend further support to the liquidity hypothesis.

POOLED REGRESSIONS: 1929-1941

The liquidity hypothesis with its emphasis on the role of financial assets in the demand for consumer durables, postulates one channel through which the bear market of 1929-1932 could have caused or intensified the economic downturn of this period. Of particular interest, then, are estimates of equation 4 and its variants for the prewar period. Estimates of pooled regressions for this period appear in Table 3. Regression results when the unemployment variable is excluded do indeed indicate that consumers' debt and gross financial asset holdings were an important determinant of the demand for consumer durables. Both the DEBT and FIN coefficients are significant at the one percent level and have the hypothesized

12 The unemployment rate is by no means a perfect proxy for perceived income variance; it embodies many other extraneous cyclical influences of the economy, including labor force participation rates, changes in weekly hours, etc. An alternative measure of risk perceptions in financial markets using

TABLE 3

ORDINARY LEAST SQUARES ESTIMATES
POOLED REGRESSIONS--1929-1941
Dependent Variable: Log(K)

REGRESSION #	Coefficients of: Log(K_{-1})	Log(DEBT)	Log(FIN)	Log(UN)	R^2	SE
Estimates with rental capital cost variable included						
7)	.8778 (25.09)				.9994	.03296
8)	.8799 (25.33)	-.1021 (-2.93)	.2842 (5.33)		.9996	.02634
9)	.8037 (20.65)	-.0490 (-1.36)	.0803 (1.06)	-.0349 (-3.58)	.9997	.02471
Estimates with rental capital cost variable excluded						
10)	.8397 (22.03)				.9991	.03952
11)	.8692 (24.84)	-.1065 (-3.53)	.3564 (7.12)		.9995	.02929
12)	.8228 (22.20)	-.0875 (-2.95)	.1542 (1.85)	-.0289 (-2.98)	.9995	.02816

SE = Standard error of regression

T-statistics in parentheses

signs. The unemployment coefficients are significant at one percent, although the debt and financial asset variables are no longer always significantly different from zero.

INDIVIDUAL SECTOR REGRESSIONS

Further information on the validity of the liquidity hypothesis is available from regression estimates for each of the nine sectors separately. One caveat should be mentioned. Individual estimates for each sector drop the number of observations for estimation to twenty-five. The resulting degrees of freedom are quite small. Estimates of the coefficients will not be as exactly determined and the significance level as high as might be desired. Ordinary least squares estimates for the nine sectors, 1929-1941, 1947-1958, appear in Table 4.

The results for the B estimates, where the capital cost and unemployment variables are excluded, are quite favorable to the liquidity hypothesis, especially when the small number of degrees of freedom is considered. In seventeen out of eighteen cases the debt and financial asset coefficients are of the expected sign. Nine of these coefficients are significant at the one percent level, two at the five percent level and three at the ten percent level.[13] When the rental capital cost measure is included in the model, as in the C regressions, the results are not appreciably different. Sixteen of the eighteen debt and financial asset

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12 (continued) yield spreads between low grade corporate bonds and comparable government securities proved to be insignificant in all the regression models tested.

13 For two-tailed t-tests, the critical t at the one percent level is 2.85, at five percent 2.09, and at ten percent 1.72.

TABLE 4

ORDINARY LEAST SQUARES ESTIMATES

Individual Sectors
1929-1941, 1947-1958

Dependent Variable: Log(K)

(SE = Standard Error of the regression
D-W = Durbin-Watson Statistic
T-statistics in parentheses)

REGRESSION # AND SECTOR	Coefficients of: Log(Y_p)	Log(K_{-1})	Log(CAPC)	Log(DEBT)	Log(FIN)	Log(UN)	R^2	SE	D-W
Furniture									
13A)	.1218	.9408	-.1065				.9710	.01417	.75
	(4.67)	(14.97)	(-1.68)						
13B)	.0503	.8504		-.0118	.0726		.9706	.01463	.54
	(1.35)	(5.72)		(-.40)	(1.53)				
13C)	.0448	1.3146	-.2864	-.1048	.1209		.9840	.01108	.99
	(1.58)	(8.11)	(-3.98)	(-3.23)	(3.17)				
13D)	.0885	1.0991	-.3584	-.0308	.0503	-.0296	.9966	.00525	2.25
	(6.13)	(13.54)	(-10.19)	(-1.72)	(2.52)	(-8.17)			
Automobiles									
14A)	.6509	.7719	.4809				.9795	.06104	1.28
	(7.27)	(20.46)	(-1.70)						
14B)	.1100	.8811		-.3544	.4766		.9887	.04633	1.73
	(1.05)	(12.91)		(-3.81)	(3.11)				
14C)	.1992	.8786	-.2786	-.3260	.4617		.9896	.04562	1.89
	(1.60)	(13.07)	(-1.28)	(-3.46)	(3.05)				
14D)	.1742	.9121	-.2509	-.3886	.4994	.0158	.9897	.04669	1.93
	(1.22)	(8.24)	(-1.07)	(-2.06)	(2.73)	(.39)			

TABLE 4 continued ORDINARY LEAST SQUARES ESTIMATES, Individual Sectors

REGRESSION # AND SECTOR	Coefficients of: Log(Y_p)	Log(K_{-1})	Log(CAPC)	Log(DEBT)	Log (FIN)	Log(UN)	R^2	SE	D-W
Automobile Accessories									
15A)	.2559 (1.25)	.5893 (6.08)	-.5031 (-1.69)				.9838	.04485	.76
15B)	.3010 (2.08)	.6770 (7.27)		-.1356 (-2.66)	.2705 (2.06)		.9864	.04204	.69
15C)	.2027 (1.00)	.6460 (6.20)	-.2301 (-.70)	-.1156 (-1.95)	.2507 (1.84)		.9868	.04259	.66
15D)	.1795 (1.13)	.4695 (4.95)	-.6326 (-2.26)	.0464 (.72)	-.0714 (-.52)	-.0767 (-3.63)	.9924	.03326	.92
Kitchen Appliances									
16A)	.5939 (11.79)	.6637 (26.83)	-.2687 (-3.97)				.9987	.01895	1.19
16B	.3160 (4.25)	.8210 (23.46)		-.1563 (-5.65)	.2219 (4.64)		.9992	.01531	1.17
16C)	.3198 (6.57)	.7650 (30.24)	-.1968 (-5.25)	-.1268 (-6.68)	.1992 (6.30)		.9997	.01003	2.27
16D)	.3225 (7.44)	.7405 (30.08)	-.2803 (-5.88)	-.0892 (-3.91)	.1251 (3.03)	-.0168 (-2.45)	.9998	.0089	2.62
Entertainment Durables									
17A)	.4791 (7.83)	.8725 (30.19)	.0927 (3.15)				.9976	.02706	1.08
17B)	.7148 (4.55)	.6323 (7.36)		.1250 (1.95)	.2164 (2.40)		.9977	.02736	.76

TABLE 4 continued ORDINARY LEAST SQUARES ESTIMATES, Individual Sectors

REGRESSION # AND SECTOR	Coefficients of: Log(Y_p)	Log(K_{-1})	Log(CAPC)	Log(DEBT)	Log (FIN)	Log(UN)	R^2	SE	D-W
17C)	.7076 (4.76)	.7027 (7.82)	.0635 (1.83)	.1062 (1.72)	.1091 (1.05)		.9980	.02589	.95
17D)	.6439 (4.76)	.6481 (7.77)	-.0247 (-.52)	.1734 (2.81)	.0637 (.68)	-.0470 (-2.41)	.9985	.02312	1.57
Medical Appliances 18A)	.8666 (4.79)	.3544 (3.12)	-.4387 (-4.15)				.9976	.02514	.61
18B)	.7501 (4.04)	.5785 (5.74)		-.1129 (-3.52)	.1247 (1.45)		.9975	.02620	.98
18C)	.8660 (5.12)	.3859 (3.34)	-.4498 (-2.61)	-.0055 (-.11)	-.1144 (-.96)		.9981	.02307	.91
18D)	.8838 (4.84)	.3833 (3.23)	-.4231 (-2.15)	-.0059 (-.12)	-.1149 (-.94)	-.0048 (-.31)	.9981	.02364	.89
Pleasure Craft & Wheel Goods 19A)	.3999 (3.93)	.8332 (27.69)	-.1054 (-1.10)				.9978	.02327	.75
19B)	.3991 (8.26)	.7767 (24.19)		-.0698 (-3.27)	.2662 (4.14)		.9988	.01739	.84
19C)	.5630 (7.31)	.7242 (20.66)	.2267 (2.56)	-.1033 (-4.49)	.3993 (5.18)		.9991	.01539	1.39
19D)	.5758 (7.37)	.7072 (18.17)	.2199 (2.47)	-.0845 (-2.84)	.3772 (4.70)	-.0100 (-1.01)	.9992	.01539	1.38

TABLE 4 continued ORDINARY LEAST SQUARES ESTIMATES, Individual Sectors

REGRESSION # AND SECTOR	Coefficients of: Log(Y_p)	Log(K_{-1})	Log(CAPC)	Log(DEBT)	Log(FIN)	Log(UN)	R^2	SE	D-W
China									
20A)	.1453	.8402	-.3656				.9877	.01537	1.17
	(6.74)	(19.33)	(-4.20)						
20B)	.0292	.9643		-.0924	.0796		.9905	.01386	.87
	(.89)	(17.85)		(-5.14)	(1.77)				
20C)	.0552	.9065	-.1948	-.0649	.0882		.9917	.01330	1.03
	(1.56)	(14.48)	(-1.65)	(-2.70)	(2.03)				
20D)	.0898	.7798	-.2181	-.0047	.0096	-.0279	.9960	.00952	1.20
	(3.39)	(14.61)	(-2.57)	(-.21)	(.27)	(-4.37)			
Books and Jewelry									
21A)	.1032	.9371	-.1755				.9950	.01725	.43
	(2.59)	(36.95)	(-2.33)						
21B)	.1064	.9242		-.0595	.1158		.9957	.01635	.44
	(3.03)	(31.34)		(-3.07)	(2.03)				
21C)	.0895	.9414	-.0977	-.0452	.0640		.9959	.01635	.38
	(2.30)	(27.56)	(-1.00)	(-1.87)	(.83)				
21D)	.1046	.8716	-.0414	-.0008	.0142	-.0344	.9983	.01102	.81
	(3.96)	(32.16)	(-.62)	(-.05)	(.26)	(-4.88)			

coefficients are of the expected sign. Eight of these coefficients are significant at one percent, one at five percent and four at ten percent. In both the B and C estimates the DEBT and FIN variables never enter the regressions significantly (ten percent level or higher) with the wrong sign.

The liquidity variables, debt and gross financial assets, have their largest short and long-run impact on the demand for automobiles. Similar results were found using post-war, quarterly time-series data in the previous chapter. The DEBT and FIN variables also seem to have strong impact on other durables that high high income elasticities: kitchen appliances, and pleasure craft and wheel goods.

Estimates which include both the capital cost and unemployment rate variables appear as the D regressions in Table 4. The debt financial assets and unemployment variables have the signs hypothesized by the liquidity hypothesis in twenty-two out of twenty-seven cases. Seven of these coefficients are significant at the one percent level, five at the five percent level and two at the ten percent level. Only in one case does a debt financial asset or unemployment coefficient enter a regression significantly with the wrong sign.

The Durbin-Watson statistics are very low in the regressions of Table 4, indicating the presence of serial correlation of the residuals.[14] The regressions of Table 4 have been corrected for first order serial

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14 The serial correlation of residuals is especially severe since the Durbin-Watson statistic is biased towards two when a lagged dependent variable is present.

TABLE 5

ORDINARY LEAST SQUARES ESTIMATES

WITH FIRST ORDER SERIAL CORRELATION CORRECTION

Individual Sectors
1930-1941, 1947-1958

Dependent Variable: Log(K)

(ρ = 1st order serial correlation coefficient
SE = Standard Error of the regression
D-W = Durbin-Watson statisti
T-statistics in parentheses)

GRESSION # D SECTOR	Coefficients of: Log(Y_p)	Log(K_{-1})	Log(CAPC)	Log(DEBT)	Log (FIN)	Log(UN)	ρ	R^2	SE	D-W
ırniture ʒE)	.2162 (10.62)	.8055 (16.73)	-.1992 (-4.88)				.4727	.9950	.00604	2.52
ʒF)	.3082 (4.95)	.4408 (2.92)		-.0228 (-.72)	.0419 (1.40)		.8182	.9946	.00644	1.55
ʒG)	.2489 (5.51)	.5818 (3.76)	-.1696 (-3.76)	.0394 (1.16)	.0105 (.33)		.5127	.9958	.00584	2.26
3H)	.0941 (5.52)	1.1182 (14.38)	-.3658 (-10.39)	-.0334 (-1.98)	.0458 (2.33)	-.0286 (-6.93)	-.1970	.9968	.00527	1.87
utomobiles 4E)	1.3529 (7.67)	.3572 (4.00)	-.3473 (-1.33)				.6177	.9904	.04259	1.95
4F)	1.1700 (4.34)	.1651 (1.08)		.0041 (.03)	.5381 (3.33)		.6398	.9939	.03497	2.20
4G)	1.2002 (4.10)	.1817 (1.18)	-.2445 (-1.05)	.0759 (.47)	.4900 (2.85)		.6133	.9941	.03539	2.22
4H)	1.1267 (3.70)	.1697 (1.06)	-.2758 (-1.16)	.1458 (.78)	.4724 (2.67)	-.0272 (-.68)	.6032	.9942	.03606	2.13

BLE 5 continued ORDINARY LEAST SQUARES ESTIMATES with...CORRECTION

GRESSION # D SECTOR	Coefficients of: Log(Y_p)	Log(K_{-1})	Log(CAPC)	Log(DEBT)	Log(FIN)	Log(UN)	ρ	R^2	SE	D-W
tomobile cessories										
5E)	.5792	.4555	-.3763				.5432	.9948	.02565	1.55
	(3.85)	(5.12)	(-1.88)							
5F)	.8432	.4645		-.0947	.0302		.6595	.9945	.02718	1.65
	(4.43)	(5.20)		(-1.47)	(.23)					
5G)	.6995	.4246	-.2996	-.0601	.0102		.6285	.9950	.02655	1.53
	(3.41)	(4.52)	(-1.39)	(-.94)	(.08)					
5H)	.5436	.4195	-.4112	-.0073	-.0083	-.0265	.6179	.9952	.02684	1.48
	(1.99)	(4.35)	(-1.60)	(-.08)	(-.06)	(-.78)				
tchen pliances										
5E)	.6673	.6110	-.3458				.1790	.9993	.01358	1.47
	(14.69)	(26.65)	(-5.99)							
5F)	.3150	.8060		-.1642	.2633		.0880	.9992	.01527	1.29
	(3.51)	(20.73)		(-5.09)	(4.14)					
6G)	.3287	.7679	-.2109	-.1173	.1674		-.0502	.9997	.00995	2.39
	(6.10)	(30.12)	(-5.28)	(-5.36)	(4.03)					
6H)	.2946	.7530	-.2760	-.0938	.1281	-.0182	-.0406	.9997	.00914	2.63
	(5.54)	(30.87)	(-5.75)	(-4.08)	(3.00)	(-2.08)				
ntertainment urables										
7E)	.8127	.6709	-.1203				.6861	.9984	.02200	2.31
	(5.63)	(9.20)	(-1.03)							
7F)	.7810	.6213		.0662	.1948		.6143	.9987	.02024	2.03
	(5.23)	(8.29)		(1.16)	(2.00)					

BLE 5 continued ORDINARY LEAST SQUARES ESTIMATES with...CORRECTION

GRESSION # ID SECTOR	Coefficients of: Log(Y_p)	Log(K_{-1})	Log(CAPC)	Log(DEBT)	Log(FIN)	Log(UN)	ρ	R^2	SE	D-W
'G)	.7851 (5.13)	.6112 (7.59)	-.0431 (-.41)	.0632 (1.08)	.1877 (1.85)		.6163	.9988	.02070	2.07
'H)	.7876 (4.68)	.6116 (7.36)	-.0443 (-.39)	.0611 (.84)	.1877 (1.80)	.0010 (.04)	.6183	.9988	.02130	2.07
edical Appliances										
3E)	.5037 (3.59)	.4177 (4.88)	-.4964 (-5.82)				.9148	.9990	.01621	1.84
3F)	.8334 (4.34)	.5573 (6.26)		-.2121 (-4.40)	.1157 (1.36)		.7059	.9987	.01890	2.14
3G)	.6623 (3.90)	.4837 (5.93)	-.3600 (-2.89)	-.1112 (-1.81)	.0265 (.35)		.7695	.9991	.01614	2.12
3H)	.5268 (3.09)	.4769 (6.06)	-.3837 (-3.28)	-.0381 (-.51)	.1188 (.02)	-.0260 (-1.76)	.8120	.9992	.01530	2.43
Leasure Craft & heel Goods										
9E)	.4666 (4.39)	.7979 (20.58)	-.1431 (-1.95)				.5634	.9993	.01303	1.19
9F)	.5354 (6.93)	.7605 (19.81)		-.0380 (-1.42)	.1361 (2.24)		.4417	.9994	.01263	1.19
9G)	.6765 (8.83)	.6945 (21.33)	.2098 (2.67)	-.0654 (-2.77)	.3030 (4.25)		.1028	.9995	.01218	1.50
9H)	.7057 (8.76)	.7083 (21.04)	.2088 (2.61)	-.0792 (-3.02)	.2950 (4.10)	.0164 (1.48)	.1462	.9995	.01183	1.83

BLE 5 continued ORDINARY LEAST SQUARES ESTIMATES with...CORRECTION

GRESSION # D SECTOR	Coefficients of: Log(Y_p)	Log(K_{-1})	Log(CAPC)	Log(DEBT)	Log(FIN)	Log(UN)	ρ	R^2	SE	D-W
ina										
E)	.1950	.7565	-.2663				.3001	.9960	.00895	1.68
	(9.69)	(19.88)	(-4.33)							
F)	.1928	.7823		-.0609	.0040		.5750	.9966	.00856	2.12
	(4.20)	(12.25)		(-2.93)	(.09)					
G)	.1731	.8132	-.1299	-.0363	-.0052		.3885	.9968	.00853	2.06
	(4.43)	(14.73)	(-1.61)	(-1.74)	(-.13)					
H)	.1426	.7698	-.1703	-.0142	-.0023	-.0161	.3959	.9972	.00817	1.77
	(3.37)	(13.00)	(-2.08)	(-.58)	(-.06)	(-1.61)				
oks and welry										
E)	.3023	.7792	-.0905				.6901	.9907	.00458	3.22
	(12.35)	(40.64)	(-3.63)							
F)	.3220	.7781		-.0036	.0173		.6603	.9995	.00596	2.48
	(9.89)	(29.98)		(-.23)	(.63)					
G)	.3022	.7739	-.1228	.0278	-.0272		.6714	.9997	.00442	2.65
	(11.95)	(39.51)	(-4.06)	(1.97)	(-1.17)					
H)	.2786	.7644	-.1321	.0450	-.0298	-.0085	.6988	.9998	.00406	2.82
	(9.33)	(40.46)	(-4.72)	(2.82)	(-1.40)	(-2.01)				

correlation and the results appear in Table 5 for 1930-1941 and 1947-1958.[15] The results are still supportive of the liquidity hypothesis, although they are not so favorable as the Table 4 estimates. When the capital cost and unemployment variables are excluded from the regression model, the DEBT and FIN variables have the expected sign in sixteen of eighteen cases. Five of these coefficients are significant at the one percent level, one at the five percent level and one at the ten percent level. Neither of the coefficients with the wrong sign is significantly different from zero at the ten percent level. When the capital cost variable is added to the regressions, twelve of the eighteen DEBT and FIN coefficients have the expected sign; four of these are significant at the ten percent level, two at the five percent level and three at the one percent level. In the _H_ regressions where the unemployment variable enters as a proxy for perceived income variance, nineteen of the twenty-seven debt, financial assets and unemployment coefficients have the hypothesized sign. Of these, four are significant at the ten percent level, three at the five percent level and five qt the one percent level. Only in the _G_ and _H_ regressions for the books and jewelry sector is a DEBT, FIN or UN coefficient of the wrong sign and significantly different from zero.

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15 One observation is lost in correcting for serial correlation.

III. CONCLUDING REMARKS

Tests on a different set of sample data lend further support to the liquidity hypothesis, although the results for the individual sector regressions are not strikingly strong. The small number of observations and the limitations of the data, some of which have had to be interpolated between benchmarks, unfortunately do not allow more precise tests of the liquidity hypothesis. There is an additional result of interest from the empirical work of this chapter. The pooled regression estimates for the pre-war period indicate that the decline in equity values from 1929 to 1932 depressed consumer durable demand, thereby intensifying the economic downturn of that period.

APPENDIX

THE DATA

The stock level for each of the nine sectors was created by the perpetual inventory method from National Income Accounts expenditure data using the following depreciation rates: furniture, .10; automobiles, .25; automobile accessories, .30; kitchen appliances, .15; entertainment durables, .15; medical appliances, .30; pleasure craft and wheel goods, .15; china, .15; books and jewelry, .15. Choice of the depreciation rates was dictated by Goldsmith's (8) Table Q-12, "Life expectancies and depreciation rates of consumer durable goods." Benchmarks were calculated from Goldsmith's (8) expenditure data with suitable adjustments for differences in definition of his consumer durables categories and those in the National Income Accounts.

Population and the unemployment rate were taken from Long Term Economic Growth. The permanent income series was created from disposable income data in the National Income Accounts using Darby's (1972) method with an adjustment coefficient of .4 where the growth trend was found to be linear rather than quadratic. The interest rate series used was Moody's AAA corporate bond rate. All necessary price deflators were obtained from the National Income Accounts.

The nominal consumers' liabilities measure after 1944 was obtained from national balance sheets in Goldsmith, Lipsey and Mendelson (1962). Before 1945 the components of consumer liabilities were obtained by interpolation with Chow and Lin's (1971) best linear unbiased interpolation procedure, or by straight geometric interpolation (assumption of a constant growth rate between benchmarks). The method and data series used for interpolation of each component is listed in Table A-1. The interpolated components were then summed up to yield the nominal liabilities series. The nominal liabilities series for the entire period 1929-1958 was then deflated by the personal consumption expenditure deflator and population to obtain the debt variable used in estimation.

The gross financial assets measure used in this study was constructed by adding the consumers' liabilities series to Ando, Brown, Solow and Kareken's (1963) net wealth data, subtracting off a constructed series for tangible assets, and then deflating the resulting figure by population and the personal consumption expenditure deflator. The tangible asset series before 1945 was interpolated between Goldsmith, Lipsy and Mendelson's benchmarks using Chow and Lin's (4) procedure and a series which is the sum of columns 4,7,12,14,15,20 and 21 from Goldsmith's (1955) Table W-1.

Table A-1
Interpolation Procedures for the
Components of Consumers' Liabilities

Component	Method and Data Series Used
Farmer's Financial Liabilities	Chow and Lin using "Farmers' Liabilities" series (Goldsmith, Table A-54)
Consumer Debt	Chow and Lin using "Consumer Debt" series (Goldsmith, Table D-1)
Mortgages	Chow and Lin using "1-4 Family Mortgages" series (Goldsmith, Table R-35)
Loans on Securities	Chow and Lin using "Bank Loans to Customers Excluding Brokers for Carrying Securities" series (Goldsmith, Table D-8)
Other Loans	Chow and Lin using "Policy Loans and Premium Notes of Life Insurance Companies" series (Goldsmith, Table I-5)
Bonds and Notes	Constructed from "Bonds on Apartment Houses" and "Bonds on Non-profit Institutions" series (Goldsmith, Table R-43) using proportions dictated from Goldsmith Table R-29
Other Liabilities	Geometric Interpolation
Bank Loans, n.e.c.	Geometric Interpolation

CHAPTER FIVE

MONETARY POLICY AND LIQUIDITY: SIMULATION RESULTS

The work presented so far in this thesis has demonstrated that there are several factors that have been left out of analysis of consumer durable demand, while empirical estimates in chapters three and four indicate that household liabilities and financial assets may be important determinants of consumer durable expenditure. We now return to the issue raised in the introduction: what new transmission channels of monetary policy influence on the economy result from the work found here, and how important might these monetary policy channels be?

The analysis of the previous chapters indicates that there are now three routes for short-run monetary policy effects on consumer durable expenditure.[1]

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1 In discussing these three channels, I am concerned with the short-run (three years or less) effects of monetary policy on consumer durable demand. In discussing the direction of the short-run monetary policy effects, I am making the implicit assumption that price effects are fairly sluggish. (This is a feature of the MPS model used here for simulation experiments.) If this assumption were abandoned, the directional effect of an increase in the money stock on consumer durable expenditure through the three channels discussed here would no longer be clear. For example, if an increased growth of the money stock immediately led to a sharp upward revision of the expected rate of inflation, we might find that the long-term bond rate would rise rather than fall, as would be expected in the standard fixed price ISLM model. Hence, the directional effect of an increase in the money stock on consumer durable expenditure through the interest rate channel would now be ambiguous. Similarly, if an increased money stock caused a rapid increase in prices, we might find that household financial asset holdings would decline in real terms, even though in nominal terms they would be rising; while liabilities in real terms might fall, even though they were rising in nominal terms as a result of "easier" money. In this case, the directional effect of an increased money stock would again no longer be as clear.

Although I am only dealing with short-run responses of consumer

1. The Interest Rate Channel

In the literature, interest rate effects have been the traditional channel of monetary policy influence on this type of expenditure.[2] Tight monetary policy which raises interest rates increases the opportunity cost of holding the consumer durable asset and thus diminishes demand.

2. The Financial Assets Channel

In a Tobin (1969), Foley-Sidrauski (1971) theoretical framework, (and in the MPS model) 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 gross financial assets in the community. This will lead to decreased purchases of consumer durables because consumers' financial positions have deteriorated.

3. The Household Liabilities Channel

Past monetary policy will have affected the cost and availability of credit to the consumer and will have thus affected the size of consumers' liabilities. Easy past monetary policy which has encouraged the buildup of household debt holdings will eventually prove a deterrent to future consumer durable purchases, as would a buildup of the stock of consumer durable capital.

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1 (continued) durable expenditure in this chapter, it should be realized that there is a long-run relation of consumer durable expenditure to permanent income and interest rates that could be derived from the liquidity consumer durables expenditure model and the household liabilities equation.

2 See Hamburger (1967) and Modigliani (1971).

The theoretical and empirical work on the liquidity hypothesis mentioned above suggests that the channels disucssed in (2) and (3) may be important in the determination of aggregate demand. The direction of these monetary policy effects in the short-run is clear from a priori reasoning, yet questions still remain: how important are these monetary channels;what difference do these effects make in our perception of the strength of monetary policy; what are the implications for stabilization policies?

In this paper these questions will be explored and quantitative answers given using dynamic simulation experiments with the MPS model. The paper proceeds as follows: the first section discusses the use and design of the simulation experiments; the following section uses dynamic simulations to view the partial effects of the monetary mechanisms mentioned above; the next section contains full system simulations which are used to assess these mechanisms' overall effects on aggregate demand; and a final section contains a summary and concluding remarks.

I. THE USE AND DESIGN OF THE SIMULATION EXPERIMENTS

To answer the questions posed in the introduction, the full effects of the monetary mechanisms -- i.e., including all the interactions of these mechanisms with others in the economy -- must be studied in a general equilibrium framework of a macroeconomic model. The MIT-PENN-SSRC (MPS) macro-economic model[3] is especially suited to the study of the

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3 The properties of this macro-economic model are described in Modigliani (1971).

monetary policy channels described in the introduction, because it explicitly models the impact of monetary policy on the valuation of financial assets which the liquidity hypothesis indicates can have a major impact on consumer durable expenditure. Because of the complexity of the MPS model, the system of equations can not be solved analytically, and the monetary policy channels must be analyzed with dynamic simulation experiments where a control simulation with exogenous variables set to their historical values is compared to simulations where one or more of these exogenous variables is changed.

Lucas (1973) has warned that policy prescriptions based on simulations of large macro-econometric models such as the MPS model are suspect because if expectations are rational, the lag structure of the model may change when policy changes. In particular, the Lucas critique indicates that the use of macro-econometric models to help policy makers to fine-tune the economy may be very dangerous. Lucas's criticism of macro-econometric models is even more severe for the MPS model which transmits much of the monetary policy effects through changes in the valuation of common stocks. Not only are the prediction errors in the common stock valuation sector large, but the equations in this sector often violate the assumptions of efficient markets theory[4] in using distributed lags on past variables (information) to determine current stock prices. Certainly, in the clearly rational, efficient financial markets where stocks are traded, different expectations on the direction of policy would markedly change distributed lags in stock market valuation formulas.

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4 See Fama (1970).

Lucas warns us that the timing relationships found via simulation experiments with macro-econometric models must be inexact. Nonetheless, such simulation experiments are useful tools, and are often the only tools we have, for obtaining quantitative information on the structure of the economy and the importance of policy transmission mechanisms. Even if lag structures in the macro-econometric model do change when policy changes, simulation exepriments still contain information on the overall magnitudes of policy effects and illustrate some important interactions of different policy transmission mechanisms.

In the simulation experiments, the monetary policy effects of the liquidity hypothesis will be explored with one of the consumer durable expenditure models found in chapter three. Expenditure is modeled with a standard stock-adjustment framework where the consumer only adjusts his actual stock of durables to the desired level slowly over time. The desired stock of durables is a function of variables often used in the literature such as permanent income and a Hall-Jorgenson (1967) cost of capital measure. The liquidity hypothesis indicates that in addition the desired stock is a function of household liabilities and household financial asset holdings. Including the effects of transitory income on consumer durable purchases, we have a model where consumer durable expenditure is a function of transitory income, permanent income, a Hall-Jorgenson cost of capital measure, household liabilities, household gross financial asset holdings, and the lagged stock of consumer durables.

Gross financial asset holdings are in part made up of common stocks which are subject to sharp fluctuations in value. Capital gains may not be fully considered part of financial assets until they are realized. Hence, 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 stock market assets would affect the desired consumer durables stock and thus expenditure with a distritued lag. Incorporating a distributed lag on stock market assets into the consumer durables expenditure model not only resulted in a better fit for the regression model, but also led to a more sensible speed of adjustment in this stock-adjustment model. The instrumental variables estimates of the "liquidity" consumer durables expenditure equation used in this study appears below. Asymptotic t-statistics are in parentheses and the coefficient of u_{-1} is the first order serial correlation coefficient.

$$EXP^D = \underset{(-3.30)}{-.5239} + \underset{(2.94)}{.2167}\, Y_T + (\underset{(3.39)}{.7026} - \underset{(-3.25)}{.6409}\, CAPC^D) Y_P$$

$$\underset{(-1.18)}{-.2630}\, K^D_{-1} - \underset{(-4.43)}{.3118}\, DEBT + .0632\, NSIN + \underset{(3.50)}{.0231}\, STK$$

$$\underset{(4.61)}{+.0173}\, STK_{-1} + \underset{(2.75)}{.0121}\, STK_{-2} + \underset{(1.58)}{.0074}\, STK_{-3} + \underset{(1.03)}{.0034}\, STK_{-4}$$

$$+.6383\, u_{-1}$$

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

R^2 = .9940 Durbin Watson = 2.01 Standard Error = .007104 where, EXP^D = real per capita consumer durable expenditure -- annual rate,

Y_P = real per capita expected average (permanent) income,

Y_T = real per capita transitory income,

$CAPC^D$ = user rental cost of consumer durable capital
= (RCB + D)(PCD/PCON),

RCB = Moody's AAA corporate bond rate,

D = annual depreciation rate,

PCD = consumer durables implicit price deflator,

PCON = consumption implicit deflator,

DEBT = real per capita household liabilities of households -- beginning of quarter,

NSFIN = real per capita non-stock market financial asset holdings of households -- beginning of quarter,

STK = real per capita value of stock market asset holdings -- beginning of quarter

K^D_{-1} = real per capita stock of durables -- beginning of quarter.

Further details on the estimation procedure used here and the comparison of this model to models without distributed lags on stock market assets can be found in Chapter Three.

The balance sheet effects predicted by the liquidity hypothesis appear to be quite large in the estimated equation above. For every dollar of debt held at the beginning of the quarter, durable purchases at an annual rate will be decreased by thirty-one cents, while a one dollar increase in the value of financial asset holdings leads to a little over six cents of increased durables expenditure. The interest rate effects on consumer durable expenditure are also quite strong in the model above; the interest elasticity of expenditure is .20 at the sample means of the data. It seems that all three channels of monetary policy discussed in the introduction are indeed important in the empirical estimates found here.

The other equations in the MPS model used in these simulation experiments are described in the MIT-PENN-SSRC (1973) equations listing. Several endogenous variables appear in the liquidty consumer durables equation above that are not included in the MPS model. In order to close the model for simulation purposes, equations that explain these variables -- household non-stock market gross financial assets, household liabilities, permanent income and transitory income -- have been developed and are used in the simulation experiments of this chapter. Of the non-included variables only household liabilities need be explained by a stochastic behavioral relation; the other variables can be explained with identities. Detailed descriptions of these equations appear in the Appendix, yet a few comments on the household liabilities equation are necessary because it does play an important role in the simulation experiments. Since most expenditures on consumer durables and residential housing are financed by borrowing, we would expect that increased expenditures on these real assets would raise the level of household liabilities. The household liabilities equation developed for use in this paper is based on a generalized stock-adjustment framework where the change in household liabilities is positively related to the size of the net investment in consumer durables and residential housing. Since net investment in consumer durables and housing is closely related to expenditures (gross investment) for these items, the household liabilities equation does have the property that expansionary policy which leads to increased consumer purchases of real assets will result in a buildup of household liabilities as might be expected.

II. DYNAMIC SIMULATIONS OF PARTIAL EFFECTS

To ascertain the importance of the three channels of monetary policy mentioned in the introduction, the impact of exogenous shifts in household liabilities, the interest rate component of durables rental and the value of stock market financial assets are explored with dynamic simulation experiments.[5] A decision must be made on which policy variables should be exogenously set at their historical levels in conducting these experiments. For fiscal policy, tax rates and Federal expenditures in real terms are set at their historical values, while for monetary policy, the money supply (demand deposits plus currency) is taken as exogenous.[6]

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5 These experiments are carried out under the assumption that the exogenous shifts in these three variables only affect other variables in the system over time through their effect on expenditure. This assumption cannot be valid and thus in some sense all the simulation experiments in this section are very artificial. An exogenous shift in household liabilities could not occur without other immediate portfolio adjustments in the household balance sheet: the interest rate component of durables rental could not shift exogenously without immediate shifts in other interest rates in the system; and the value of stock market wealth could not change exogenously without an instantaneous effect on the dividend-price ratio. In spite of the artificial nature of these experiments, they are very useful in the context of this paper because they give us some idea how large as the separate effects from the three channels discussed in the introduction. The information obtained from this section will prove useful in answering questions on the importance of the different channels of monetary policy to aggregate demand.

6 Since much discussion of monetary policy centers on changes in the money stock, setting the money supply at historical levels seems to be the appropriate assumption to answer the questions posed in the introduction.

Real System Response to a Change in the Interest Component of Durables Rental

In Figure 1 are the results of a dynamic simulation where the interest rate component (the AAA corporate bond rate) of $CAPC^D$, the rental cost of consumer durable capital, is exogenously increased by one hundred basis points in 1962-1.[7] In order to eliminate any other long-term interest rate effects, the AAA corporate bond rate is set at its historical values for all other sectors in the MPS model.[8] Figure 1 shows the change in real GNP and real consumer durable expenditure from this simulation and a control simulation where all exogenous variables[9] are set at their historical values.

The impact effect of this change in the consumer durables interest rate is sharp and fairly strong. Real[10] consumer durable expenditure falls by close to two and a half billion 1958 dollars in the first quarter; thereafter the decline decreases in absolute value. This last response is the result of the capital cost measure, $CAPC^D$, entering the "liquidity" consumer durables equation in an unlagged form. The effect on real

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7 Only simulation experiments where the variable of interest has been increased are reported in this paper. Although there are asymmetries in the MPS model which lead to differences in multipliers when variables are increased rather than decreased, none of the conclusions in this paper would be appreciably affected by using simulations with decreases in the variables of interest.

8 Because of the artificial nature of this experiment it is still necessary to make a decision on how to hold monetary policy constant to determine interest rates other than the AAA corporate bond rate. Thus, as mentioned above, the money supply (M1) is set at historical values even in this experiment where such a procedure seems somewhat peculiar.

9 In this case, this includes the AAA corporate bond rate.

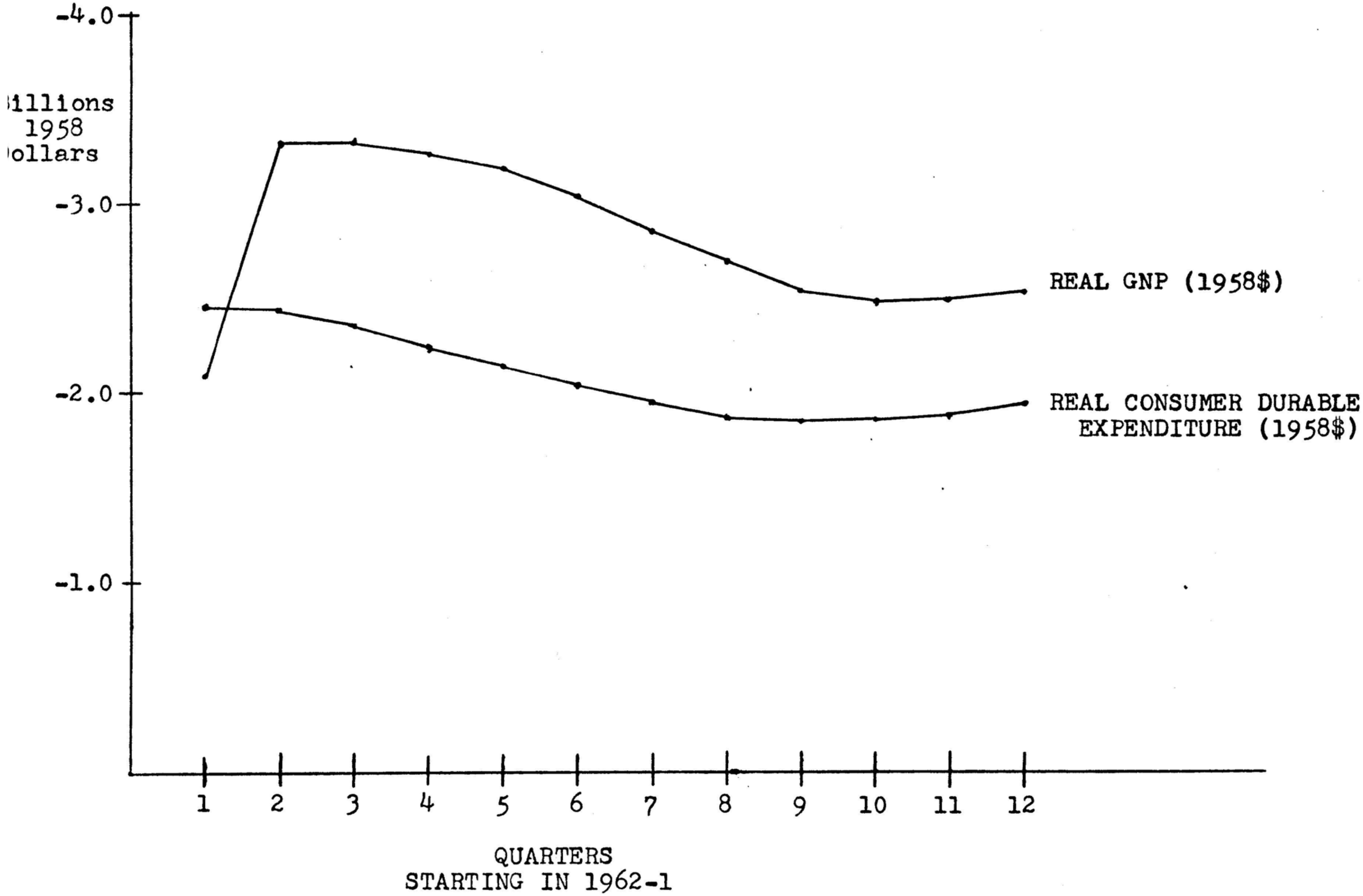
10 All real magnitudes in this paper are denominated in billions of 1958 dollars.

FIGURE 1

RESPONSE OF DEMAND TO AN EXOGENOUS CHANGE IN THE INTEREST COMPONENT OF DURABLES RENTAL

Interest Rate Component of Rental Increased by 100 Basis Points in 1962-1

(Sign Reversed)



consumer durable expenditure decreases over time as a result of the flexible accelerator[11] mechanism of the consumer durables model.[12] The effect on real GNP reaches its peak within three quarters -- in the third quarter the real GNP has declined by three and a third billion dollars -- and declines thereafter.

The AAA bond rate was around four and a half percent in 1962-1, while real GNP was around 550 billion 1958 dollars. The simulation experiment described here thus indicates that a twenty percent increase in the consumer durables interest rate leads to approximately a half percent decrease in real GNP within two quarters.

Real System Response to a Change in Household Liabilities

In Figure 2 are the results of a dynamic simulation experiment where starting at the beginning of the first quarter of 1962 the household liabilities variable is exogenously increased by ten billion dollars over its historical values. Real consumer durable expenditure immediately falls by slightly more than two and a half billion dollars which is very close to its peak decline of 2.65 billion reached in the third quarter. Properties of the flexible accelerator mechanism cause the household liabilities effect to diminish over time. Real GNP falls rapidly to its peak decline of 3.6 billion dollars in the third quarter.

Total household liabilities were around two hundred and fifty billion dollars in 1962-1; thus, the four percent increase in consumers' liabilities leads to approximately a two-thirds of one percent decline in real GNP within two quarters.

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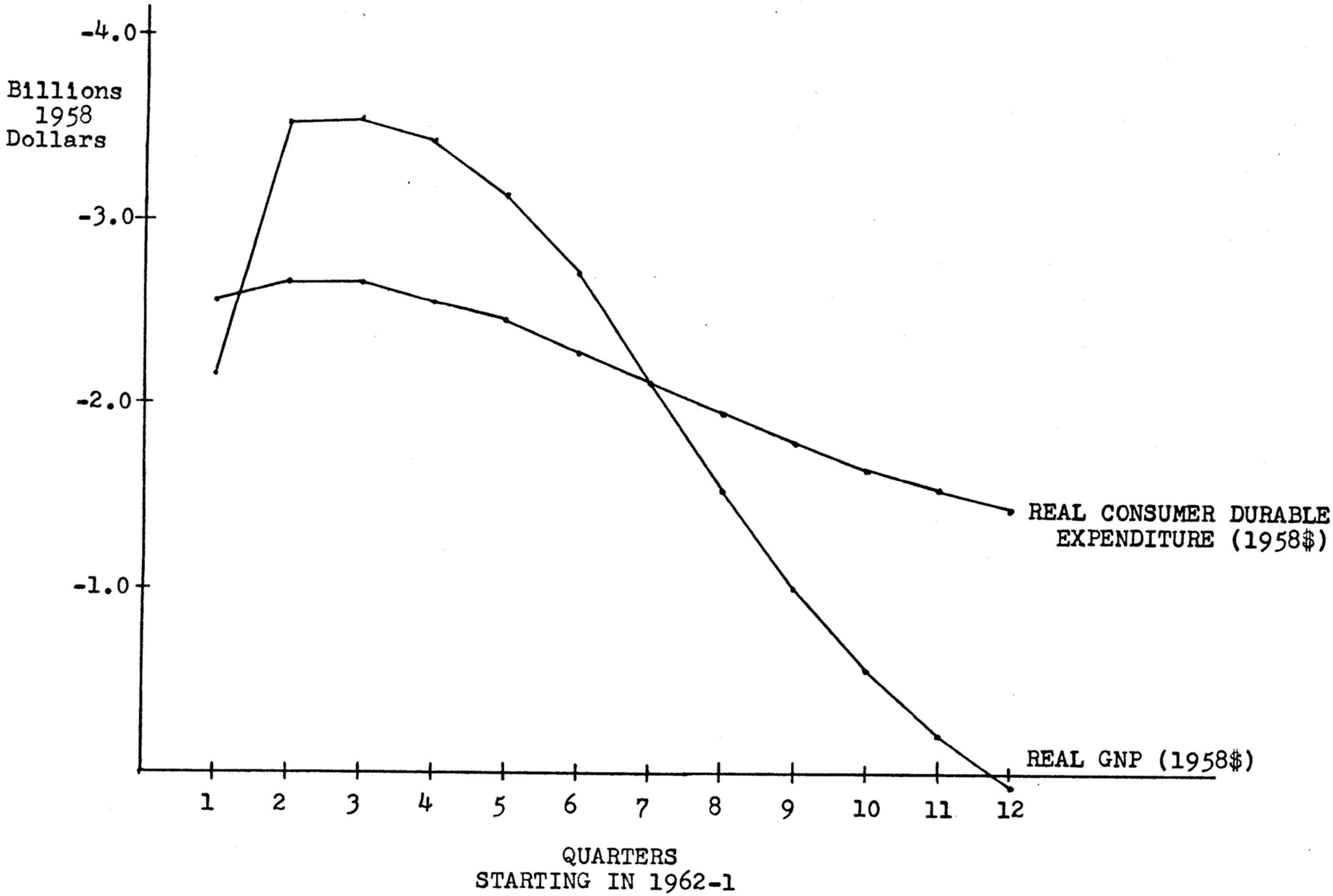
11 Also called the stock adjustment mechanism.

12 See Modigliani (1971) for further explanation of this point.

FIGURE 2
RESPONSE OF DEMAND TO AN EXOGENOUS CHANGE IN HOUSEHOLD LIABILITIES

Household Liabilities Increased Ten Billion at the Beginning of 1962-1

(Sign Reversed)



Real System Response to a Change in the Value of Stock Market Financial Assets

In the simulation model used here there are two primary channels through which a change in the value of stock market assets could affect aggregate demand. In the MPS model the consumption equation is based on the "life-cycle hypothesis of saving" of Ando and Modigliani (1963). Consumption is a function of net wealth and a distributed lag on disposable income. Changes in the value of stock market assets cause a corresponding change in net wealth and hence cause changes in consumption. The liquidity hypothesis also postulates that changes in the value of stock market assets affect consumer durables expenditure through the consumer durables financial assets channel. The liquidity financial assets channel differs from the net wealth channel in that it is derived from a model where the composition of the balance sheet, and not just its overall net characteristics, is critical to the consumer's spending decisions. Both the consumption net wealth and consumer durables financial assets channels contribute to the overall stock market effects on aggregate demand.

Figures 3 and 4 show the results of dynamic simulations where the value of households' stock market financial assets is exogenously increased fifty billion dollars over its historical values at the beginning of 1962-1. Appearing in both figures are simulation results with "liquidity effects" -- the consumer durable household liabilities and financial asset effects which are implications of the liquidity hypothesis -- included and excluded from the simulation model. The liquidity effects are excluded from the simulation model by exogenously setting the house-

FIGURE 3
RESPONSE OF REAL CONSUMER DURABLE EXPENDITURE TO AN EXOGENOUS CHANGE IN THE VALUE OF STOCK MARKET ASSETS

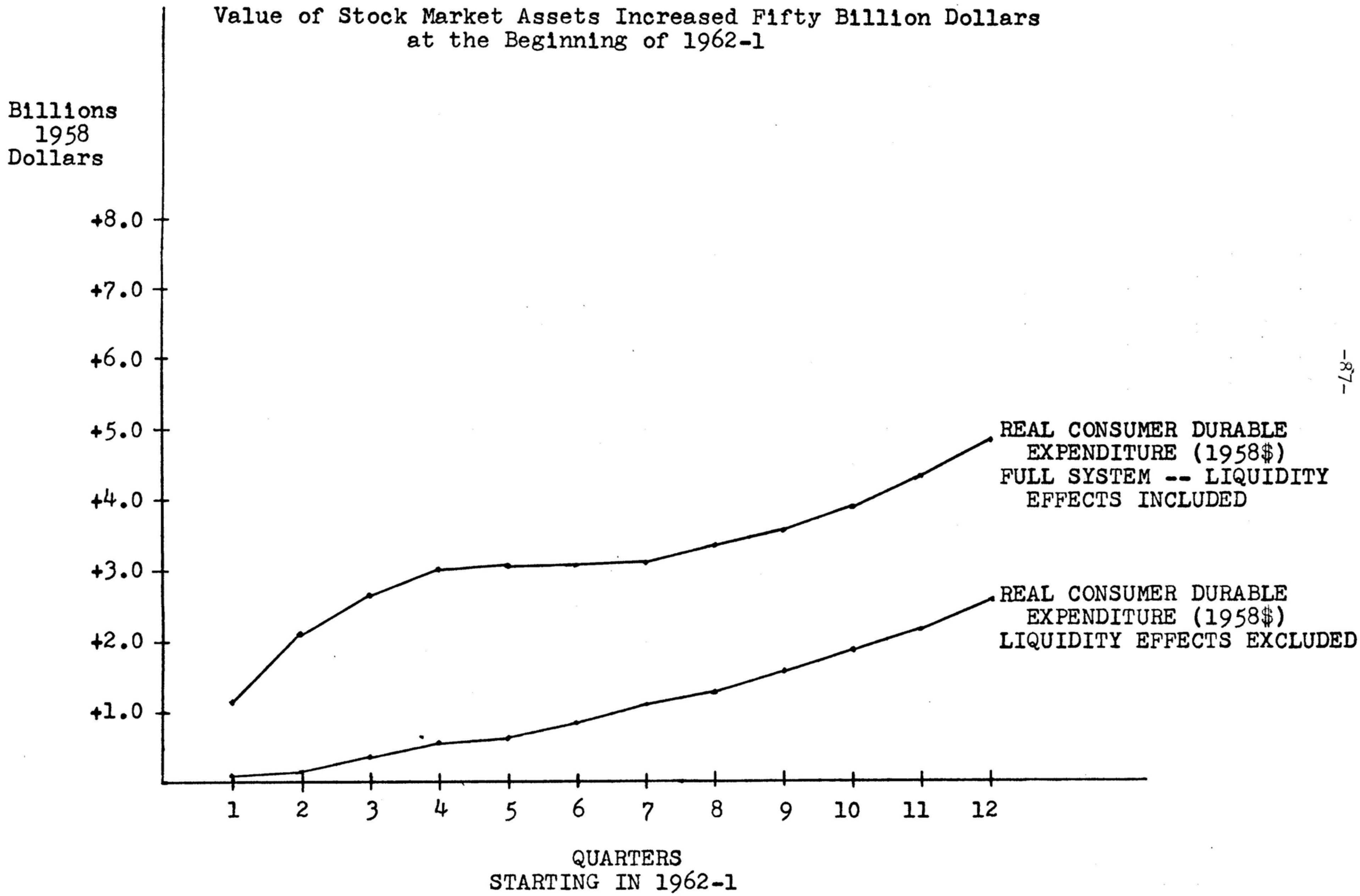
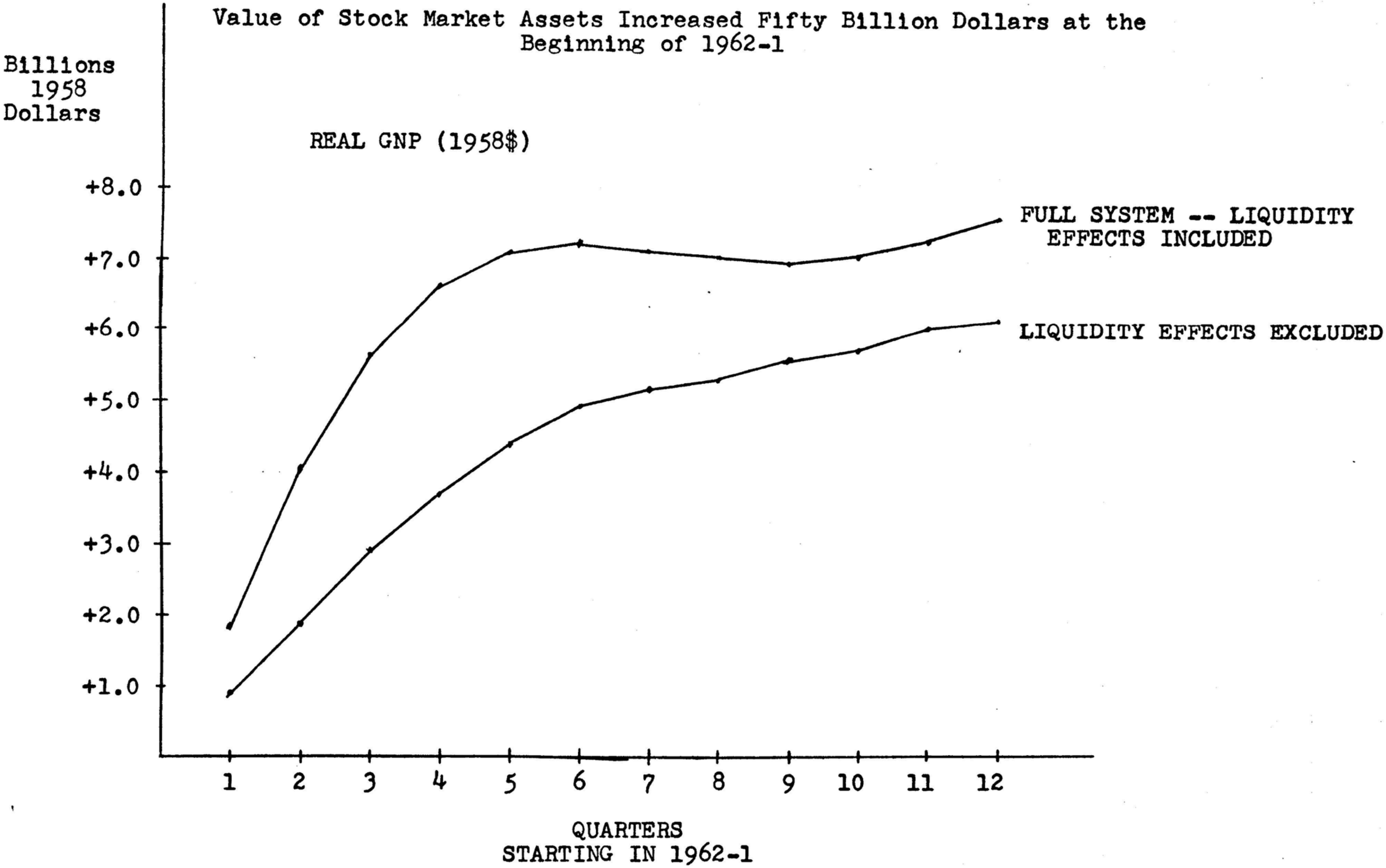


FIGURE 4
RESPONSE OF REAL GNP TO AN EXOGENOUS CHANGE IN THE VALUE OF STOCK MARKET ASSETS



hold liabilities and household gross financial assets, both stock market and non-stock market, at their historical values in the consumer durables equation.[13]

When the liquidity effects are included in the model, the fifty billion dollar increase in the value of stock market assets leads to a strong and steady rise in real consumer durable expenditure; it rises rapidly to three billion dollars by the fourth quarter, then rises more slowly until the eighth or ninth quarter and then rises more rapidly again. When the liquidity effects are excluded, the increase in real consumer durable expenditure is much smaller, especially in the early quarters. The impact of changes in common stock valuation on consumer durable expenditure reaches its peak by the fourth quarter when consumer durable expenditure is two and a half billion dollars above the simulation values where liquidity effects are excluded. This occurs because as consumer durable expenditure increases, net investment in real assets rises. This leads to a rise in household liabilities which then has a depressing effect on consumer durable expenditure which counteracts the stock market financial assets effect.

Real GNP responds strongly and rapidly to the increased value of stock market assets with the liquidity effects included in the simulation model; within a year the increase in real GNP has almost reached a plateau of seven billion dollars. The response to the rise in the valuation of stock market assets is smaller and most importantly slower when the liquidity effects are excluded. In the first two quarters over half the stock market effects are generated by the consumer durables financial assets channel. This results from the coefficients on stock market assets in

13 With the liquidity effect excluded the consumer durables equation

the liquidity consumer durables equation being larger in the first few lag quarters than in the MPS consumption function, which is the other channel for stock market effects.[14] The percentage of the total stock market effect that stem from the liquidity channels diminishes over time as household liabilities build up and choke off some consumer durables demand.

In 1962-1, stock market financial asset holdings were a little under 500 billion dollars, while real GNP was approximately 550 billion 1958 dollars. Therefore, a ten percent drop in the value of stock market financial assets when the money supply is held constant leads to a decline in real GNP of over one percentage point.

III.

FULL SYSTEM RESPONSE TO CHANGE IN FISCAL AND MONETARY POLICY

Information on stabilization policy and the relative importance of the monetary channels discussed above can be obtained through dynamic simulation experiments where all these channels interact. So-called monetary and fiscal policy multipliers will be calculated by comparing historical control simulations to simulations where one policy variable is shifted from its historical path.

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13 (continued) is very similar to the original MPS consumer durables equation that was replaced. Hence, the "liquidity effects excluded" simulation experiments will have characteristics very similar to simulation experiments with the 1973 version of the MPS model.

14 The consumer durable lag coefficients on stock market assets starting with the current quarter and going back are: .0231, .0173, .0121, .0074, and .0034. The consumption equation lag coefficients on stock market assets are: .016421, .012742, .009540, .006788, .004503, .002684, .001327 and .000425.

Money Supply Multipliers

There are many possible choices of the appropriate policy variables for monetary policy.[15] The money stock -- demand deposits plus currency -- is used as the policy variable here, because much of the discussion of monetary policy centers on changes in the money stock. In any case, the conclusions from this simulation study would not be appreciably different if other variables were chosen as the exogenous policy variables. As in the previous simulations, tax rates and Federal expenditure in real terms will be set at their historical values.

The multipliers found in Figures 5, 6 and 7 were obtained from simulations where the money stock was raised one billion dollars in 1962-1 and raised two billion dollars above its historical level thereafter. As in Modigliani (1971), this particular pattern was chosen to avoid problems of rounding errors and risk premium effects.[16] The multipliers, with and without the "liquidity effects," per billion dollar change in M1 starting in 1962-2 are found in Figures 5 and 6. The presence of liquidity effects leads to a faster response of real and nominal GNP to monetary policy; by the fourth quarter the monetary policy multipliers are twenty percent higher when the liquidity effects are operating. By the ninth quarter the money multipliers are higher for the simulations where the liquidity effects have been excluded.

15 Money supply, unborrowed base, unborrowed bank reserves, the discount rate, the Treasury Bill rate, etc.

16 See Modigliani (1971), pages 46-48.

FIGURE 5

RESPONSE OF GNP TO AN EXOGENOUS CHANGE IN THE MONEY STOCK

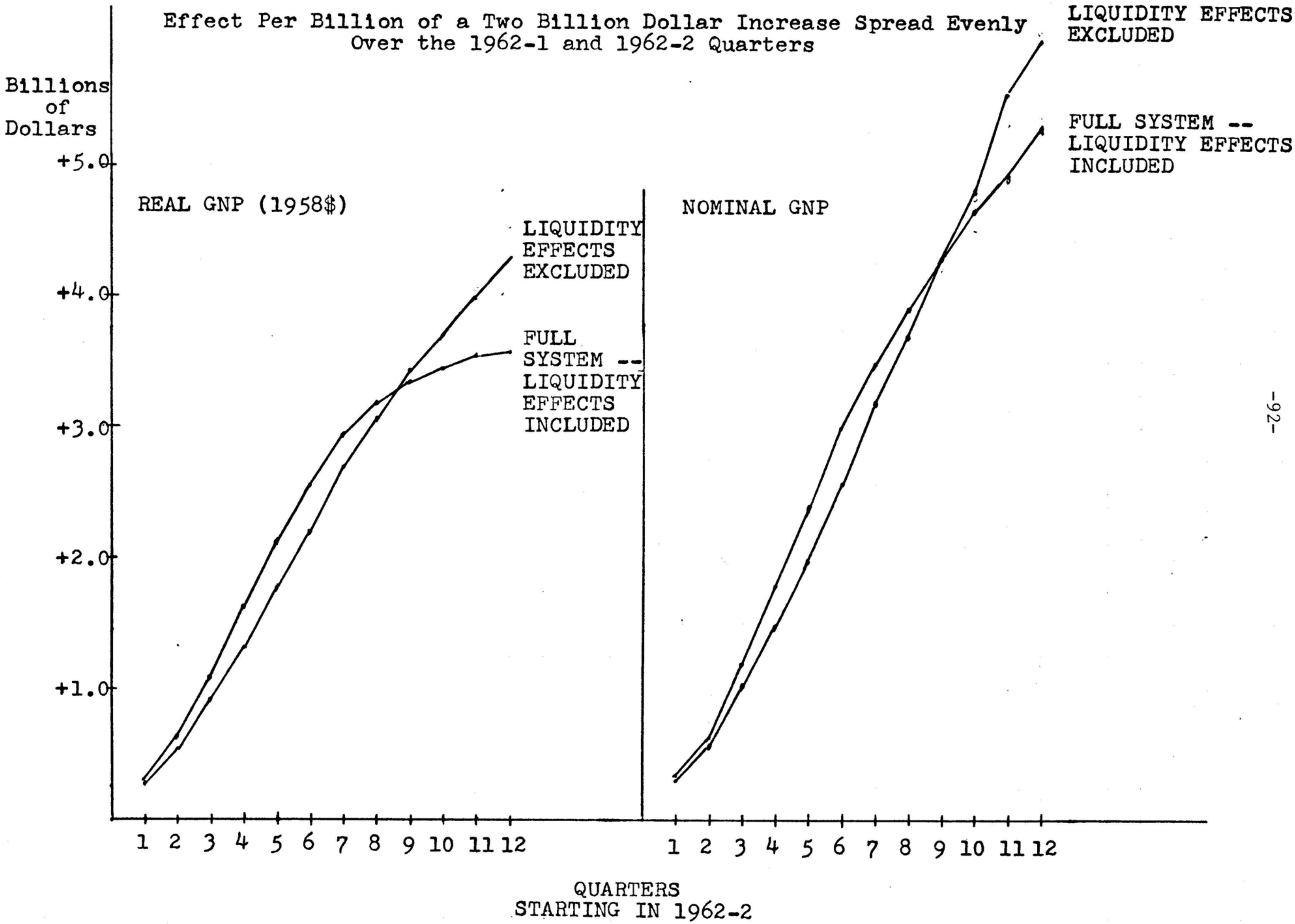


FIGURE 6

RESPONSE OF REAL CONSUMER DURABLE EXPENDITURE TO AN EXOGENOUS CHANGE IN THE MONEY STOCK

Effect Per Billion of a Two Billion Dollar Increase Spred Evenly Over the 1962-1 and 1962-2 Quarters

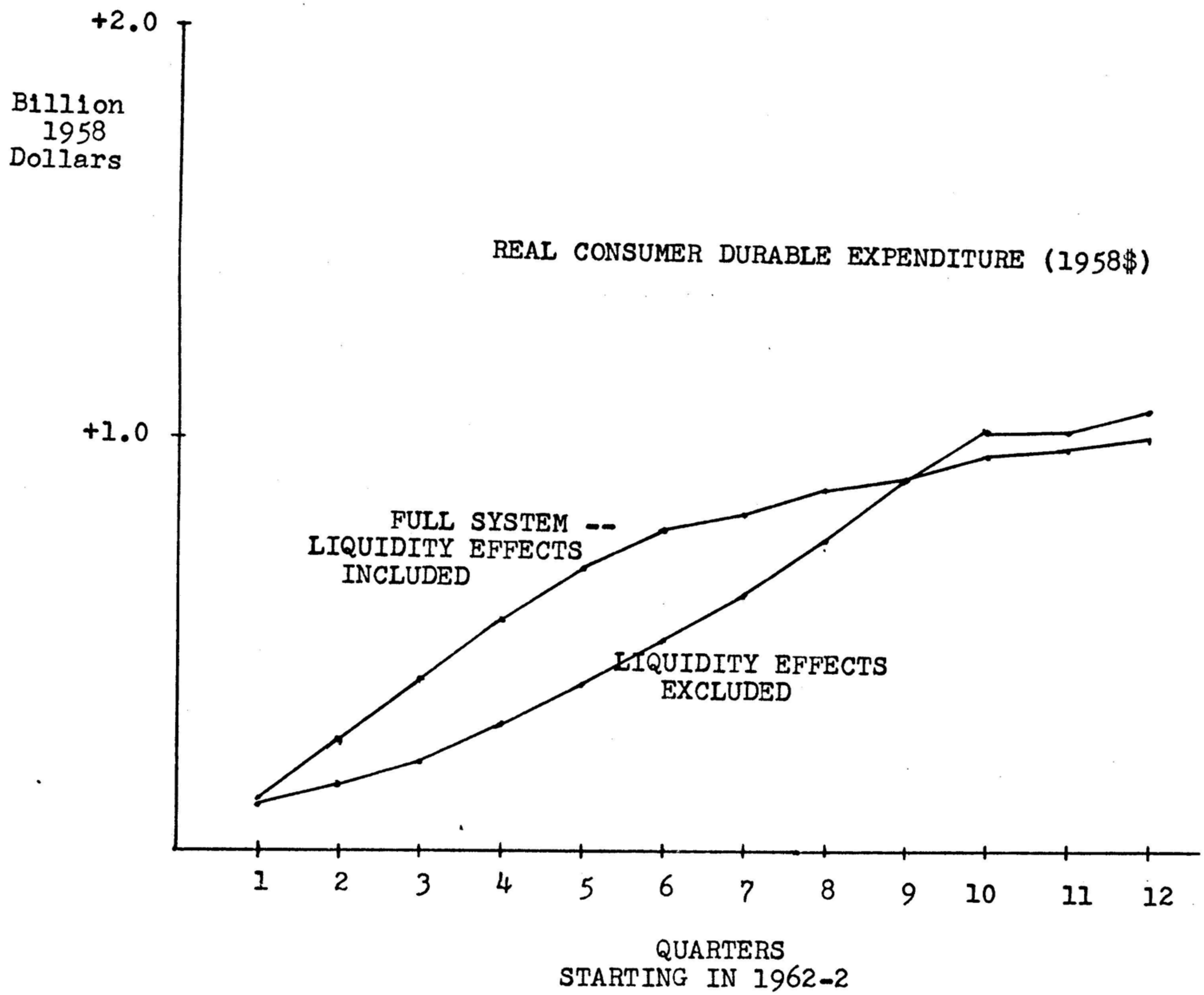
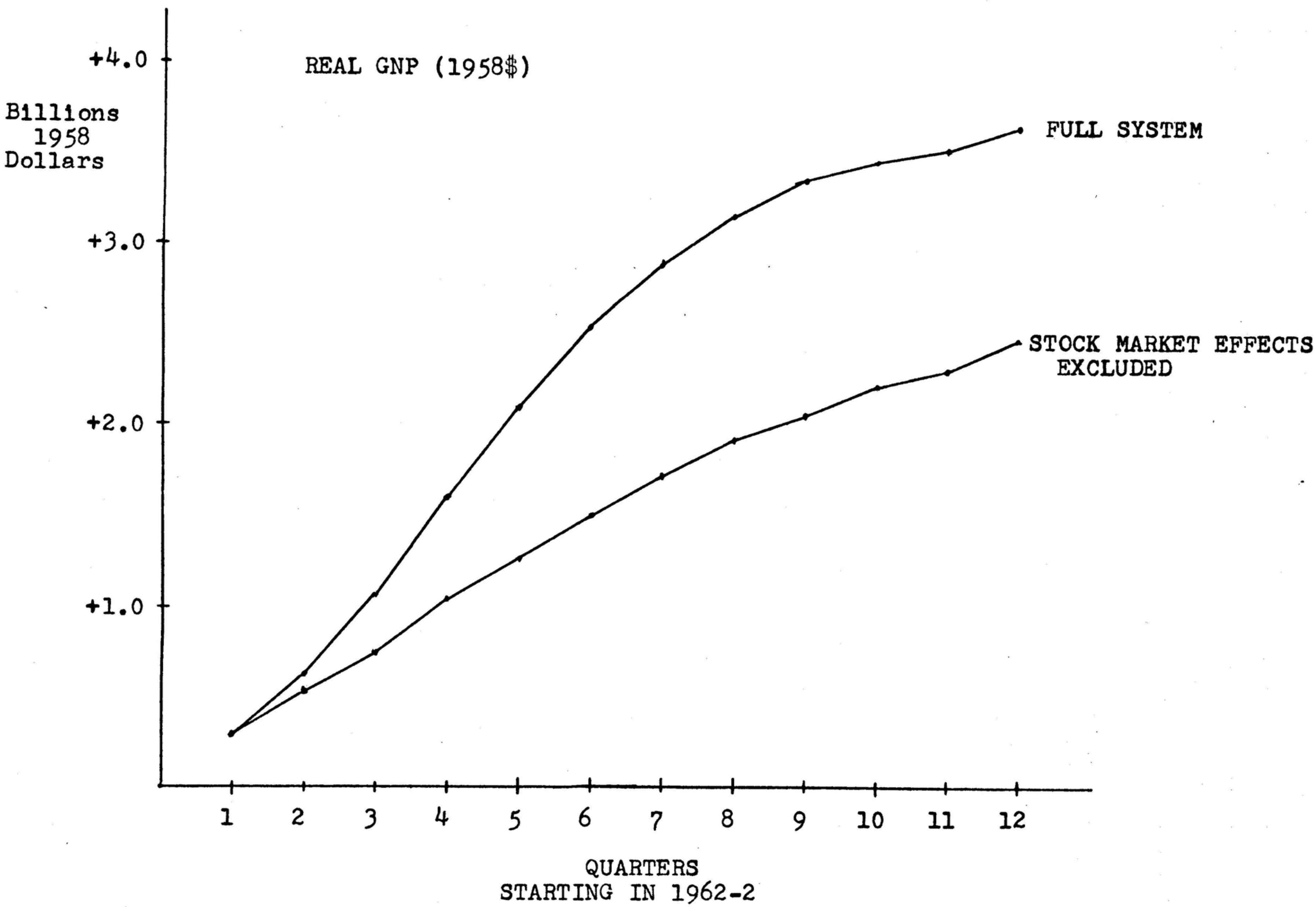


FIGURE 7

COMPARISON OF REAL GNP MONEY-MULTIPLIERS WITH AND WITHOUT STOCK MARKET EFFECTS

Effect Per Billion of a Two Billion Dollar Increase Spread Evenly Over the 1962-1 and 1962-2 Quarters



The liquidity channels of monetary policy thus first significantly strengthen the impact of monetary policy and then weaken the impact. Viewing the response of real consumer durable expenditure to the change in the money stock, as pictured in Figure 6, clarifies this phenomenon. Increased money stock results in a drop in the long-term bond rate and a rise in the value of stock market assets which improves consumers' financial positions; this stimulates consumer durables purchases. This increase in durables expenditure plus the increase in housing expenditure stimulated by easier money leads to higher net investment in real assets and thus a higher stock of consumer liabilities. By the ninth quarter, consumer liabilities have increased to such an extent that the liabilities effect completely counteracts the consumer durables financial assets effect. Consumer durables expenditure is now lower than in the case where liquidity effects are absent. The liabilities effect continues to grow over time and this lowers the money multiplier further relative to the "liquidity effects excluded" case.

The consumer durables interest rate channel of monetary policy is of some importance, although the effect on GNP from this source is not particularly strong. The long-term corporate bond rate drops six basis points per billion dollar increase in the money stock. Previous simulation experiments would indicate that this change in the interest rate would only have a .2 billion dollar effect on real GNP.[17] In contrast, with the same monetary stimulus the stock market asset effects,

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17 In the interest rate simulation experiments, a change of one basis point leads to a maximum effect on real GNP of .033 billion 1958 dollars. Six times the .033 figures gives the .2 billion figure mentioned above.

over half of which come through the consumer durables financial assets channel, have over a one billion dollar impact on real GNP within a year and a half. This can be seen by a comparison of the money supply multipliers with and without the stock market effects; these are found in Figure 7. Stock market effects are excluded from the model by setting the dividend-price ratio at its historical level in both the control and multiplier simulations. This effectively cuts the link between monetary policy and changes in the valuation of households' stock market financial assets. By the twelfth quarter household liabilities have risen by one and a half billion dollars per billion dollar increase in the money stock; this would lead to approximately a half billion dollar maximum decrease in GNP as indicated by earlier simulation experiments.[18]

Although the consumer durables interest rate channel of monetary policy does have a role to play in determining aggregate demand, its importance is overshadowed by the liabilities and financial assets effects which are implications of the liquidity consumer durables model.

Expenditure Multipliers

A primary concern of monetary economists is the "crowding out" effect. In this view, increased government expenditure with no accomodating monetary policy results in tight money which then "crowds out" private borrowers from the credit markets. The resulting drop in private expenditure

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18 In the household liabilities simulation experiments, a change of one billion dollars of liabilities would lead to a maximum decrease in real GNP of .36 billion dollars. One and a half times the .36 value gives the .5 billion figure given above.

leads to a zero net effect on aggregate demand. Much Keynesian theory supports the existence of the crowding out phenomenon, and it is indeed a feature of the MPS model.[19] The critical question for stabilization policy is the length of time it takes for crowding out to eliminate the fiscal policy effects on aggregate demand. Simulation experiments conducted here shed some light on this issue, and furthermore, indicate that the liquidity effects play an important role in the transmission of crowding out.

Figures 8, 9, and 10 give the results of simulation experiments where exports in real terms are increased ten billion 1958 dollars over their historial values starting in 1962-1.[20] The non-accomodating monetary policy necessary to discussion of the crowding out effect is achieved by exogenously setting the money supply at its historical value in both the control and non-control simulations.

Figures 8 and 9 show the multipliers per billion dollars of expenditure change when the liquidity effects are included and when they are excluded from the simulation model. Real GNP's pattern of response to a fiscal stimulus is quite different under the two regimes. When the liquidity effects are operating the real GNP multiplier quickly reaches its peak response of close to two by the sixth quarter and declines thereafter. In contrast, the multiplier without liquidity effects has not yet reached its peak by the twelfth quarter when it is over forty percent larger than the "liquidity effects included" multiplier. The real consumer durable

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19 See Ando (1974) and Modigliani (1971).

20 Exports are used in these experiments because they are a pure measure of expenditure and avoid the many problems of definition when government expenditures are used.

FIGURE 8
RESPONSE OF GNP TO AN EXOGENOUS CHANGE IN EXPENDITURE

Effect Per Billion of a Ten Billion Dollar Increase in Real Exports in 1962-1

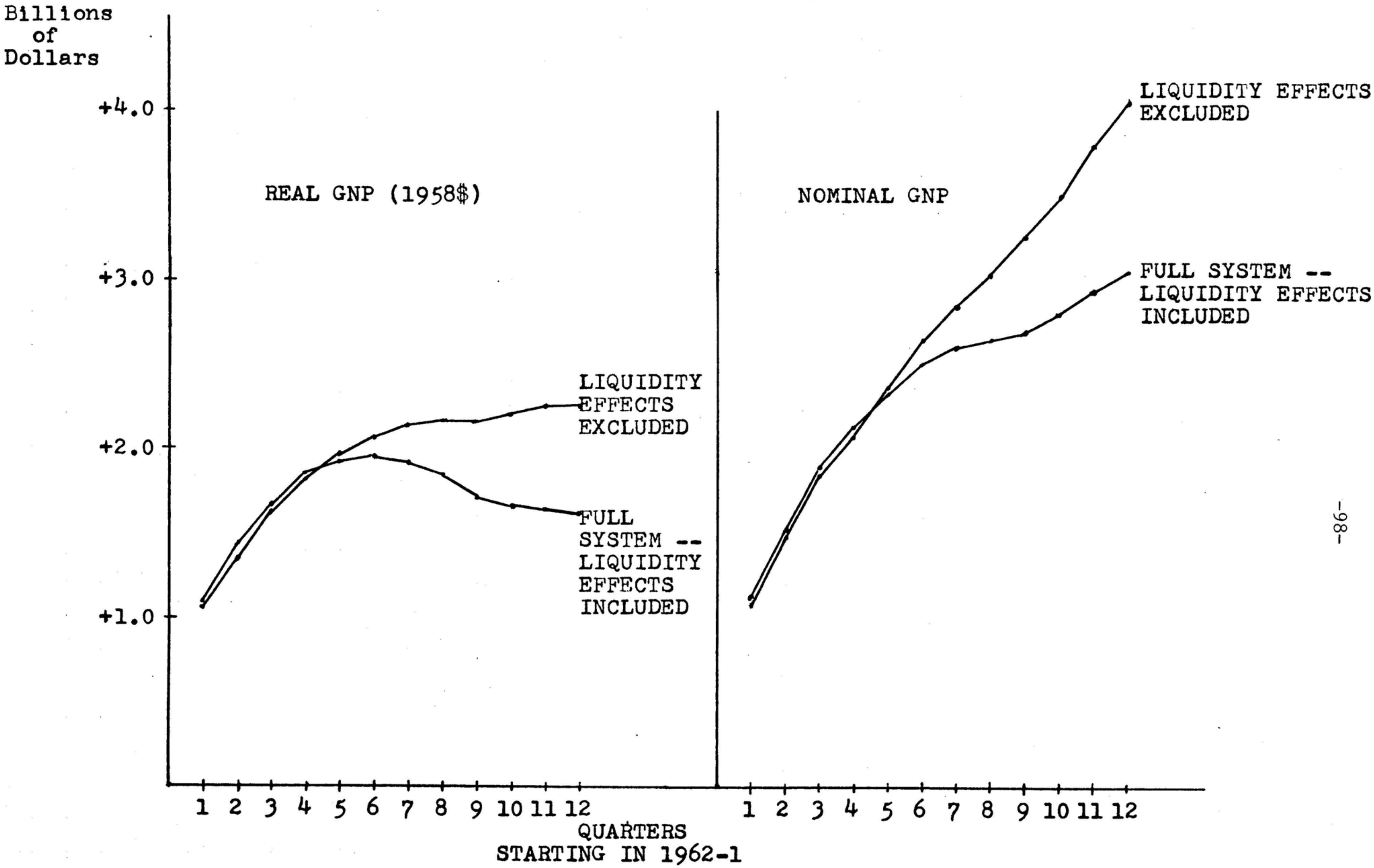


FIGURE 9
RESPONSE OF REAL CONSUMER DURABLE EXPENDITURE TO AN EXOGENOUS INCREASE IN EXPENDITURE

Effect Per Billion of a Ten Billion Dollar Increase in Real Exports in 1962-1

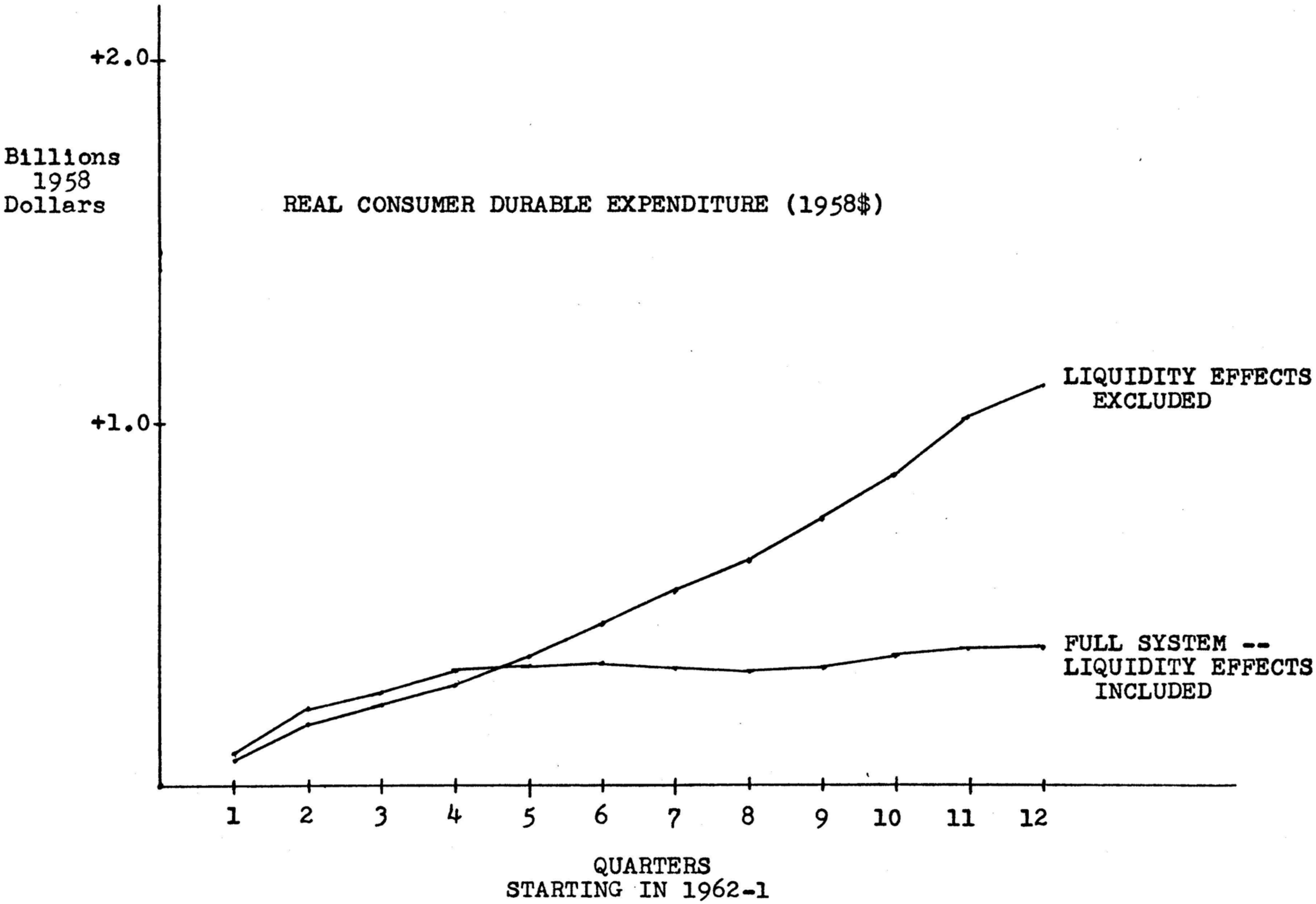
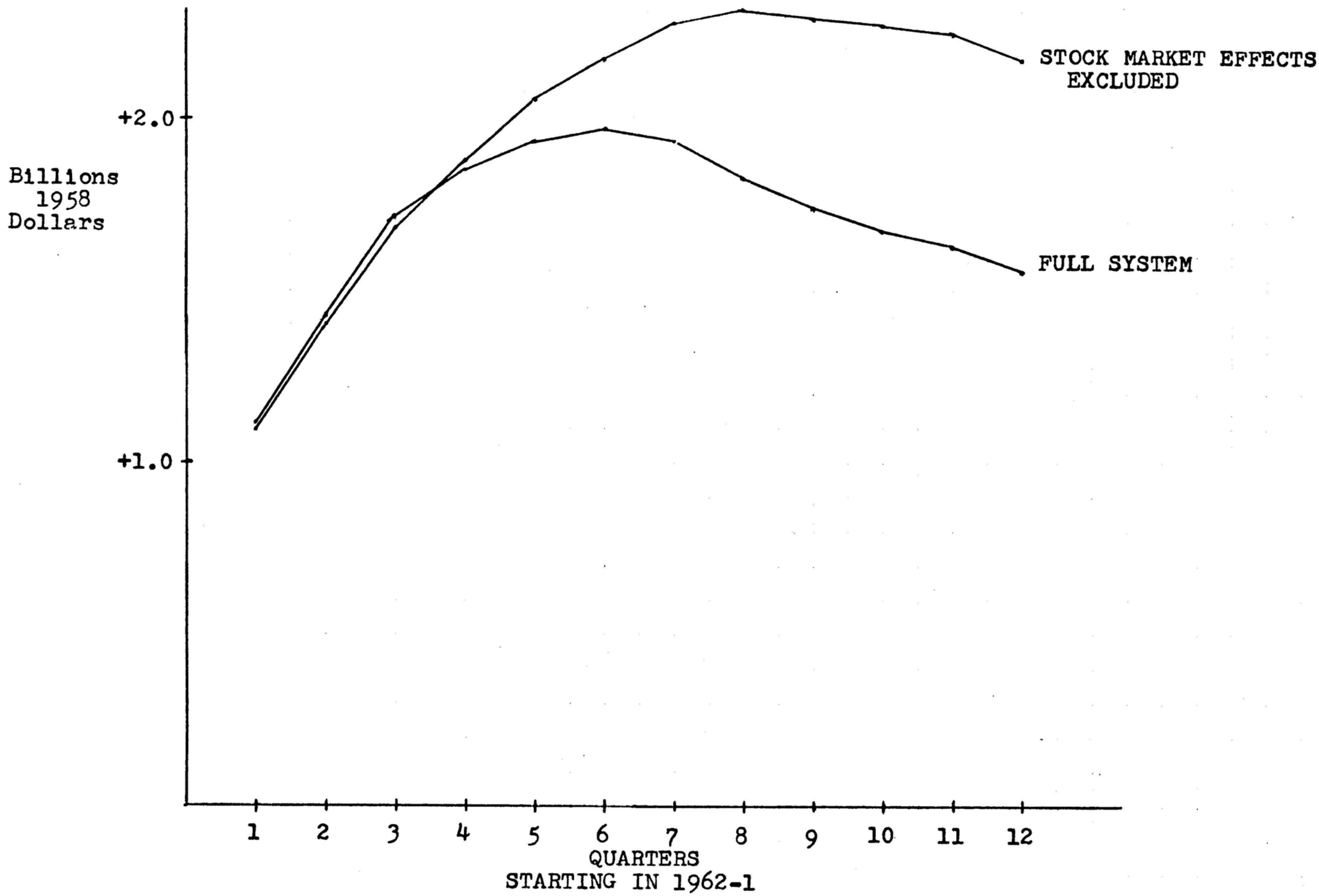


FIGURE 10

COMPARISON OF REAL GNP EXPENDITURE-MULTIPLIERS WITH AND WITHOUT STOCK MARKET EFFECTS

Effect Per Billion of a Ten Billion Dollar Increase in Real Exports in 1962-1



expenditure multipliers found in Figure 9 show that the difference in the GNP multipliers is almost entirely due to the different response of consumer durable expenditure when liquidity effects are present or when they are absent.

The liquidity channels are especially important in the crowding out mechanism because, contrary to the money supply multiplier case, the consumer durables financial assets and liabilities effects complement rather than oppose each other. The increase in export expenditure results in higher interest rates and hence a decline in the valuation of stock market assets which inhibits consumer durable expenditure. The expansionary fiscal stimulus also stimulates net investment in real assets and thus increases household liabilities. This too inhibits purchases of consumer durables. The importance of both the consumption and consumer durables stock market effects becomes apparent in Figure 10, which shows GNP multipliers for the full system -- i.e., the liquidity effects are included -- and for the case where all stock market asset effects are excluded by setting the dividend-price ratio at historical values. By the twelfth quarter, the stock market assets effects contribute to a thirty percent decline in the expenditure multiplier.

IV.

SUMMARY AND CONCLUDING REMARKS

There are several conclusions that can be drawn from the simulation study presented in this chapter.

1. The liquidity effects are important channels of monetary policy. They substantially strengthen the response of aggregate demand to

monetary policy in the early quarters while they weaken the response after the eighth quarter.

2. The traditional consumer durables interest rate channel of monetary policy does play some role in the determination of aggregate demand; yet, the consumer durables financial assets and liabilities mechanisms, which are feature of the liquidity consumer durables model, are more important in the transmission of monetary policy effects.

3. The consumer durable liquidity effects are key mechanisms in the crowding out phenomenon. As a result of the liquidity channels, with non-accomodating monetary policy the peak response of real GNP to fiscal policy stimulus occurs sooner and is substantially smaller.

4. Changes in the valuation of households' stock market financial assets have even more pronounced effects on aggregate demand as a result of the financial assets liquidity effect. Changes in common stock prices may have far greater impact on the business cycle than changes in the interest rates. This then gives a further reason for considering interest rates as a misleading macroeconomic indicator.[21]

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21 This is especially critical in a period such as the last two quarters of 1974.

APPENDIX TO CHAPTER FIVE

EXTRA EQUATIONS NEEDED TO CLOSE THE SIMULATION MODEL

Household Liabilities

The household liabilities equation is modeled with the generalized stock-adjustment concept of Zellner (1960), and Watts and Tobin (1960).[22] Debt is just one more asset in the consumer's portfolio. Consumers have a desired stock of debt to which they adjust only slowly; hence the change in debt in any period is only a fraction of the gap between the desired stock of debt and the actual stock at the beginning of the period. In addition, the change in debt is affected by other adjustments in consumers' portfolios. More specifically:

$$\text{A1)} \quad \Delta DEBT = \lambda_D(DEBT^* - DEBT_{-1}) + \Sigma\lambda_i(K_1^* - K_{i-1}) + \varepsilon_A$$

where,

$DEBT$ = household liabilities -- end of quarter,

$\Delta DEBT$ = change in household liabilities

K_i = stock of the i^{th} asset -- end of quarter,

and * denotes desired stock while the numbered subscripts refer to the time period.

Consumers hold four assets in addition to debt: money (demand deposits plus currency); time deposits at commercial banks; savings deposits at non-bank financial intermediaries -- i.e., the savings and

22 This approach has been used previously in studies of consumer debt by Motley (1970) and by Dunkelberg and Stafford (1971).

loans and mutual savings banks; and real assets (consumer durables and residential housing).[23] The desired stock of money, time deposits, savings deposits and debt are functions of permanent income and interest rates. Linearizing

A2) $$M^{*} = a + bY_p + cR + \varepsilon_B$$

A3) $$TD^{*} = d + eY_p + fR + \varepsilon_C$$

A4) $$S^{*} = g + hY_p + jR + \varepsilon_D$$

A5) $$DEBT^{*} = m + nY_p + pR + \varepsilon_E$$

where, Y_p = permanent income,

R = interest rate,

M = money balances -- demand deposits plus currency,

TD = time deposits are commercial banks (excluding large CD's),

S = savings deposits at S+L's and mutual savings banks,

$\varepsilon_B, \varepsilon_C, \varepsilon_D, \varepsilon_E$ = additive error terms.

In the modern literature on durable goods (real assets) the consumer derives benefits from the flow of services from the stock, not from the flow of purchases. The demand for real consumer assets is then modeled with a standard stock-adjustment formulation where the stocks of real

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23 Subscripts which identify the asset in question are as follows: M for money, TD for time deposits, S for savings deposits, D for debt, and R for real assets.

assets adjust only slowly to their desired levels.[24] Therefore:

A6) $$NI_R = (K_R - K_{R-1}) = \mu_R(K_R^* - K_{R-1}) + \varepsilon_F$$

where, NI_R = net invesment in real assets = end of quarter stock of consumer durables and single family housing minus beginning of quarter stock of these assets.

K_R = stocks of real assets

μ_R = adjustment coefficients

ε_F = addition error term

Solving for $K_R^* - K_{R-1}$

A7) $$(K_R^* - K_{R-1}) = NI_R/\ _R - \varepsilon_F/\mu_R$$

Substituting 2-5 and 7 into equation 1 we have the form of the model to be estimated

A8) $$\Delta DEBT = (a\lambda_M + d\lambda_{TD} + g\lambda_S + m\lambda_D) + (b\lambda_M + e\lambda_{TD} + h\lambda_S + n\lambda_D)Y_P$$
$$+ (d\lambda_M + f\lambda_{TD} + j\lambda_S + p\lambda_D)R - \lambda_D DEBT_{-1} - \lambda_M M_{-1}$$
$$-\lambda_{TD} TD_{-1} - \lambda_S S_{-1} + \lambda_R/\mu_R\ NI_R + u$$

where, u = additive error term = $\varepsilon_A + \lambda_M\varepsilon_B + \lambda_{TD}\varepsilon_C + \lambda_S\varepsilon_D + \lambda_D\varepsilon_E - \lambda_R/\mu_R\ \varepsilon_F$

24 See Harberger (1960).

Using equation 7 to derive 8 rather than substituting for K_R^* provides more information on the disequilibrium of desired and actual stocks of real assets. It also avoids the problem of determining the appropriate specification for the desired real assets stock.

This model is estimated with quarterly data from the period 1954-1 to 1973-4.[25] All quantities (except interest rates) are in real per capita terms (thousands of 1958 dollars per capita) with the DEBT and NI_R flows as seasonally adjusted quarterly rates while Y_P is a seasonally adjusted annual rate. The interest rate of residential mortgates is used in estimation to reflect the interest cost of liabilities and the opprotunity cost of holding money, time deposits and savings deposits.

Ordinary least squares (OLS) estimations of equation 8 would result in biased parameter estimates. Equation 8 is just one of many equations in a simultaneous system; hence OLS would lead to least squares bias. Further, ε_F and the right-hand-side variable NI_R -- net investment in real assets -- are correlated, thus violating the OLS assumption of zero correlation between the error term and the explanatory variables. To assure consistent parameter estimates, equation 8 is estimated with an instrumental variables technique.[26]

25 M1 and the total stock of time deposits (excluding large CD's) and savings deposits are used in estimation rather than household holdings of these assets. The Flow of Funds Accounts indicate that households hold sixty percent of M1, and over ninety percent of time deposits (excluding 's) and savings deposits at non-bank financial intermediaries. The correlation of the houshold and more inclusive measures of these financial assets is very high as well, so that parameter estimates would not be much affected by use of the more inclusive measures.

26 The instruments used are as follows: unborrowed reserves at member banks plus currency outside of banks, the discount rate, exports, federal government expenditures, the effective rate of personal income tax, the price of farm commodities, the price of imports, these seven variables lagged one period, the constant term and population.

In the resulting estimates the interest rate term enters insignificantly.[27] This variable is thus dropped from the model and the following estimates are the result.

A9)

$$\Delta DEBT = \underset{(1.55)}{.1044} + \underset{(2.82)}{.0337}\, Y_P - \underset{(-4.38)}{.0933}\, DEBT_{-1} - \underset{(-2.10)}{.1595}\, M_{-1}$$

$$- \underset{(-.79)}{.0373}\, TD_{-1} + \underset{(1.20)}{.1421}\, S_{-1} + \underset{4.43)}{1.1960}\, NI_R + u$$

$R^2 = .8500$ Standard Error $= .004152$ Durbin-Watson $= 2.27$

Asymptotic t-statistics are in parentheses.

The estimated model with many of its coefficients significant at the one percent level is quite satisfactory. As indicated by the NI_R coefficient which is significant at one percent, consumers do increase their liabilities in trying to build up the stocks of their real assets to desired levels as would be expected. As mentioned in the text, this is a critical property of the household liabilities equation in the simulation experiments. Over nine percent of the discrepancy between the desired and actual level of debt is made up within the quarter; this is an annual adjustment rate of over thirty percent. Increased income does lead to significantly larger debt holdings. Further discussion of the properties of this equation and the interpretation of the coefficients can be found in Mishkin (1975c).

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27 Its asymptotic t-statistic was only .23.

28 The generalized stock-adjustment model used in developing the debt equation does have some undesirable aspects. The model does not deal with life-cycle effects on the accumulation of debt. This problem might be especially severe in estimation on aggregate data, because the distribution of age, income and wealth in the economy might have important implications for the pattern of aggregate debt accumulation during the business cycle. Furthermore, life-cycle effects coupled with imperfections in consumer loan markets might indicate that the cons-mer's desired level of debt is directly affected by his stock of real tangible assets, a possibility not allowed for in the generalized stock-adjustment model, and might also indicate that the portfolio adjustment process is different from that postulated by the generalized stock-adjustment model. Further research should be devoted to these issues, especially considering the importance that changes in household liabilities appear to have on aggregate demand.

Household Financial Assets

Household non-stock market gross financial assets identically equals the sum of household liabilities and households' non-stock market net financial wealth.

A10) FIN\$ = DEBT\$ + NFIN\$

where

GFIN\$ = nominal household non-stock market gross financial assets,

NFIN\$ = nominal household non-stock market net financial wealth,

DEBT\$ = nominal household liabilities,

and these stocks are end of quarter figures.

NFIN\$ is endogenized by use of a perpetual inventory method; current financial saving, which is approximated by subtraction of personal consumption expenditures and expenditures on residential housing from disposable income, is added to last quarter's NFIN\$ to get this quarter's NFIN\$. This procedure cannot capture all changes in non-stock market net financial wealth, so an exogenous discrepancy term is added in computing NFIN\$.[29]

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29 This is the procedure used in the MPS model in the non-stock market net wealth equations.

A11) $NFIN\$ = NFIN\$_{-1} + (YD\$ - EPCE\$ - EH\$)/4.0 + VFIN\$$

where subscripts refer to time period and

YD\$ = nominal disposable income at annual rates,

EPCE\$ = nominal personal consumption expenditures at annual rate,

EH\$ = nominal expenditures on residential housing at annual rate,

VFIN\$ = discrepancy term.

Equations 10 and 11 are used in calculating household non-stock market gross financial wealth. The stock market household financial asset variable is generated in the MPS model.

Permanent Income and Transitory Income

Permanent income per capita is computed using the procedure outlined in Darby (1972). As in Darby, a speed of adjustment of .1 per quarter is used.

A12) $Y_P = .1*YD + .0(1.00164 + .000082425*TIME)*Y_{P-1}$

where,

Y_P = permanent income per capita (1958\$),

YD = disposable income per capita (1958\$),

TIME = time trend, 1948-1 = 0.

Transitory income is just the difference between permanent income and disposable income per capita, i.e.

A13) $$Y_T = YD - Y_P$$

where

Y_T = transitory income per capita (1958\$).

CHAPTER SIX

CONCLUSIONS

This thesis has been at attempt to explore new channels through which monetary policy affects the economy. This thesis views the consumer durable as an illiquid asset which must be traded in imperfect capital markets. The illiquidity of the consumer durable asset causes a rise in the effective opportunity cost of holding the consumer durable as the consumer's probability of encountering financial distress increases. The consumer thus must take account of his income stream risk and balance sheet status -- i.e., his debt and gross financial asset position -- in determining the desired level of his consumer durables stock. This approach differs from other work in household balance sheet effects where net wealth affects consumer behavior in that the composition of the balance sheet, and not just its net characteristics, is critical to the consumer's spending decisions. A two-period mean-variance model was developed in which the illiquidity of the consumer durable asset leads to the following results: a consumer durable is a less desirable portfolio asset if (a) the consumer's debt holdings are high, (b) gross financial asset holdings are low, (c) income variance is high, or (d) expected income is low.

The implications of the "liquidity" hypothesis were tested in Chapter Three using a standard stock-adjustment model of consumer durable expenditure with postwar, aggregate quarterly time-series data. The evidence supporting the theoretical results was quite strong. The debt and financial assets terms entered significantly with the hypothesized signs in regressions for the consumer durables category and its two components, autos and parts and non-auto consumer durables; and the magnitudes of the other coefficients were quite reasonable with this specification. Comparisons with expenditure models which did not reflect the influence of consumer durable illiquidity indicated the superiority of specifications that include this effect. Further tests of the liquidity hypothesis were also carried out on a totally different sample of data in Chapter Four; nine different categories of consumer durables from 1929 to 1958 were used in this study. The results were again quite favorable to the liquidity hypothesis.

The work on the liquidity hypothesis indicates that monetary policy can affect aggregate demand through two new channels that have been previously unexplored. The consumer durables financial assets channel indicates that tight (easy) monetary policy which leads to a fall (rise) in stock and bond prices, and hence a lower (higher) valuation of gross financial assets in the community, will lead to decreased (increased) purchases of consumer durables because consumers' financial positions have deteriorated (improved).[1] The household liabilities channel indicates that easy (tight) past monetary policy which has encouraged (discouraged) the buildup of household debt holdings will eventually prove a deterrent (encouragement) to future consumer durable purchases. Simulation experiments with the MPS macro-econometric model are undertaken in Chapter Five to study the importance of the two "liquidity" channels discussed above.

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1 The financial assets channel has been important in monetary policy transmission mechanism in the MPS model, although there the effects occur through effects on consumption, rather than through effects on consumer durable expenditure.

The liquidity channels are indeed found to be important channels of monetary policy and are in fact more critical in the determination of aggregate demand than is the traditional consumer durables interest rate channel. The consumer durable liquidity effects also significantly enhance "crowding out" when the economy is stimulated by fiscal policy and lead to even more pronounced effects on aggregate demand from changes in the valuation of households' stock market financial assets.

There are several important policy implications from the analysis in this thesis. Monetary policy may be substantially stronger in the short-run as a result of monetary policy effects on the household's balance sheet. On the other hand, fiscal policy may be a less effective stabilization tool as a result of the liquidity effects which promote the "crowding out" phenomenon. The work contained here also implies that the monetary authorities should not concentrate too heavily on interest rates, or the growth in the money stock for that matter, as macroeconomic indicators. Events in other financial markets can be quite critical to the level of aggregate demand. Information on the level of household liaiblities and the valuation of households' financial asset holdings should be used by policy makers in designing effective stabilization policies.

FUTURE RESEARCH

The liquidity hypothesis developed in this thesis might throw new light on the macroeconomic events of the Great Depression period, as Chapter Four indicates, and this is the subject of current research.[2] In

2 Mishkin (1976).

addition, the liquidity hypothesis should have applications in such areas as residential housing demand and this is also the subject of further research.[3] Many producer's goods, such as inventories and producer's durables are also illiquid assets; incorporating this feature into investment models might lead to the discovery of other possible channels of monetary policy effects in our economy.

3 Kearl and Mishkin (1975).

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