

PERSONAL CONSUMPTION, PROPERTY INCOME, AND CORPORATE SAVING

by

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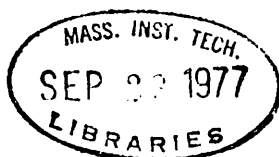
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ABSTRACT

This thesis is an empirical investigation of the relationship between U.S. personal consumption, property income (including corporate saving), and wealth.

The second chapter critiques previous work exploring the relationships between personal saving, corporate saving and government expenditures. The first section shows that the proposition that taxes are regarded by U.S. consumers as equivalent to consumption cannot be accepted. The second section finds no evidence that U.S. consumers regard corporate and personal saving as substitutes in the short run.

The third chapter develops a specification of the consumption function using labor income, property income, and wealth. It is found that there is little evidence that consumers respond to property income changes as to labor income changes or that corporate savings is treated the same as other forms of property income by consumers.

The fourth chapter develops an estimate of permanent property income based upon the hypothesis that wealth is capitalized permanent property income. It is shown that this produces propensities to consume out of various components of income in line with the generalized version of the life cycle hypothesis of saving.

Name and Title of Thesis Supervisor: Franco Modigliani,  
Institute Professor

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CHAPTER 1

INTRODUCTION

This thesis is an empirical investigation, based upon aggregate United States time series data, of certain questions concerning the determination of aggregate consumer spending.

We begin with the traditional citation from The General Theory (27, p. 96) "if  $C_W$  is the amount of consumption and  $Y_W$  is income...  $dC_W/dY_W$  is positive and less than unity." The major issues to be discussed in this thesis is how  $dC_W/dY_W$ , the aggregate marginal propensity to consume with respect to national income, varies with the composition of income. This is a question of enormous policy significance. Government tax policies (and for that matter, monetary policies) alter the composition of income, both between the private and public sectors as determined by aggregate tax collections, and within the private sector by differential taxation of different sources of income (monetary policy alters the timing and financing of capital investments and so helps determine which groups have claims to expansions in output).

This issue has hardly been ignored in the massive literature on the consumption function, but as I will attempt to show, previous empirical work has been marred by a number of errors:

1. Equations have been estimated regressing consumption on labor and property income, and the resulting coefficients have been labelled propensities to consume of "workers" and "capitalists". This approach has serious flaws. In order to

identify the estimated coefficients of the payments to factors as class propensities to consume we must assume that no laborers are capitalists, which seems absurd in advanced Western industrial societies. Also, no rationale is advanced for the differing coefficients other than some implicit observation that the "rich" save more and are "capitalists." This theory is hard put to explain a surgeon's having a higher average propensity to save than a widow living on savings.

2. An approach popular among students of U.S. consumption (Arena (4), Bhatia (5), Feldstein (17, 18)) in analyzing the effect of a non-disposable personal income component of national income on consumption is to add the new variable (usually capital gains, which is not a component of national income as usually measured) to an empirical consumption function and compare its coefficient to that of disposable personal income. The problem with this method is that no justification is usually given for the use of disposable personal income as the standard of comparison. There is no reason given why the propensities to consume out of the various pretax income and tax series that make up disposable income should be equal.
3. Some investigators, particularly Thomas Juster and Lester Taylor (see (24) and (48) and references there cited), who work in the context of the Houthakker-Taylor model of savings, have attempted to directly measure the propensities to consume out of the different components of disposable personal income. This approach has considerable merits compared to the first two in

that it is based on accepted theory and avoids the pitfall of using disposable personal income as the standard of comparison. But, as I have helped to argue elsewhere (Modigliani-Steindel, (38)) this approach has been flawed in practice by the identification of changes in components of income as permanent changes in these components.

The thesis is divided into three parts. A theme running through all three is the measurement of the importance for personal saving and consumption of the division of corporate profits into dividends (which are part of disposable personal income) and corporate saving (which is not). Corporate savings is the largest component (other than taxes and transfers) separating national and disposable personal income. In recent years it has fluctuated greatly, with a recent low of 1.7 billion dollars in 1974 and a recent high of 25.9 billion in 1972.\* While corporate saving is small relative to GNP, it provides a large fraction of the financing for net capital formation and the budget deficit in the U.S. (almost 50% in the mid 60's, but considerably less in recent years). The relevant question is how this component of national income affects the total amount of resources freed for capital formation, which is equivalent to asking about the effect of corporate savings on consumption. Chapters 2, 3, and 4 discuss increasingly more complex models of consumption and the role of property income (and corporate saving) in them.

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\* This concept of corporate saving excludes profits due to accounting conventions with regard to inventories and capital depreciation.

Chapter 2, after discussing and rejecting a conjecture advanced by David and Scadding that  $dC_W/dY_W$  is totally independent of the composition of GNP (which was made to explain the rough constancy of the private saving -GNP ratio in the U.S.) discusses previous attempts, along the lines of method 2, to add corporate saving as a variable in the consumption function. It is found that the earlier work is deficient on both theoretical and empirical grounds.

Chapter 3 discusses the implications of the division of income into the product of human and non-human capital in the life-cycle theory of consumption. Simple tests are made of the empirical relevance of this distinction, both with and without the presence of wealth in the consumption function, by dividing disposable income into property and non-property shares and adding corporate saving to property income. It is found that little can be shown by these tests - the data is such as to support almost any hypothesis about the roles of property income and corporate saving in the consumption function.

Chapter 4 derives an alternative estimator of permanent property income from existing wealth, income and interest rate data. An alternate specification of the consumption function is used which recognizes the importance of dealing carefully with the effects of government tax and transfer operations on consumer behavior. The effects of permanent income from stock market and non-stock market wealth on consumption are estimated and are shown to be broadly similar to that proposed by the life cycle model. The effect of changes in the corporate saving ratio is then discussed.



It is the contention of this thesis that the estimation of consumption is not a dead issue. Aside from the obvious practical importance of estimating consumption accurately even when no policy changes are intended, there is the issue of taking seriously the implications of the permanent income and life cycle theories as to the effect of changes in the composition of income on consumption. As Lucas noted a few years ago (28), it is easy to be led down the garden path in making policy recommendations by merely admiring the excellent fits of standard consumption functions. A small error in forecasting the effect of policy on consumption can lead to rather large errors in other policies. At least in the folklore of economists a most notorious example of this is the Federal Reserve's acceleration of monetary growth as a consequence of overestimating the effect of the 1968 surcharge in restraining consumption. A great deal of work in macroeconomics, mostly theoretical but some empirical, uses the independence of aggregate demand to the composition of national income after taxes as an implicit\* or explicit\*\* assumption. It is hoped that this thesis can help spur some rethinking of this assumption.

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\* See any typical statement of macro theory, such as Blinder-Solow (7).

\*\* Foley-Sidrauski (22), Darby (11, 12, 13).

CHAPTER 2

PERSONAL AND CORPORATE SAVING

With relatively few exceptions the empirical work on the consumption function explains consumption by disposable personal income - which is only a fraction, albeit a very sizable one, of income accruing to the private sector - and other, non-income variables such as wealth. Such equations imply that changes in the composition of private sector property income will shift the short-run consumption function, since a good deal of property income - namely capital gains and/or corporate saving - is omitted from disposable income. Then changes in the composition of property income can increase the fraction of private income saved and more resources will be available for capital formation and the financing of government deficits. If differential taxation of different sources of property income can alter the composition of property income then it can increase the fraction of income saved. It is then of obvious interest from a policy point of view - for example, if one is concerned with possible "capital shortages" - to see if aggregate saving or consumption responds to the composition of property income.

There have been few studies of the private saving-income relationship in the U.S. (Private saving is the sum of personal and corporate saving. Personal saving by the National Income Accounts definition is Disposable Personal Income less Personal Consumption Expenditures. Gross corporate saving is corporate cash flow plus inventory valuation adjustments less dividends. Gross Private Saving,

by the NIA definition, is the sum of personal saving, gross corporate saving, and non-corporate capital consumption allowances). The most provocative studies are those of Denison (15) and David and Scadding (14). Denison showed that Gross Private Saving for high income years from 1929 to 1956 could be explained very well by the equation  $S = aY^* + b\Delta Y^*$ , where  $S$  = gross private saving,  $Y^*$  = peak GNP, and  $\Delta Y^*$  = the difference between current and peak GNP. Since the composition of GNP changed greatly during this period this result suggests that private saving is not only independent of the composition of private income but also of the transfer of income from private to public hands.

David and Scadding attempted to explain the Denison result, which has been dubbed "Denison's Law," by hypothesizing:

- (A) Personal and corporate saving are perfect substitutes - meaning that all corporate cash flow is regarded as income by consumers.
- (B) Taxes are regarded as substitutes for consumption by consumers.

The result of these hypotheses is that GNP is the appropriate income variable in the consumption function and that the coefficient of taxes in the function should be -1. Assuming the equivalence of long run MPC and APC, we have Denison's Law. Table 2-1 gives the results of imposing these conditions, using the relative income specification favored by Denison and David and Scadding. Postwar annual U.S. data (1948-1974) was used. The income variables are peak GNP or Disposable Personal Income (DPI) and the change in income term is the difference

Table 2-I

Consumption Expenditures, 1948-1974 (t-statistics in parentheses)

Equation	GNP <sup>*</sup>	ΔGNP <sup>*</sup>	DPI <sup>*</sup>	ΔDFI <sup>*</sup>	Taxes	R <sup>2</sup>	SE/mean of LHS	DW	SSR
1.			.909 (375.4)	1.359 (4.381)		.9980	.0138	1.2442	593.9
2.			.951 (36.154)	1.373 (-4.564)	-.141 (-1.609)	.9982	.0138	1.6206	536.1
3.	.630 (275.2)	.208 (1.154)				.9965	.0186	.6409	1073.5
4.	.760 (41.737)	.621 (5.248)			-.622 (-7.188)	.9989	.0107	1.3551	340.5
5.	.834 (465.4)	.864 (6.100)			-1	.9989	.0111	1.1757	666.7

- 12 -

All data in billions of 1958 dollars and obtained from the 1975 Economic Report of the President (16)

between current and peak income - so it was usually zero due to the generally upward trend of income in the U.S. since the Second World War. Personal consumption expenditures was the consumption variable used. The sum of government expenditures on final goods and services plus the (algebraic) surplus is used as the tax variable. All variables are converted to 1958 dollars by the personal consumption expenditures deflator.

We can now see how well the two new propositions derived from the David and Scadding claims hold up.

In equation 4 we see that the coefficient of government revenues in the consumption function is somewhat greater than -1 when GNP is the income term. Equation 5 can be viewed as a re-estimation of equation 4 with the constraint that the coefficient on taxes is -1. An F-test comparing the two equations shows us that this constraint should be rejected at any reasonable significance level:

$$F = \frac{(666.7 - 340.5)}{340.5/24} = 22.98 \quad F_{.01}(1,25) = 7.77.$$

Comparisons of equations 1 with 3 and 2 with 4 show some weaknesses in the proposition that GNP is the proper income variable in the consumption function. Equation 4 (with GNP and taxes) has a lower standard error than equation 2 (DPI and taxes) but also has a lower Durbin Watson statistic than 2. Equation 3 (GNP alone) has a larger standard error and lower Durbin-Watson statistic than equation 1 (DPI alone).

The equations of Table 2-I have obvious flaws in testing the propositions derived from the David-Scadding claims. The LHS variable

in the estimated consumption functions is consumption expenditures, not use consumption (i.e., consumer expenditures on non-durables and services plus the implicit rental income and depreciation on durable good holdings). The specification consumption function may be disputed.<sup>\*</sup> Nevertheless, I feel that my results do show that it is unreasonable to believe that the coefficient on taxes in the aggregate consumption function is -1 when GNP is the income variable. Hence the David-Scadding hypothesis B (that personal consumption expenditures and taxes are perfect substitutes) is untenable. This is not to say that the Denison relationship does not exist or that there might not be some non-coincidental reason for it, but rather just says that the David and Scadding explanation for the relationship is not acceptable.

We see that it is not reasonable to regard consumption and taxes as substitutes. However, nothing has been demonstrated about hypothesis A—that personal and corporate savings are substitutes. There is no evidence in Table 2-I showing that GNP less taxes is an inferior variable to DPI as the income variable in the consumption function, as shown by a comparison of equation 4 (GNP and taxes) and 1 (DPI alone). Since equation 4 has a slightly better fit than 1 and the coefficient on taxes is roughly equal and opposite to that in GNP, there is some evidence

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\* The tax variable is also open to dispute. At one point David and Scadding claim that tax financed government expenditures are perfect substitutes for personal consumption (14; p. 241), but unless a surplus is regarded as an "expenditure" on debt retirement this claim does not appear to lead to Denison's Law (in a footnote on the same page the authors do claim that taxes and consumption are the substitutes).

that corporate saving policy does not affect consumption. We can express this as Hypothesis A', which is equivalent to Hypothesis A: A': The effect of corporate profits (alternatively-corporate cash flows) on consumption is independent of their composition. A follows directly from A' when we consider that an increase in the corporate saving ratio implies an equal decrease in dividends, thus an equal fall in disposable personal income (the role of taxes will be considered later). Personal saving, as mentioned above, is the difference between disposable personal income and personal consumption expenditures (the difference between personal consumption expenditures and consumption will also be considered below). By A' consumption is unchanged, so a dollar increase in corporate saving implies a dollar fall in personal saving. So A' implies A. Similarly, A implies A' (a dollar increase in corporate saving causes a dollar fall in personal saving and a dollar fall in DPI due to the fall in dividends, so consumption must be unchanged).

There are a number of works in the literature which impose A or A'. An early work was Modigliani's 1949 (33) study for the National Bureau. He estimated equations using net private saving (the sum of personal saving and undistributed corporate profits - equivalently, gross private saving less capital consumption allowances and inventory valuation adjustments) as the dependent variable and the sum of disposable personal income and undistributed profits as an independent variable. This amounts to imposing condition A'. The paper was devoted primarily to forecasting and no tests were made of A' versus any

alternate hypothesis. Spiro (44) used disposable personal income plus retained earnings as an income variable in a permanent income consumption function for the U.S. but some years later Arak and Spiro (3) reported that disposable personal income alone gave superior results, which weakens A'. Darby (11, 12, 13) has used private disposable income adjusted for depreciation as the income variable in his work on the permanent income hypothesis and the determination of consumer expenditures.

In 1971 Modigliani (34) attempted to measure the effect of corporate saving upon private saving. In a sample of 14 developed countries he found that the coefficient of the ratio of corporate saving to national income in equations explaining the fraction of national income saved was on the order of .25 and tended to be smaller than its standard error, which supports hypothesis A.

In a series of papers using annual data from Britain and the U.S. respectively, Feldstein and Fane (18) and Feldstein (17) added corporate saving as a separate variable to the consumption function. Feldstein found that in the U.S. the coefficient on corporate saving was significantly greater than zero and about  $\frac{2}{3}$  the sum of the coefficients of current and lagged disposable personal income for the period 1929 through 1966. Since dividends are a part of disposable personal income this evidence seems to support hypothesis A'.

It is worthwhile to follow Feldstein and re-examine the reasoning which leads to inserting corporate saving in the consumption function. The life cycle hypothesis of saving, as presented by Ando and



Modigliani (2), asserts that aggregate consumption is proportional to wealth plus the capitalized value of non-property income. If it is assumed that the capitalized value of non-property income is proportional to the current value we can then construct an aggregate consumption function of the form

$$(2-1) C_t = a YL_t + b W_{t-1}$$

where  $C_t$  = aggregate consumption in period t,

$YL_t$  = disposable labor or non-property income in period t,

$W_{t-1}$  = net worth at the start of period t.

The concept of consumption here is the "use" one which included expenditures on non-durable goods and services and the depreciation and implicit rental income on the current stock of durable goods.

The parameters a and b in (2-1) are in principle affected by such things as the age distribution of the population, consumer's preferences, the formation of expectations and the interest rate. Modigliani and Tarantelli (39) have argued that changes in the interest rate have a greater effect on the marginal propensity to consume out of wealth than out of labor income, and can be modelled as  $b = b_0 + b_1 r_t$ , where  $b_1$  reflects the relative strength of income and substitution effects of changes in the rate of return on the marginal propensity to consume out of wealth. For empirical purposes Modigliani has assumed that  $b_1$  can be considered near a, although in principle  $b_1$  can be negative if substitution effects outweigh income effects (Modigliani, (35)).<sup>\*</sup> Then if  $b_1 = a$ , (2-1) can be modified to give

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<sup>\*</sup> This will be discussed in greater detail in Chapter 2 below.

$$\begin{aligned}
 C_t &= aYL_t + (b_0 + b_1 r_t)W_{t-1} \\
 &= aYL_t + ar_t W_{t-1} + b_0 W_{t-1} \\
 (2-2) \quad &= a(YL_t + r_t W_{t-1}) + b_0 W_{t-1}.
 \end{aligned}$$

$r_t$  is the interest rate, so  $r_t W_{t-1}$  is property income. Disposable personal income is usually taken as a proxy for  $YL_t + r_t W_{t-1}$  (Modigliani, (35)). Disposable personal income differs from the sum of disposable labor and property income by capital gains, not corporate saving. Also, the property income term should be an expected property income term, and some account might be taken of the formation of these expectations. Suppose

$$r_t W_{t-1} = D_t + G_t^P$$

where  $D_t$  = after tax dividends and  $G_t^P$  = permanent after tax capital gains. Then (2-2) can be transformed to

$$(2-3) \quad C_t = a(YL_t + D_t) + a G_t^P + b_0 W_{t-1}.$$

$YL_t + D_t$  is disposable personal income, if we assume that the effective tax rate on capital gains is zero.

In a world of perfect certainty and no differential taxation of different sources of income, corporate saving policy should have no effect upon consumption. Corporate saving should not affect labor income, and by the Modigliani-Miller theorem (31) it will not affect the market value of corporations and so not affect net worth. Hence we have hypothesis A.

There is some recent evidence supporting (2-3) from cross sectional

data (Friend and Lieberman, (21)), but attempts to construct aggregate consumption functions of this type have not been very successful (Arena, (4); Bhatia, (6)). One reason may be the difficulty of measuring the "permanent" component of capital gains. Feldstein has suggested that the permanent component of capital gains comes from retained earnings or corporate savings, or

$$G_t = \lambda RN_t + X_t,$$

where  $RN_t$  is some measure of corporate saving,  $\lambda RN_t (=G_t^P)$  is then the "permanent" component of capital gains, and  $X_t$  is capital gains due to revaluations - changes in the rate of return. Hence, Feldstein inserts corporate saving and capital gains into the consumption function. He has estimated equations with both  $RN$  and  $G$ . The coefficient on  $G$  will then be the revaluation effect, and the effect of permanent gains will be a function of the coefficients on both  $G$  and  $RN$ . His equations are of the form

$$(2-4) \quad C_t = a(YL_t + D_t) + a'RN_t + a''G_t + b'W_{t-1}.$$

We have to be careful in interpreting the coefficients of (2-4). The coefficients on the property income terms should be interpreted as differential effects above the effects of expected property income on wealth. In an estimated function of type (2-4) we would expect the coefficient  $a'$  to be less than  $a$ .  $a'$  also does not represent the short run marginal propensity to consume out of corporate saving, which will be  $a'+a''\lambda$ . It is extremely difficult to estimate  $\lambda$ , which is the increase in aggregate capital gains from a dollar increase in aggregate corporate

saving. In the certainty no-tax world  $\lambda$  should equal one. In a certainty world with different tax rates on dividends and capital gains income  $\lambda$  will be somewhat less than one. (See appendix 2). But in the uncertain world there is little if any evidence that an increase in the aggregate corporate saving ratio will increase current capital gains. In the vintage 1971 (M.I.T.-Penn-SSRC) MPS model an increase in the corporate saving ratio lowered stock prices (Modigliani, (36)). (But not in the 1975 version, (30)).  $\lambda$  may also shift over time which may affect the stability of the coefficients of (2-4) (may; because the same factors which change  $\lambda$ , like the interest rate, can change the coefficients of the consumption function).

There are a number of problems in estimating (2-4):

- (1) The corporate saving term should be after tax. This should not be a serious problem as estimates of the effective tax rate on capital gains are near zero (Bailey, (5)).
- (2) Corporate saving (however measured) is a highly volatile series and there may be a large transient element in the measure chosen which will tend to bias downward the estimate of  $a'$  (the same argument applies to the capital gains term).
- (3) There are the usual simultaneity problems of consumption functions--coefficients of income terms in consumption functions estimated by ordinary least squares may be biased upwards since increases in consumption may be expected to increase income.
- (4) I have been using the terms "retained earnings" and corporate

saving loosely and interchangeably. It is time to define the term more clearly. The value of corporate saving which should affect personal consumption decisions is that fraction of gross corporate saving which is capitalized by equity markets. Due to the discrepancies between accounting and true economic depreciation we might expect the true figure to lie somewhere between undistributed profits (= retained earnings) and gross corporate saving (but see Chapter 3, below).

- (5) We come again to the distinction between personal consumption and personal consumption expenditures. From one point of view it might be preferable to look at the effect of corporate saving upon personal consumption expenditures, if we are interested in finding how much cash will be available for financing business investments and the deficit. But from another point of view this may not be so reasonable. If the funds available for businesses and the government come from reduced consumer durables purchases then we cannot measure the full increase in capital formation from an increase in private saving. Another difficulty in estimating consumption expenditure equations is that we do not have an accepted theory of consumer durable expenditures.

In his article on the U.S. Feldstein estimated consumption expenditure equations by ordinary least squares. He did not consider the distinction between consumption and consumption expenditures and

any simultaneity problems. He used both the undistributed profits and gross corporate saving definitions of corporate saving - there were no important differences in the results of equations using either definition. Capital gains were measured as the change in wealth less personal saving. Net worth was given by the Ando-Brown (1) series as updated by Branson and Klevorick (8). The best results were obtained when the coefficient of current capital gains was constrained to be equal to that of net worth, which indicates that capital gains not due to corporate saving are treated as windfall increments to wealth. This procedure is not strictly correct unless it is assumed that gains accrue to wealth holders at the start of the period. If gains accrue throughout the period then the consumer will probably not be able to make as complete an adjustment of his behavior as to a start of period gain.\* The unemployment rate was added as a variable in order to pick up any cyclical bias. The usual justification for this or similar procedures is that a fall in employment will lead to a fall in labor income but labor income expectations may be unaltered. The same argument may apply to corporate saving; it may fall with employment but long run expectations may be unaltered. Hence the sign on the unemployment rate term is expected to be positive. Annual real (in 1958 dollars) per capita U.S. data for 1929 to 1941 and 1948 to 1966 was used by Feldstein. A typical result of his was (standard errors in parentheses):

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\* I owe this point to Frederic Mishkin.

$$(2-5) \\ C_t = 0.57YD_t + 0.19YD_{t-1} + 0.024(G + W_{t-1}) + 0.49RN_t + 3.00RU_t + 41, \\ (0.05)^t \quad (0.03)^{t-1} \quad (0.008)^t \quad (0.09)^t \quad (0.86)^t$$

where  $C_t$  = personal consumption expenditures in year  $t$ ,

$W_{t-1}$  = net worth of households at the start of year  $t$ ,

$YD_t$  = disposable personal income in year  $t$ ,

$RN_t$  = undistributed corporate profits in year  $t$ ,

$G_t$  = capital gains in year  $t$ ,

$RU_t$  = unemployment rate in year  $t$ .

The coefficient on each term is significantly different from zero by the usual standards, has the preconceived sign and appears to be of the right magnitude.

If we suppose that  $\lambda = 1$  and the marginal tax rate on dividends to be 50% then (2-5) suggests that a billion dollar cut in dividends which is assumed to be permanent will, in the year it takes place (assuming that the change in dividend policy does not change the market value of corporations), lead to

- (1) A 500 million dollar fall in disposable personal income and a billion dollar rise in undistributed profits.
- (2) A 380 million dollar fall in consumption from the permanent fall in DPI.
- (3) A 490 million dollar rise in consumption from the increase in corporate saving.

- (4) A 24 million dollar increase in consumption from the increase in capital gains.

All in all, consumption will increase by 134 million dollars in the first year. Disposable income has fallen by 500 million dollars, so personal saving falls by 634 million dollars in the first year. Private saving then increases by 366 million dollars from the billion dollar increase in corporate saving. This result is not out of line with Modigliani's cross sectional estimate. The increase might seem substantial, but it is less than the fall in tax revenue. Only if the marginal tax rate on dividends is less than 30% will the increase in private saving be greater than the fall in tax revenue at the given level of national income and resources freed for private capital formation.

Feldstein's results are attractive. It seems of obvious interest to attempt to extend them to the "use" definition of consumption and to quarterly data. Table 2-II presents the results of annual and quarterly consumption expenditure equations for 1952-72. All quarterly data is seasonally adjusted per capita data deflated by the PCE deflator. The equations were estimated by ordinary least squares. The "A" equations are annual and the "Q" equations are quarterly. The net worth data for the quarterly equations was taken from the data file of the MPS model and the annual net worth data was supplied by Professor Feldstein. Equation 1 is a simple specification using only current and lagged income, wealth, the unemployment rate, and a constant. Equation 2 adds current capital gains, 3 undistributed profits, 4 both undistributed



profits and gains, and 5 undistributed profits and gains with the coefficient on gains constrained to equal that of net worth. There appears to be a great deal of serial correlation in the quarterly equations (Cochrane-Orcutt re-estimation of these equations gives similar results). In only one of the equations in Table 2-II is the unemployment rate coefficient significantly greater than zero (5Q), and it is the wrong sign in eight of them. The quarterly equations, not surprisingly, give more weight to lagged income than the annual. The chief result of these equations is that the Feldstein hypothesis does not hold up well. In the annual equations there is some improvement in the fit from the benchmark equation (1A) from adding capital gains (2A) but not retained earnings (3A). But the capital gains term in equation (2A), while significantly different than zero by usual standards, has the wrong sign. The retained earnings term in equation (3A) is fairly large but is smaller than its standard error. When retained earnings and capital gains are added to the equation (4A), there is little improvement in the fit over the benchmark equation, the capital gains term has the wrong sign, and the retained earnings term is small and insignificant. In equation (5A) capital gains are constrained to have the same coefficient as net worth, and the large increase in the standard error and small, insignificant, and wrong signed net worth coefficient allows us to reject this constraint. Almost the same story can be told about the quarterly equations. Strictly speaking, the quarterly equations are not comparable to Feldstein's annual equations because the annual specification assumes that last

Table 2-II

U.S. Annual and Quarterly Consumption Expenditures, 1952-1972 (standard errors in parentheses)

	1A	1Q	2A	2Q	3A	3Q
Constant	93.902 (21.537)	83.385 (12.201)	117.795 (19.988)	86.250 (12.271)	69.930 (33.667)	59.165 (16.081)
RU	-1.196 (2.892)	-2.582 (1.433)	-2.643 (2.479)	-2.649 (1.424)	-.0722 (3.146)	-.578 (1.660)
YD	.739 (.114)	.509 (.0720)	.694 (.0966)	.480 (.0742)	.680 (.130)	.481 (.0713)
YD <sub>-1</sub>	-.0295 (.102)	.190 (.0710)	-.0975 (.0855)	.216 (.0728)	.0428 (.128)	.238 (.0725)
FN					.197 (.212)	.205 (.0917)
G <sub>t</sub>			-.00249 (.000392)	-.00159 (.00109)		
W <sub>t-1</sub>	.0338 (.00812)	.0381 (.00408)	.0376 (.00694)	.0383 (.00405)	.0315 (.00853)	.0333 (.00451)
D.W.	2.0660	.9283	1.9307	.9768	2.0133	.9417
SSR	2408	15530	1587	15111	2277	14581
S.E.	12.27	14.11	10.28	14.01	12.32	13.76

Table 2-II  
continued

	4A	4Q	5A	5Q
Constant	110.269 (33.215)	62.860 (16.251)	31.981 (46.542)	7.024 (18.911)
RU	-2.279 (2.851)	-.734 (1.656)	5.911 (3.695)	5.135 (1.911)
YD	.679 (.112)	.457 (.0733)	.865 (.169)	.568 (.0940)
YD <sub>-1</sub>	.00990 (.114)	.260 (.0740)	.00415 (.178)	.304 (.0966)
RN	.0553 (.191)	.195 (.0916)	.407 (.284)	.521 (.106)
G <sub>t</sub>	-.00240 (.000964)	-.00141 (.00107)	-.000559 (.00142)	.000906 (.00134)
W <sub>t-1</sub>	.0368 (.00765)	.0337 (.00450)	-.000559 (.00142)	.000906 (.00134)
D.W.	1.8818	.9931	1.6532	.7211
SSR	1577	14257	4305	24776
S.E.	10.61	13.70	16.94	17.94

There are 21 annual observations and 83 quarterly

year's income affects this year's consumption, while the quarterly do not. There is no real improvement in the fit from the benchmark equation (1Q) from adding either capital gains or corporate saving. The corporate saving terms are significantly greater than zero, and the term is fairly large in the equation where capital gains are added to wealth (5Q) - but this equation has an extremely small wealth coefficient and a worse fit than the others.

The results of the equations seem to depend upon the period of estimation. Equations for 1952-1966 give results similar to Feldstein's. Possibly the inflation of the late 1960's and the sharp fluctuations in monetary policy during the period make realized capital gains and corporate saving very poor proxies for their expectations. The increased uncertainty may also have made consumers more cautious in anticipating gains in making their spending decisions, thus the insignificant coefficients of gains.

Table 2-III presents the equations of Table 2-II re-estimated with the "use" concept of consumption as the dependent variable. This series, the series on disposable personal income and net worth are taken from the MPS data.\* The deflator used is the consumption deflator of the model, and all data is in per capita 1958 dollars. The unemployment rate coefficients are all of the preconceived sign and are all significantly greater than zero (more than twice their standard errors).

---

\* The MPS model series on disposable personal income differs from the BEA series by (1) treating Federal personal income taxes on a liability rather than a cash basis, and (2) adding the imputed rental income on durables and subtracting interest paid by consumers from disposable personal income.

Table 2-III

U.S. Annual and Quarterly Consumption, 1952-1972 (standard errors in parentheses)

	1A	1Q	2A	2Q	3A	3Q
Constant	3.600 (13.587)	23.180 (9.256)	48.270 (15.063)	21.887 (9.350)	20.170 (20.366)	64.673 (11.686)
RU	7.809 (1.655)	8.706 (1.065)	7.746 (1.784)	8.752 (1.066)	7.056 (1.786)	5.460 (1.142)
YD	.392 (.0566)	.246 (.0768)	.389 (.0640)	.268 (.0799)	.428 (.0655)	.389 (.0733)
YD <sub>-1</sub>	.279 (.0536)	.450 (.0758)	.281 (.0582)	.429 (.0785)	.236 (.0664)	.275 (.0753)
RN					-.136 (.125)	-.334 (.0677)
G <sub>t</sub>			-.0000955 (.000782)	.000824 (.000836)		
W <sub>t-1</sub>	.0482 (.00411)	.0381 (.00281)	.0483 (.00450)	.0379 (.00282)	.0493 (.00421)	.0451 (.0677)
D.W.	2.1583	.6563	2.1664	.6781	2.1651	.8179
SSR	938	8513	937	8407	870	6466
S.E.	7.66	10.45	7.91	10.45	7.61	9.16

Table 2-III  
continued

	4A	4Q	5A	5Q
Constant	21.951 (22.268)	63.292 (11.801)	-37.656 (59.259)	-6.144 (21.063)
RU	6.911 (1.938)	5.525 (1.146)	16.003 (4.728)	13.853 (1.940)
YD	.423 (.0712)	.406 (.0756)	.715 (.179)	.523 (.146)
YD <sub>-1</sub>	.239 (.0699)	.260 (.0772)	.152 (.191)	.329 (.150)
RN	-.140 (.130)	-.332 (.0679)	.206 (.347)	.151 (.116)
G <sub>t</sub>	-.000191 (.000783)	.000661 (.000735)	.00361 (.00189)	.00420 (.00135)
W <sub>t-1</sub>	.0497 (.00465)	.0449 (.00285)	.00361 (.00189)	.00420 (.00135)
D.W.	2.1812	.8432	1.3462	.3931
SSR	866	6398	7077	24592
S.E.	7.87	9.18	21.72	17.87

There are 21 annual observations and 83 quarterly

The equations of Table 2-III show that there is no improvement in the fit of the annual consumption function over the benchmark (1A) by adding either capital gains or retained earnings. There is an improvement in the fit of the quarterly equations when retained earnings is added (3Q) and (4Q) compared with (1Q), but it has the wrong sign. As in the consumption expenditure equations of Table 2-II the constraint that the coefficient of capital gains equals that of net worth can be rejected (by comparison of the standard errors and the sums of squared residuals of equations (4A) and (4Q) with (5A) and (5Q) respectively).

The most striking thing about the results of Table 2-III is the coefficients on the undistributed profits terms. In two of the annual equations they are negative and insignificant (3A) and (4A). In two of the quarterly equations (3Q) and (4Q) they are negative, fairly large (very close in magnitude to those on current disposable income), and significantly less than zero (in magnitude, more than twice their standard errors). Only when the coefficient of capital gains is constrained to equal that of the rest of wealth are the retained earnings coefficients positive, but then the fit of the equation deteriorates, the Durbin-Watson statistics fall greatly, indicating a great deal of positive serial correlation in the errors, and the coefficients of the wealth term are exceedingly small. It is hard to explain the negative coefficients. It is possible that the undistributed profits term is picking up some negative substitution effects of changes in the rate of return in the consumption function (it does not seem unreasonable to suggest that corporations increase their saving with the interest rate),

but the addition of the Aaa bond yield to the quarterly equations as a RHS variable did not eliminate this problem. It is also curious that such substitution effects would be stronger in a consumption than a consumption expenditure function, for one would expect that durables purchases would be more responsive to rate of return effects than other consumer expenditures.

The quarterly equations of Tables 2-II and 2-III were re-estimated by means of instrumental variables. The instrument list included the constant term, the unemployment rate, current and lagged exports, current and lagged government purchases of goods and services, the current and lagged Aaa bond yield, the value of household holdings of corporate stock, and net worth less the value of corporate stock. The results were little changed from OLS estimation. The quarterly consumption equations, like the quarterly consumption expenditure equations, were re-estimated by the Cochrane-Orcutt technique in order to eliminate first order serial correlation. Once again the results were generally similar to the OLS ones, except that the coefficients on both undistributed profits and wealth in equation III-5Q become negative.

The next obvious step was to estimate "permanent" series on the variables by means of distributed lags. Quarterly equations 1 and 3 of Tables 2-II and 2-III were re-estimated using polynomial distributed lags. Permanent disposable income was approximated by an 11 quarter 2nd degree polynomial constrained to equal zero at quarter  $t-12$ , permanent wealth by a 7 quarter 2nd degree polynomial constrained to



equal zero at quarter  $t-8$ ,\* and permanent retained earnings by a 15 quarter 3rd degree polynomial constrained to equal zero at quarter  $t-16$ .

We see by comparing the Durbin-Watson statistics of the equations in Tables 2-IV and 2-V (which report the consumption expenditure and consumption equations estimated using the longer lags) with their counterparts in Tables 2-II and 2-III the advantages gained by estimation with the longer lags. Each equation in Tables 2-IV and 2-V has a higher Durbin-Watson statistic than its counterpart in Tables 2-II and 2-III, indicating less serial correlation in the residuals.

Table 2-IV gives the results of the consumption expenditure equations with the long lags. The lag weights on disposable personal income and net worth decline; those on undistributed profits decline below zero around the sixth quarter and then gradually rise above zero.

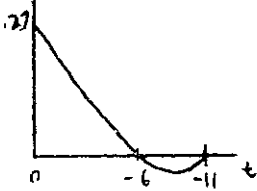
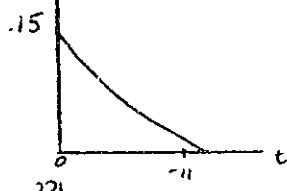
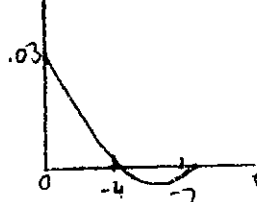

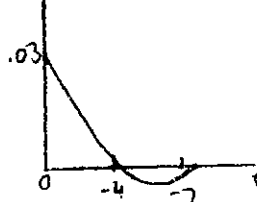
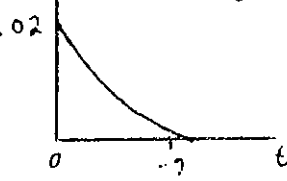
The results of Table 2-IV are broadly similar to those of Table 2-II. The coefficient on "permanent" corporate saving (the sum of the lag coefficients) in IV-3Q is slightly larger than that of II-3Q but it is not significant. The addition of retained earnings does improve significantly the fit over the benchmark equation (IV-1Q). The erratic lag shape on RN is somewhat inconsistent with the belief that retained earnings act like other income variables in the consumption function. The high leading coefficient (.33) on RN can be contrasted with the surprisingly low (.15) leading coefficient on YD and indicates that RN

---

\* The justification for a distributed lag on wealth is the assumption that there is a cost in altering consumption habits to changes in wealth, hence short run fluctuations (especially in the stock market) have less affect than persistent changes.

Table 2-IV

U.S. Quarterly Consumption Expenditures, 1955:IV-1972:IV  
(standard errors in parentheses)

	1Q	3Q
Constant	9.992 (15.395)	-24.886 (29.739)
RU	3.132 (1.871)	-.392 (2.529)
$\sum_{i=1}^{11} a_i YD_{t-i}$	$\Sigma a_i =$  .658 (.0235)	 .673 (.0215)
$\sum_{i=1}^{15} b_i RN_{t-i}$	$\Sigma b_i =$ 	 .270 (.200)
$\sum_{i=1}^7 c_i W_{t-i}$	$\Sigma c_i =$  .0499 (.00544)	 .0525 (.00472)
D.W.	1.2565	1.6073
Sum of Squared Residuals	9404	6563
Standard Error	12.22	10.46

There are 69 observations

Table 2-IV

U.S. Quarterly Consumption Expenditures, 1955:IV-1972:IV (standard errors in parentheses)

	30	10	Constant	RU	11	15	7	D.W.	Sum of Squared Residuals	Standard Error
			9.992 (15.395)	3.132 (1.871)	$\hat{a}_1 = .658$ (.0235)	$\hat{b}_1 = .270$ (.200)	$\hat{c}_1 = .0499$ (.00544)	1.2565	9404	12.22
			-24.886 (29.739)	-.392 (2.529)	$\hat{a}_1 = .673$ (.0215)	$\hat{b}_1 = .270$ (.200)	$\hat{c}_1 = .0525$ (.00472)	1.6073	6563	10.46

There are 69 observations

may be picking up transitory income effects on consumption expenditures which are washed out by the rest of the lag.

Table 2-V presents the results of consumption equations III-1Q and III-3Q estimated using the longer lags. The shapes of the lag distributions are largely the same as the corresponding ones in Table 2-IV. Once again we see that it is fairly difficult to find a role for retained earnings in the consumption function. The permanent retained earnings term is neither large nor significant in V-3Q, but there is some improvement in the fit as measured by the standard error and lessening of serial correlation as measured by the Durbin-Watson statistic.\*

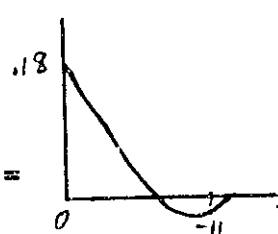
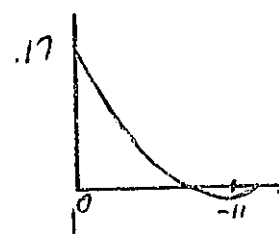
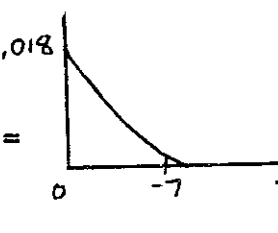
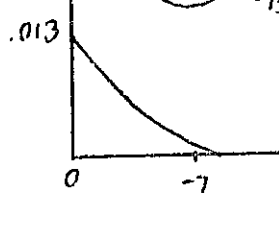
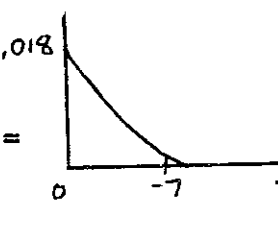
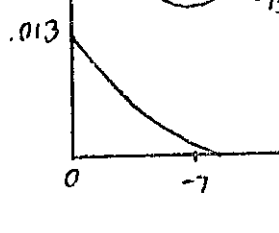
The conclusions of this chapter are tentative. The effect of corporate saving upon consumption is hard to detect. Whatever effect there is is not as strong as that measured by Feldstein in his annual equations. No strong conclusions can be reached about hypothesis A' (that the effect of corporate earnings upon consumption is independent of their composition). Equations were estimated imposing the constraint that the coefficient of retained earnings equal that of disposable personal income (omitting capital gains). In no case could this hypothesis be accepted. However, unless account is taken of the differential taxation of dividends and capital gains and the distinction between labor and property income in the consumption function no fair test of this hypothesis can be made.

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\* Cochrane-Orcutt re-estimation of equation V-3Q resulted in a negative sum of lag coefficients on corporate savings, although the shape of the lag was largely the same as that of V-3Q.

Table 2-V

U.S. Quarterly Consumption, 1955:IV-1972:IV  
(standard errors in parentheses)

	1Q	3Q
Constant	-16.606 (10.742)	4.374 (21.035)
RU	8.078 (1.244)	5.838 (1.722)
$\sum_{i=0}^{11} a_i YD_{-i}$	$\Sigma a_i =$  .639 (.0134)	$\Sigma a_i =$  .628 (.0129)
$\sum_{i=0}^{15} b_i RN_{-i}$	$\Sigma b_i =$  .0557 (.00333)	$\Sigma b_i =$  .00300 (.131)
$\sum_{i=0}^7 c_i W_{-i}$	$\Sigma c_i =$  .0557 (.00333)	$\Sigma c_i =$  .0572 (.00298)
D.W.	1.0176	1.3619
Sum of Squared Residuals	4004	2896
Standard Error	7.97	6.95

There are 69 observations

There is some evidence that recent events in the economy have affected the response of consumption to corporate saving. The annual and quarterly equations of Tables 2-II and 2-III were re-estimated over the sample period 1952-1966. As mentioned above, the results for the consumption expenditure equations were similar to Feldstein's, with large and significant coefficients on the undistributed profits term. The consumption equations were similar to those reported in Table 2-III, except that the coefficient of undistributed profits in equations III-5A and III-5Q were negative. Equations were estimated testing whether or not the corporate savings coefficient shifted after 1966 by inserting a variable which equaled corporate saving after 1966 and zero at all other times. There was no evidence of a significant decline in the corporate savings coefficient.

This chapter has presented no substantial evidence that consumers respond to corporate savings (the gross corporate savings variable- undistributed profits plus capital consumption allowances did about the same as the retained earnings variable) as quickly as to other components of income, especially in consumption but also in consumption expenditure functions. The corporate savings variable does not behave like a property income variable - its insertion in the consumption function does not seriously reduce either the income or wealth coefficients. Computation of the correlation matrix for the variables of Table 2-III shows that retained earnings are much less correlated with either wealth or disposable income than they are with each other (the correlation of FN with YD is .176, FN with W is .252, YD with W is .962. Gross corporate saving is much more highly correlated with

income and wealth than retained earnings - .875 with income and .921 with wealth). This chapter has not tested the hypothesis that there is no response of consumption to current property income in the presence of a wealth variable, or that the speed of adjustment to corporate saving is the same as to other components of property income.<sup>\*</sup> This involves assigning tax liabilities to different forms of income. Modigliani and Tarantelli (39) did this for Italy by assuming proportional taxation of all forms of income but this is unacceptable for the U.S. Once this allocation is done we can attempt to measure labor and property income and wealth effects on consumption, and how changes in tax policy toward different forms of income can alter consumption. Since there is some evidence that aggregate dividend policy does respond to the differential taxation of dividends (Brittain, (9)) a differential effect on consumption of corporate saving and dividends would indicate that tax policy toward dividends will alter consumption. In this chapter we have rejected the David-Scadding hypothesis that aggregate saving will not respond

---

\* When wealth was dropped as an argument of the equation in Tables 2-IV and 2-V undistributed profits did have a large positive sign. However, in the consumption function (V-3Q) the addition of the term scarcely improved the overall fit, and the sum of the lag terms became negative when the equation was re-estimated by the Cochrane-Orcutt technique. In the consumption expenditure equation the permanent coefficient on RN went from .677 to .343 when the estimation technique was changed from ordinary least squares. Additionally there was an enormous deterioration in the overall fit when wealth was dropped - the SE of (V-3A) went from 6.95 to 18.67 and the D.W. from 1.3619 to .2370. All in all, it seems that wealth is a more valuable variable to keep in a consumption function than corporate savings, so the interesting question is whether corporate savings and property income belong in a consumption function with a wealth variable.

to aggregate taxation at given levels of national income. In later chapters we will first develop the theory of consumer responses to labor and property income and wealth and then attempt to measure how aggregate consumption and saving responds to the composition, and hence the differential taxation, of income.



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CHAPTER 3

PROPERTY INCOME, WEALTH, AND CONSUMPTION: THEORY AND FIRST TESTS

Theories of the personal consumption function based upon utility maximizing behavior draw a distinction between consumer responses to changes in labor and property income. Increases in expected labor income expand the present value of resources available to be consumed over an individual's life. Thus we expect an increase in expected labor income to increase current consumption. Increases in expected property income have somewhat different effects. Property income increases may arise from increases in wealth or increases in the rate of return. An increase in the rate of return will have both income effects favoring current consumption and substitution effects working against current consumption. It is therefore unsuitable to impose restrictions, without previous testing, that the coefficients on labor and property income in an empirical consumption function are equal. Typical empirical consumption functions impose such constraints by regressing consumption on disposable personal income, which includes both labor and a good deal of property income. This procedure may be adequate for most forecasting purposes but should be questioned for uses such as comparing the coefficient of other forms of property income with disposable personal income. The relationship between property income, wealth, and consumption can be considered more explicitly by considering a consumer with a specific utility function designed to show the relationship between changes in the rate of return and intertemporal allocation. Let us consider a consumer with a (certain) life expectancy of  $T$  years, a

working life of  $L$  years and an intertemporal preference function for consumption in every year of the form

$$(3-1) \quad U(C_1, \dots, C_T) = \left( \sum_{i=1}^T C_i^{-\beta} \right)^{-\frac{1}{\beta}}$$

where  $C_i$  = consumption services used in period  $i$  (durable goods purchases are not included in consumption, but their service income is). This preference mapping is a form of the CES (constant elasticity of substitution) utility function.\* We assume that it is homogeneous of the first degree, but no changes in the results derived will come from changing the degree of homogeneity to some other positive number).

The consumer's problem is to maximize his or her preference function subject to an intertemporal budget constraint. The budget constraint is of the form

$$(3-2) \quad \sum_{i=1}^T \frac{C_i}{(1+r)^{i-1}} = \sum_{i=1}^L \frac{YL_i}{(1+r)^{i-1}} + W_0 = PV_0$$

where  $YL_i$  = non-property income earned in year  $i$  (it is assumed that this income is received at the start of each year and all consumer goods for the year are purchased then),  $W_0$  = initial non-human wealth holdings, and  $r$  is the interest rate. (From now on the summation is always from 1 to  $T$ ).

---

\* One can in principle add factors representing systematic time preference for consumption in every period but I feel that this will complicate the analysis unnecessarily. Warren Weber (54) has used explicit consumption functions derived from this type of utility function in empirical work.

The Lagrangian problem is

$$\text{Max}_{C_1} U(C_1, \dots, C_T) + \lambda [PV_0 - \sum \frac{C_i}{(1+r)^{i-1}}]$$

The first order conditions for a maximum are

$$(3-3) \quad C_i^{-\beta-1} (\sum C_i^{-\beta})^{-1/\beta} = \frac{\lambda}{(1+r)^{i-1}}, \quad i = 1, \dots, T$$

and

$$(3-4) \quad \sum \frac{C_i}{(1+r)^{i-1}} = PV_0$$

From (3-3) we have

$$C_i = C_1 \left(\frac{1}{1+r}\right)^{-\left(\frac{i-1}{\beta+1}\right)}$$

Then

$$\sum \frac{C_i}{(1+r)^{i-1}} = C_1 \sum \left(\frac{1}{1+r}\right)^{-\left(\frac{i-1}{\beta+1}\right) + i-1} = PV_0$$

and

$$C_i = \delta PV_0, \text{ where}$$

$$\delta = \frac{1}{\left(\sum \left(\frac{1}{1+r}\right)^{\frac{(i-1)\beta}{\beta+1}}\right)} \frac{1 - \left(\frac{1}{1+r}\right)^{\beta/\beta+1}}{1 - \left(\frac{1}{1+r}\right)^{T\beta/\beta+1}}$$

Since  $1/(1+r) \leq 1$  and  $T \geq 1$ ,  $\delta \leq 1$ , if  $\beta > -1$ .

$(1/(1+r))$  is the "price" of a unit of year  $i$  consumption in terms of current consumption - it is the amount of current consumption that must be given up to obtain a unit of consumption in year  $i$ . Let us denote this price by  $P_i$ .  $C_i/C_1$ , the ratio giving the desired allocation

of consumption between year  $i$  and today, is given by (3-3).  $\sigma$ , the elasticity of substitution between period  $i$ 's and today's consumption, is defined as the (absolute value of the) percentage change in the ratio of consumption in year  $i$  to this year's consumption when there is a one percent change in the price ratio of period  $i$ 's consumption to today's.

That is,

$$\sigma = - \frac{d(C_1/C_0)}{(C_1/C_0)} / d(P_i/P_1) = - \frac{d(C_1/C_0)}{d P_1} \times P_1 \left( \frac{C_1}{C_0} \right)$$

By (3-3),

$$C_1/C_0 = P_1^{-1/\beta+1}$$

Hence

$$\sigma = - \left( - \frac{1}{\beta+1} \right) P_1^{-(1/\beta+1)-1} \times P_1 \times P_1^{1/\beta+1} = 1/\beta+1$$

For  $\sigma$  positive - that is to say, consumption in each period is a normal good (it will decline relative to current consumption when its price increases),  $\beta > -1$ .

There are two special cases of the preference mapping of some interest.\* First consider the case  $\beta = 0$ . The preference function does not exist at this point, but we can consider

$$\lim_{\beta \rightarrow 0} \left( \sum C_1^{-\beta} \right)^{-1/\beta}$$

---

\* The discussion of these special cases of a CES utility function follows closely Ferguson's (19) discussion of the corresponding special cases of CES production functions.

Now

$$\lim_{\beta \rightarrow 0} \ln(\sum C_i^{-\beta})^{-1/\beta} = \lim_{\beta \rightarrow 0} - \frac{\ln(\sum C_i^{-\beta})}{\beta}$$

Applying L'Hospital's rule (since both numerator and denominator are zero in the limit) we see that the limit of this ratio is

$$- \lim_{\beta \rightarrow 0} \frac{\sum -(\ln C_i) C_i^{-\beta}}{\sum C_i^{-\beta}} \Big/ \lim_{\beta \rightarrow 0} 1 = \frac{\sum \ln C_i}{T}$$

Hence

$$\lim \ln U(C_1, \dots, C_T) = \frac{1}{T} \sum \ln C_i = \sum \ln C_i^{1/T}$$

or

$$\lim U(C_1, \dots, C_T) = C_1^{1/T} C_2^{1/T} \dots C_T^{1/T}$$

Then the FOC for utility maximization are

$$C_1^{1/T-1} \prod_{j \neq 1} C_j^{1/T} = \frac{\lambda}{(1+r)^{i-1}}$$

and

$$\sum \frac{C_i}{(1+r)^{i-1}} = PV_0$$

or

$$C_i = C_1 \left( \frac{1}{1+r} \right)^{-(i-1)}$$

and

$$\sum \frac{C_1}{(1+r)^{t-1}} = C_1 \sum \left(\frac{1}{1+r}\right)^{-(t-1)} \left(\frac{1}{1+r}\right)^{t-1} = PV_0; \text{ so}$$

$$C_1 = PV_0/T.$$

Thus in the  $\beta = 0$  case (unitary elasticity of substitution or "Cobb-Douglas" case) the current propensity to consume out of current wealth (human and non-human) is independent of the interest rate - it only depends upon the individual's point in the life cycle (i.e.,  $T$  is the number of years of life remaining). This will also be the solution if the interest rate were assumed to be zero, as was the case in the very earliest formulations of the life-cycle hypothesis of saving (Modigliani-Brumberg (37)).

Another interesting special case is that of zero elasticity of substitution ( $\beta = \infty$ ). Now

$$(3-6) \quad \lim_{\beta \rightarrow \infty} U(C_1, \dots, C_T) = \lim_{\beta \rightarrow \infty} \left( \sum C_1^{-\beta} \right)^{-1/\beta}$$

Assume, without loss of generality, that  $C_j$  is the smallest of the  $C_1$ . Then (3-6) can be rearranged to give

$$\lim_{\beta \rightarrow \infty} C_j \left( \sum \left(\frac{C_1}{C_j}\right)^{-\beta} + 1 \right)^{-1/\beta} = C_j$$

Thus  $\lim_{\beta \rightarrow \infty} U(C_1, \dots, C_T) = \min(C_1, \dots, C_T)$ .

In this zero-substitution or Leontief case the desired allocation obviously will be

$$C_1 = C_2 = \dots = C_T.$$

Then, by the budget constraint,

$$C_1 \times \sum_{t=1}^T \frac{1}{(1+r)^{t-1}} = PV_0$$

or

$$\delta = \frac{1}{\left[ \sum_{t=1}^T \left( \frac{1}{1+r} \right)^{t-1} \right]} = \frac{1 - 1/(1+r)^T}{1 - (1/(1+r))^T}$$

The special case of zero elasticity of substitution (or "Leontief" case), where the desired allocation of consumption is an absolutely even flow, roughly corresponds to the hypothesis that the marginal propensity to consume out of permanent income is constant (i.e., the MPC is fairly inelastic with respect to the interest rate. This will be illustrated below.)

Consider the general version of  $\delta$ .

$$\delta(r) = \frac{1}{\sum_{t=1}^T \left( \frac{1}{1+r} \right)^{t-1}} = \frac{1 - (1/(1+r))^{\beta/\beta+1}}{1 - (1/(1+r))^T \beta/\beta+1}$$

There are two general cases:

- (a)  $\beta > 0$ . In this case  $\delta'(r)$  is positive, as can be seen by observing that every term in the denominator of the first expression defining  $\delta$  will fall with an increase in  $r$  (since  $\beta/\beta+1$  is positive). Hence, when there is less than unitary elasticity of substitution - the consumer's indifference curves are "kinkier" than in the Cobb-Douglas case - an increase in the interest rate leads the consumer to allocate



a larger fraction of an increase in resources to the present (of course, this effect is independent of the effect of an increase in  $r$  on  $PV_0$ ).

- (b)  $\beta < 0$ . In this case  $\delta'(r)$  is negative. Hence, when the indifference curves are "smoother" than the Cobb-Douglas case the consumer will respond to an increase in the interest rate by slowing the rate at which he consumes his assets. Thus we see that in general the MPC out of wealth is affected by changes in the interest rate, although in principle we cannot say whether or not the effect is positive or negative.

Let us consider the MPC out of labor income. Assume that labor income is constant, so

$$\sum_{i=1}^L \frac{YL_i}{(1+r)^{i-1}} = YL \sum_{i=1}^L \frac{1}{(1+r)^{i-1}} = \frac{1 - (1/(1+r))^L}{1 - (1/(1+r))} YL$$

Then, from the expression defining  $PV_0$  and  $\delta$ , the MPC out of labor income is

$$\alpha = \sum \frac{1}{(1+r)^{i-1}} / \sum \frac{1}{(1+r)} \frac{\beta/(1-1)}{\beta+1} = \gamma \delta$$

Hence, the MPC out of labor income is also a function of the interest rate. If we consider the Leontief case ( $\beta = \infty$ )  $\alpha$  will not fall with the interest rate, since  $L$  is not greater than  $T$ . This is because  $\alpha$  is the product of two factors. One is  $\delta$ , the marginal propensity to consume out of wealth, which is also the inverse of the present value of a bond paying one dollar a year for  $T$  years. The other term is  $\gamma$ , the present value of a bond paying one dollar a year for  $L$  years. Now the

longer lived an asset, the more elastic its value is with respect to the interest rate. Hence the percentage increase in the  $\delta$  term from an increase in the interest rate will be greater than the percentage fall in the other term, since  $T$  (the life expectancy of the consumer) is greater than  $L$  (the working life of the consumer). For  $\beta$  positive, the percentage increase in  $\alpha$  from an increase in the interest rate will be less than the percentage increase in  $\delta$ , since  $\alpha'/\alpha = \gamma'/\gamma + \delta'/\delta$  and  $\gamma' < 0$ .

It might be of interest to exhibit  $\delta$ ,  $\delta'(r)$ , and  $\alpha$  for  $\delta = 0$ . The table below record these numbers for various interest rates and two positions in the life cycle, one for an individual with a life expectancy of 10 years and no working life left and the other for a life expectancy of 50 years with 40 years of working life. A somewhat similar table is in Ando and Modigliani (1).

Table 3-I

Marginal Propensities to Consume out of Labor Income and Wealth,  $\delta = 0$

a. $T = 10, L = 0$				b. $T = 50, L = 40$			
$r$	$\delta$	$\delta'(r)$	$\alpha$	$r$	$\delta$	$\delta'(r)$	$\alpha$
.00	.100	.454		.00	.0200	.526	.800
.01	.105	.464	N/A	.01	.0253	.594	.838
.02	.109	.467		.02	.0312	.653	.871
.03	.114	.475		.03	.0377	.703	.898
.04	.118	.477		.04	.0448	.740	.921
.05	.123	.484		.05	.0522	.768	.940
.06	.128	.489		.06	.0599	.787	.955
.07	.133	.493		.07	.0677	.797	.966
.08	.138	.496		.08	.0757	.801	.975
.09	.143	.500		.09	.0837	.799	.981
.10	.148			.10	.0917		.986

Note:  $\delta'(r)$  is defined as the difference between the current and next  $\delta$  divided by the change in  $r$ .

It is seen that both  $\delta$  and  $\alpha$  increase with the rate of return, with the rate of increase in  $\delta$  faster for the younger consumer. While the increase in  $\alpha$  is large, as a percentage of its value it is considerably smaller than the change in  $\delta$ . For example, an increase in  $r$  from .03 to .05 - which is probably a large increase in the real rate of return - raises  $\delta$  (in part b) 38% but  $\alpha$  only 5%, which will probably be well within an estimated standard error of such a coefficient on labor income while not within such an error band for a coefficient on wealth.

$\delta'$  is reasonably invariant to  $r$ , even if  $\sigma > 0$ , so it seems safe to linearize  $\delta$  as  $\delta_0 + \delta_1 r$ . We regard  $\alpha$  as relatively constant too (in practice  $\alpha$  will reflect expectations of labor income growth too.  $\alpha$  is the propensity to consume out of permanent income - which is why it was mentioned above that the Leontief case provides a basis for the permanent income hypothesis that the MPC out of permanent income is constant). With these hypotheses we derive a linear approximation of the individual consumption function of the form

$$(3-7) \quad C_1 = \alpha YL + (\delta_0 + \delta_1 r)W_0.$$

This function has been dubbed the "general" version of the life-cycle by Modigliani (35 ).<sup>\*</sup>  $rW_0$  is the long run rate of return times net

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<sup>\*</sup> If  $\delta_1$  is positive we have Tobin and Dolde's (49 ) hypothesis that consumers will respond more strongly to an increase in wealth caused by increased income expectations than by a fall in the interest rate.

worth, so it may be regarded as permanent property income (YP).<sup>11</sup> Hence (3-7) can be re-written as

$$(3-8) \quad C_1 = \alpha YL + \delta_1 YP + \delta_0 W_0.$$

Making the usual assumptions necessary for aggregation, we derive the aggregate consumption function for year t,

$$(3-9) \quad C_t = A YL_t + B_1 YP_t + B_0 W_{t-1}$$

where  $W_{t-1}$  is aggregate net worth as the start of period t. The coefficients A, B, and  $B_0$  will be functions of the age structure of the population. We would then expect to find the aggregate coefficients somewhere between the hypothesized individual propensities in the two parts of Table 3-I - since the two halves represent extremes in the age structure and we would expect to find the population averages somewhere in the middle. Since wealth is discounted permanent property income, if

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\* Strictly speaking this expression is only true for an infinitely lived individual. For an individual with a finite horizon,

$$YP \sum \frac{1}{(1+r)^i} = W_0, \text{ so}$$

$$YP = \frac{W_0}{\sum \frac{1}{(1+r)^i}}, \text{ which is slightly greater than } rW_0.$$

(Note that it is here assumed that assets do not pay returns until the end of a period). Weber (54) has explicitly estimated  $\delta(r)$  as a function of its components by non-linear techniques. However, he also is forced to estimate a real rate of interest at the same time, and he finds that his nominal interest rate series do not fully respond to expected inflation. The technique described here avoids the problems of estimating expected inflation along with propensities to consume.

we drop either property income or wealth from the consumption function we rewrite (3-9) as

$$(3-10) \quad C_t = A YL_t + (B_1 + \frac{B_0}{r_t}) YP_t \quad \text{or}$$

$$(3-11) \quad C_t = A YL_t + (B_1 r_t + B_0) W_{t-1}.$$

It is necessary to restate the assumptions needed to justify (3-9) as a useful consumption function:

- (1)  $r_t$  must vary over time. If it does not, then  $YP_t$  is perfectly collinear with  $W_{t-1}$  and we cannot separate their effects.
- (2) It is necessary that  $\delta_1$  will have to be positive for a large part of the population in order to estimate (3-9), (3-10), and (3-11). If it is negative, then  $B_1$  will be negative - which is perfectly possible - and  $A$  will be very sensitive to the interest rate and it will not be safe to regard  $A$  as invariant to  $r$ .
- (3) It should be re-emphasized that the use of both permanent property income and wealth in a consumption function does not involve "double-counting". The theory outlined above asserts that a change in the rate of return will increase the MPC out of wealth, and this effect can be empirically captured by the coefficient on property income in a consumption function also including wealth. Wealth is discounted permanent property income, and once again, the use of both in the consumption function is not justified only in the case when the rate of return is constant. Thus the use of both wealth and permanent

property income is an empirical question. To restate the point, which is essential for the rest of the thesis, we have three variables under consideration for use in an empirical consumption function: Wealth, property income, and the real interest rate. "Double-counting" would occur if we used all three of these variables. However, we may use any two, since we are trying to measure two different effects, one being the pure capital gain (outward shift of the budget line) effect and the other the effect of a rotation of the budget line on the intertemporal allocation of consumption. Given wealth, the second effect is measured by the coefficient of property income.

Equation (3-9) reduces to a consumption function in (permanent) disposable income and wealth if and only if YD (disposable personal income) is proportional to  $A YL + B YP$ . A special case of this is when only that fraction of property income in disposable personal income is equal to YP and  $A = B_1$ . Equation (3-10) is an equation in labor income and property income. Consumption functions of this type have been common in capital theory and studies of economic growth. It is often asserted that the low coefficients often found on property income in such equations reflect different savings propensities of different classes. Table 3-I shows us that  $\delta'/r_t$  should be on the order of unity so the coefficient on YP should be similar to that on YL in the aggregate equation. Modigliani and Tarantelli (39) showed that the Italian data, which had seemed to support the "two-class" theory, can be reconciled with the life cycle theory if property income is allowed to affect

consumption with a lag. Equation (3-11) is the original life-cycle consumption function in labor income and wealth. Note that the constancy of the marginal propensity to consume out of wealth depends upon the constancy of the rate of return. A specification which uses disposable personal income and wealth on the grounds that labor income is a fairly constant fraction of disposable personal income is not justifiable unless the rate of return is constant, or, of course,  $B_1$  is zero.

Consumption functions similar to (3-9) have been estimated by Weber (54) (whose derivation of the consumption function from the CES utility function I have largely followed) for annual U.S. data from 1930 to 1965, by Modigliani and Tarantelli (39) for Italian data, by Stone (46) for British data, and a savings function for the Netherlands by Somermeyer and Banninck (43). Springer (45) considered the effect of the real interest rate on the marginal propensity to consume permanent disposable income in the U.S. but he did not separate labor and property income effects. Weber, Springer, Stone and Modigliani - Tarantelli found  $B_1$  to be positive, but Somermeyer - Banninck found it to be negative. I intend to estimate (3-9) using quarterly U.S. data with the use concept of consumption and to consider the role of corporate savings in YP.

Equations (3-9) and (3-10) shed light on why such problems were found in the previous chapter in adding corporate saving to consumption functions using disposable personal income. Such a procedure is justified only if (in an equation where wealth is included)  $A = B_1$  or

(in an equation where wealth is not included)  $A = B_1 + B_0/r_t$ . An equation such as (3-9) provides a better arena for testing wheather or not corporate saving policy changes personal consumption since we do not have to impose the additional constraint that  $A = B_1$  - we can test the simpler hypothesis that the coefficient on corporate saving equals that of the rest of property income.

The last chapter attempted to show that previous results, indicating that the coefficient of corporate saving in the consumption function was not terribly different from current disposable personal income, were not very robust to changing the period of estimation or the definition of consumption from personal consumption expenditures to "use" consumption. For the rest of this chapter we will explore the role of wealth and property income (including corporate saving) in the aggregate consumption function.

There are two data problems that should be discussed before the results of the estimated consumption functions are presented. They are 1, the construction of series of net of tax labor and property income, and 2, the definition of corporate saving to be used:

- (1) The chief difficulty in constructing series of labor and property income after tax is the allocation of income taxes between the two. I have generally followed the procedure of Ando and Brown (1) in doing the allocation. Details will be found in the Appendix. My labor income series consists of salaries and wages plus other labor income plus transfers plus labor income of proprietors (see Appendix) less federal and state income taxes on labor income and personal contributions



for social insurance. Property income after taxes, other than corporate saving, consists of the imputed non-labor income of proprietors plus the rental income of persons plus interest income plus dividends plus the imputed rental income of durable goods less interest paid by consumers, federal and state income taxes on property income (dividends are treated separately from the rest of property income in the quarterly allocations - the dividend series used was that used by the MPS model in constructing the market value of corporate stock and adds an estimate of dividends paid to uninsured pension funds [which is a part of personal interest income in the national income accounts] and is slightly greater than national income accounts dividends). The sum of the labor and property income series is very close to the MPS disposable income series (there are some minor differences from differing treatment of taxes).

- (2) The problem of defining an empirical analog to the concept of corporate saving is intimately connected to defining what we mean by corporate income. There are many possible definitions and all have their merits and demerits. The measure of corporate saving we are looking for corresponds to the increase in the equity capital of the corporation credited to beginning of period shareholders. We can illustrate this principle by the following highly idealized illustration:

Assume perfect capital markets, no taxation, no changes in discount

rates,\* and no debt. Following Moore's (40) argument (except that it is here assumed that the replacement cost of capital equals the market value), let  $K_t$  = market value of firm's capital at time t. Then

$K_t = P_t N_t$ , where  $P_t$  = price per share and  $N_t$  = number of shares. Now

$K_{t+1} - K_t = I_t$ , investment in period t. Since the value of investment

equals the value of funds raised to finance it,  $I_t = P_{t+1} (N_{t+1} - N_t) + CS_t$ ,

where  $CS_t$  is corporate saving - corporate saving is equal to that part

of investment not financed by sales of stock.  $G_t$ , capital gains credited

to the start of period shareholders, is equal to  $(P_{t+1} - P_t) N_t = P_{t+1} N_t - K_t$ .

But  $K_{t+1} - K_t = P_{t+1} (N_{t+1} - N_t) + CS_t$ , so  $P_{t+1} N_t = CS_t + K_t$  and  $G_t = CS_t$ .

A brief discussion of some empirical corporate saving measures and how they correspond to an increase in capital concepts follows:

- (a) Undistributed profits (RN): This is the simplest concept of all. It is simply accounting profits less dividends. Its virtues are that it is a number easily visible to shareholders, and does not involve any discussions about accounting principles - the management of corporations are supposedly successful in convincing shareholders and the securities markets that accounting profits are equal to true economic profits. The defect of this measure obviously lies in the fact

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\* The case presented in Appendix 2 reduces to this if there are no taxes. There are, of course, capital gains from changes in the rate of return. However, these do not affect permanent property income from an asset. This is the distinction Feldstein (17, 18) made between "permanent" and "transitory" gains. His terminology is slightly unfortunate, since "transitory" gains gives a connotation of market inefficiency, which is not the issue here.

that it can readily be altered by arbitrary changes in accounting techniques.

- (b) Undistributed profits plus the corporate capital consumption allowance (RG). This measure corresponds to a cash flow concept of corporate profits. Its advantage is that it gives a measure of the corporation's ability to finance gross investment from internal sources (RG plus dividends - gross corporate cash flow - has also proved to be a useful variable in explaining corporate dividend policy. See Brittain (9)). This measure's disadvantages are the same as the previous one - it can be arbitrarily changed by changes in corporate accounting techniques.

These are the measures of corporate saving that were used in the previous chapter and in previous work on the role of corporate saving in personal saving and consumption. There is at least one major adjustment to be made to profit figures in the national income accounts which should be considered important in the recent inflationary period - inventory profits due solely to accounting practices should be removed. True profits on inventories are equal to the change of market value of inventories less net purchases, but common inventory accounting practices can distort this measure. The FIFO (first-in, first-out) method, which measures the profit on an item sold out of inventory by the selling price less the original cost, will lead to exaggerated profits during periods of rising prices. The Department of Commerce handles this problem by computing the inventory valuation adjustment (IVA) to add to

corporate profits, to make sure that only the physical changes in inventories are included in investment.\*

We have four definitions of corporate saving to start with - RN, RN+IVA, RG, and RG+IVA. The relationship between these four measures of corporate saving does shift over time. After the introduction of accelerated depreciation accounting techniques in 1954 the RG measures grew faster than the RN measures until 1960 as firms adopted the more rapid techniques. There was some further growth in the RG measures relative to the RN measures through the '60's. During the inflation of the late '60's a larger fraction of accounting profits became due to inventory profits and the IVA (which was negative throughout this period) grew in magnitude (indeed, by the middle of 1974 the IVA was larger than undistributed profits), so the ratio of the profit terms plus IVA to the profit terms dropped.

There is no particular reason to choose any one of these corporate saving measures. To use RN or RG asserts that there is no accounting problem with inventories, and will lead to exaggerated measures of profits since the late '60's. To use RN+IVA or RG+IVA handles the inventory problem, but there is still the problem of capital asset depreciation accounting. Recently the Department of Commerce has engaged

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\* The IVA is not the best adjustment to make because it ignores capital gains from changes in the relative prices of inventories and so does not correspond to a Haig-Simon definition of corporate income as distributed profits and the change in net worth of initial shareholders. Shoven and Bulow's work (42) indicates that, at least before 1973, the IVA is reasonably close to a Haig-Simon correlation.

in a major revision of the National Income Accounts and part of this revision has included an attempt to measure the magnitude of this problem. The Bureau of Economic Analysis (51, 53) has estimated depreciation allowances in excess of true economic depreciation for the period back to 1947 (capital asset depreciation is measured, for the purposes of these computations, at replacement costs). The data, which result in a series called the "capital consumption adjustment" (to serve the same sort of role as the older inventory valuation adjustment) is quite revealing, showing that not until 1962, after depreciation allowances were liberalized and the investment tax credit enacted for the first time, was accounting depreciation as great as true economic depreciation (if we accept the assumption of the new National Income Accounts data on service lives of capital equipment (Shoven and Bulow, (42), and Coen, (10), who made their own assumptions about service lives, constructed similar series). This indicates that before 1962 all of the corporate saving measures so far discussed over-estimated true corporate saving, since accounting depreciation was less than true economic depreciation - part of RN was really depreciation of capital assets rather than true economic profit. The casual assumption that a measure which includes capital consumption allowances overestimates true corporate saving and a measure which excludes them under-estimates true saving was apparently false during this period. After 1962 some of the corporate saving measures (the ones with capital consumption allowances) appear to overestimate true corporate saving while the others underestimate it (by the middle of 1974 the capital consumption adjustment became negative

as the liberalization of depreciation allowances lost ground to the growing replacement cost of capital equipment - once again, as in the period before 1962, true economic depreciation was greater than accounting depreciation).

From now on, unless otherwise noted, the term "corporate saving" (and the symbol CS) will refer to the National Income Accounts measure which is the sum of undistributed profits plus the inventory valuation adjustment plus the capital consumption adjustment.

Now it is the time to see how labor income, property income other than corporate saving, corporate saving, and wealth affect personal consumption. Since the corporate saving data was derived from the 1976 revision of the National Income Accounts the data on labor and the rest of property income was also derived from the revised data. The consumption and wealth data were taken from the revised data bank of the MPS model.\* The concept of consumption is the "use" one. All data is quarterly and the flow variables are seasonally adjusted at annual rates. All data is in per capita 1972 dollars (since that, rather than 1958, is the base year for the new national income accounts). The price deflator used is the consumption deflator of the MPS model and the population figures are the beginning of quarter figures published in Business Statistics (51).

Table 3-II explores various very simple specifications of the consumption function designed to compare "Kaldorian" (26) and life-cycle

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\* Douglas Battenberg of the Board of Governors of the Federal Reserve supplied the new MPS data.

Table 3-II

Kaldorian And Life Cycle Consumption Functions,  
 United States, 1955:IV-1972:IV  
 (Standard Errors In Parentheses)

1.	$C_t = 197.228 + .962 LY_t + .0468 P2_t$	SE = 30.40
	(27.350) (.0159) t (.0756) t	SSR = 61009
		DW = .3998
2.	$C_t = 104.928 + .864 LY_t + .0275 W_{t-1}$	SE = 25.76
	(29.409) (.0222) t (.00535) t-1	SSR = 43787
		DW = .4619
3.	$C_t = 63.303 + .852 LY_t - .281 P2_t + .0426 W_{t-1}$	SE = 26.63
	(29.278) (.0201) t (.0767) t	SSR = 36298
		DW = .5389
4.	$C_t = 225.813 + .822 LY_t + 1.075 P1_t - .229 CS_t$	SE = 26.12
	(24.193) (.0314) t (.218) t (.0857) t	SSR = 44330
		DW = .3838
5.	$C_t = 82.424 + .681 LY_t + .863 P1_t - .630 CS_t + .0469 W_{t-1}$	SE = 15.15
	(18.877) (.0221) t (.128) t (.0610) t (.00413) t-1	SSR = 14694
		DW = .8009

$C_t$  = Consumption in Quarter t.

$LY_t$  = Labor Income After Taxes in Quarter t.

$P1_t$  = Property Income in Disposable Income (After taxes) in Quarter t.

$CS_t$  = Corporate Saving in Quarter t.

$P2_t$  =  $P1_t + CS_t$ .

$W_{t-1}$  = Net Worth at Start of Quarter t.

models in a simple way. The period of estimation is 1955:IV-1972:IV. The estimation technique is ordinary least squares. Five specifications are presented: Consumption is regressed against 1, labor income and property income (including corporate saving), 2, labor income and wealth, 3, labor income, property income including corporate saving, and wealth. 4 and 5 repeat 1 and 3 with corporate saving treated as a separate variable.

Not surprisingly all equations suffer from severe problems with serially correlated errors as evidenced by their low Durbin-Watson statistics. When the equations are re-estimated by the Cochrane-Orcutt technique all except 3 have considerably lower coefficients on labor income and property income other than corporate saving, and considerably higher constants. However, the relative size of the coefficients is unaltered.

Equation 1 is a version of the "Kaldorian" consumption function, splitting national income after taxes into labor and property shares. It can easily be seen that the assumption that "workers" spend everything they earn and "capitalists" save everything is strongly supported by this equation (but Cochrane-Orcutt re-estimation of this equation cuts the coefficient on labor income in half). However, equation 2, with a better fit than 1, indicates that we can more readily accept the simple life-cycle story that current property income is merely a poor proxy for wealth, hence its low coefficient. The coefficient on wealth in equation 1 is roughly in line (although low) with previous estimates and is also significantly greater than zero. If we accept 5% as a reasonable



approximation to the real rate of return in the U.S., then the coefficient on wealth in 2 implies a coefficient on property income of .55, instead of the .0468 estimated in 1. Equation 3 estimates that property income has a negative coefficient when wealth is added to the consumption function. But it should be remembered that equation 1, in the light of the wealth coefficient in 2, indicates that the current value is not a good proxy for permanent income from wealth, so this equation tells us little about the effect of permanent property income in the presence of wealth in the consumption function. Equations 4 and 5 emphasize what may have occurred to the reader - the slight effect of property income in the consumption function is a combination of the strong effect of that part of property income which is a part of disposable personal income and the small (estimated as negative) effect of corporate saving. Equation 5, which has much the best fit of any of those in the table, claims that corporate saving has a strong perverse effect on consumption - an increase in corporate saving stimulates personal saving, which is hard to reconcile with the rest of property income discouraging saving!

The significant coefficients on wealth in 3 and 5 along with the better fits of these equations in comparison with 1 and 4, do indicate the weaknesses of the Kaldorian view that the MPC's out of labor income and property income are greatly different due to class differences. The difficulties in measuring coefficients on property income is likely due to the noise in the corporate saving series and the colinearity of P1 with the labor income series.

Modigliani and Tarantelli (39) reconciled results from Italian data like 1 and 3 with the life cycle result 2 by allowing property income to affect consumption with a lag. The remainder of this chapter will be devoted to attempts to test whether similar results hold for American data, using standard techniques.

Table 3-II explores various specifications of the consumption function with distributed lags. Permanent labor income was approximated by current labor income and a five quarter second degree polynomial distributed lag on past labor income with the weight on quarter  $t-7$  constrained to equal zero. Three concepts of permanent property income were used: The first is current property income other than corporate saving and a seven quarter second degree polynomial distributed lag on past property income (P1) with the weight on quarter  $t-9$  constrained to equal zero. The second measure is exactly the same as the first except that corporate saving is added to the rest of property income (P2). The third measure is a combination of the same lag on P1 as the first measure, but with a separate lag on CS. Permanent corporate saving is approximated by its current value and a 14 quarter third degree polynomial distributed lag on past values with the weight on quarter  $t-16$  constrained to equal zero. We would normally expect, all of these lag weights to decline.

The logic of each of these three measures of permanent property income is as follows: The first measure asserts that consumers are myopic; that they do not take corporate saving into account in making their consumption decisions except insofar as it affects wealth. This

measure might be likened to what Tobin and Dolde (49) call "liquidity" views of consumption, where cash income will have a stronger influence on consumption than imputed income. The second measure asserts that consumers see completely through the corporate veil. They are perfectly rational and are fully aware that corporate saving is on the shareholder's behalf. Using this measure asserts that an increase in corporate saving - out of a given value of corporate income - will reduce personal saving by an equal amount (excepting tax considerations.) The third measure of permanent property income represents a compromise between the other two. Unlike the first, it does not assert that consumers are myopic in regards to undistributed corporate income, but unlike the second it asserts that consumers distinguish between components of corporate income in making their consumption decisions. This may be for either or both of two reasons. Either changes in corporate saving decisions signify changes in expectations of corporate profits and revisions of permanent property income (this reason is similar to "informational content of dividends" hypothesis which holds that corporations will not increase or cut dividends unless the managements feel that they can maintain the change, hence that a change in dividends gives more information about future profits than a change in undistributed profits). The other reason that changes in corporate saving may have different effects upon consumption than changes in other components of property income is the liquidity consideration that consumers have more trouble in adjusting their consumption decisions to changes in this component of income rather than to changes in other components which are paid in cash or accrue directly to

the consumer without the intervention of the corporate structure or the capital markets.

The estimation period for the equations was 1955:IV to 1972:IV. The estimating technique was ordinary least squares, with the Cochrane-Orcutt technique used to correct for first order serial correlation. No distributed lag on wealth was used. No evidence of any strong lag on the stock market component of wealth appeared with these specifications and it appeared simpler to just consider current wealth rather than complicating matters with the lags. The constant term was suppressed - the theory does not call for one and the use of one did not make very much difference in the results when added. In summary the main distinction between these regressions and the ones at the end of the previous chapter are:

- (a) The use of labor and property income rather than disposable income and corporate savings.
- (b) The reporting of GLS rather than OLS results (in general the OLS results of the specifications in the previous chapter were more favorable to previous work and conclusions on the role of corporate saving in current consumption than the GLS results and were therefore reported).
- (c) The use of the 1976 revision of the National Income Accounts rather than the previous series.
- (d) The use of current wealth rather than a lag on wealth.
- (e) The suppression of the constant term. The unemployment rate term used in the previous chapter was also eliminated - it seems unsuitable to use such an ad hoc procedure. The unemployment rate

is trendless, and it is dimensionally awkward to have it explaining strongly trending consumption.

Equation II-1 is the labor income and wealth specification; equations II-2 through II-4 are versions of equation (3-10) with labor income and the three definitions of property income; equations II-5 through II-7 are versions of equation (3-11), using labor income, property income, and wealth. Equation II-8 combines labor income and PI in an analogy to a disposable personal income and wealth specification.

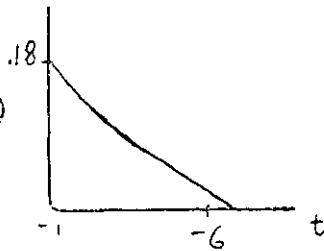
With these remarks behind us it is time to look at the regression results. The fits of all equations are in some sense "good" with the standard errors amounting to about one half of one percent of the mean value of consumption over the period. However, the estimated coefficients of serial correlation are all quite high. Equation II-1 exhibits a great deal of serial correlation. The coefficient on wealth is significantly greater than zero, but it is quite small by usual standards - less than 3% when other wealth effects estimates have been strong as 5% or more. (Modigliani, (36)). This problem appeared to be coming from the stock market component of wealth. The standard error of the regression is around four tenths of a percent of the mean of the dependent variable, but if we ignore the effect of the lagged error term the standard error will more than double. The lag structure on labor income has a shape in accord with usual expectations, with the coefficient on current labor income considerably higher than any of the lagged values, and the lagged values trailing off steadily to zero, with two thirds of the lag weight occurring in the first three quarters after an increase in labor income.

Table 3-III

Labor Income, Property Income, and Wealth Effects  
On Consumption, 1955:IV-1972:IV

$$1. C_t = \frac{.285 LY_t}{(.0571)^t} + \sum_{i=1}^6 a_i LY_{t-i} + \frac{.0299 W}{(.00568)^{t-1}} + \frac{.850}{(.0639)^{t-1}} \mu_{t-1}$$

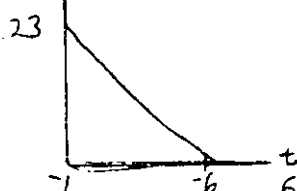
$$\sum_{i=1}^6 a_i = \frac{.615}{(.0591)}$$



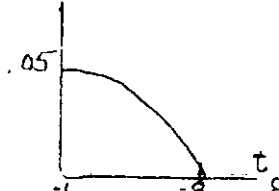
SE = 10.42  
SSR = 6948  
DW = 1.8461

$$2. C_t = \frac{.356 LY_t}{(.0647)^t} + \sum_{i=1}^6 a_i LY_{t-i} + \frac{.315 P1}{(.172)^t} + \sum_{i=1}^8 b_i P1_{t-i} + \frac{.945}{(.0397)^{t-1}} \mu_{t-1}$$

$$\sum_{i=1}^6 a_i = \frac{.595}{(.0911)}$$



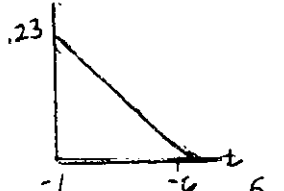
$$\sum_{i=1}^8 b_i = \frac{.375}{(.489)}$$



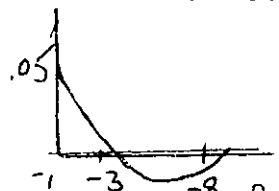
SE = 11.84  
SSR = 8692  
DW = 1.8976

$$3. C_t = \frac{.321 LY_t}{(.0695)^t} + \sum_{i=1}^6 a_i LY_{t-i} + \frac{.0983 P2}{(.0934)^t} + \sum_{i=1}^8 b_i P2_{t-i} + \frac{.936}{(.0426)^{t-1}} \mu_{t-1}$$

$$\sum_{i=1}^6 a_i = \frac{.715}{(.0749)}$$



$$\sum_{i=1}^8 b_i = \frac{-.0223}{(.215)}$$



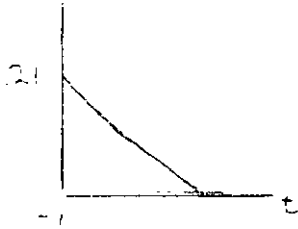
SE = 12.04  
SSR = 8990  
DW = 1.8374

$$4. C_t = \frac{.379 LY_t}{(.0815)^t} + \sum_{i=1}^6 a_i LY_{t-i} + \frac{.357 P1}{(.184)^t} + \sum_{i=1}^8 b_i P1_{t-i} - \frac{.0763 CS}{(.139)^t}$$

$$+ \sum_{i=1}^{15} c_i CS_{t-i} + \frac{.951}{(.0374)^{t-1}} \mu_{t-1}$$

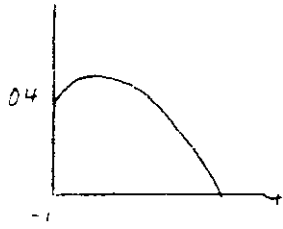
$$\sum_{i=1}^6 a_i = .573$$

(.115)



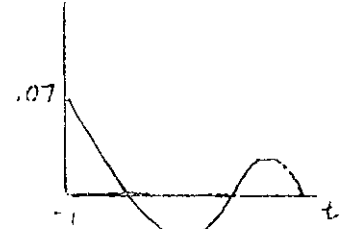
$$\sum_{i=1}^8 b_i = .362$$

(.532)



$$\sum_{i=1}^{15} c_i = -.0477$$

(.358)



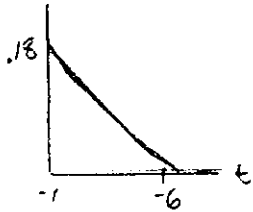
SE = 12.12  
SSR = 8522  
DW = 1.9318

$$5. \quad C_t = .266 LY_t + \sum_{i=1}^6 a_i LY_{t-i} + .204 P1_t + \sum_{i=1}^8 b_i P1_{t-i} + .0311 W_t + .844 \mu_{t-1}$$

(.0588) t (.115) t-1 (.152) t (.00579) t-1 (.0651) t-1

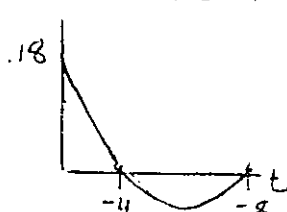
$$\sum_{i=1}^6 a_i = .572$$

(.0733)



$$\sum_{i=1}^8 b_i = .192$$

(.381)



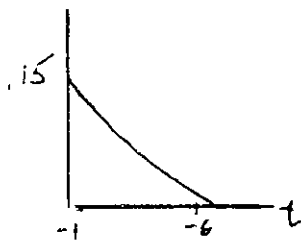
SE = 10.24  
SSR = 6401  
DW = 1.9804

$$6. \quad C_t = .270 LY_t + \sum_{i=1}^6 a_i LY_{t-i} - .000412 P2_t + \sum_{i=1}^8 b_i P2_{t-i} + .0312 W_t + .819 \mu_{t-1}$$

(.0616) t (.0652) t-1 (.0858) t (.00590) t-1 (.0696) t-1

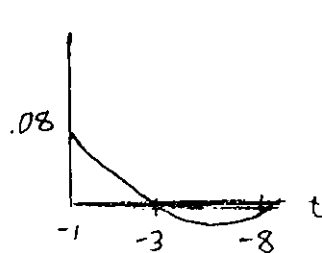
$$\sum_{i=1}^6 a_i = .632$$

(.0652)



$$\sum_{i=1}^8 b_i = -.0516$$

(.137)



SE = 10.48  
SSR = 6704  
DW = 1.8573

$$7. C_t = .298 LY_t + \sum_{i=1}^6 a_i LY_{t-i} + .287 P1_t + \sum_{i=1}^8 b_i P1_{t-i} - .233 CS_t + \sum_{i=1}^{15} c_i CS_{t-i} + .0394 W_{t-1} + .717 \mu_{t-1}$$

(.0666)  $t$   $t-1$   $t$   $t-1$   $t$   $t-1$   $t-1$   $t-1$

$$\sum_{i=1}^6 a_i = .474$$

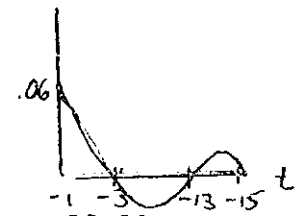
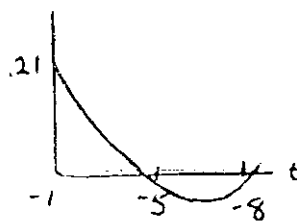
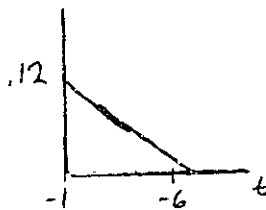
(.0845)

$$\sum_{i=1}^8 b_i = .394$$

(.354)

$$\sum_{i=1}^{15} c_i = -.131$$

(.184)



SE = 10.10  
SSR = 5812  
DW = 1.9009

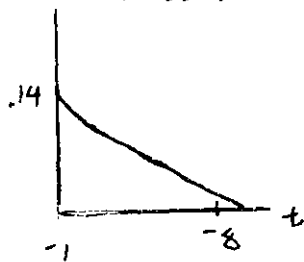
$$8. C_t = .257 (LY+P1)_t + \sum_{i=1}^8 a_i (LY+PY)_{t-i} + .0296 W_{t-1} + .839 \mu_{t-1}$$

(.0542)  $t$   $t-1$   $t-1$   $t-1$

$$\sum_{i=1}^8 a_i = .536$$

(.0552)

SE = 9.97  
SSR = 6358  
DW = 2.0018





All lag weights but the last are more than twice their standard errors and the total MPC out of labor income is quite high at .9. The strong weight on lagged income is odd as labor income is a fairly smooth series. Hall (23) has suggested that it is useful to regard consumption as a random walk about the disposable income trend. Hence a change in labor income (which is the bulk of disposable income) should be associated with a change in consumption without much of a lag.

Equations 2 through 4 report the result of using labor income and an estimate of "permanent property income". The fit of each consumption function is worse (measured by the standard error and the coefficient of serial correlation) than the labor income and wealth specification. What is strange is that the effect of wealth on consumption seems to show more strongly in current property and labor income rather than their lagged values. This is shown by the increase in the coefficient on current labor income in from 1 to 2 (.284 to .358). The first lagged value on labor income also rises slightly but all others fall. The coefficient on current P1 is quite large - in fact, almost as large as that of labor income - and almost twice its standard error, but the lagged values are fairly insignificant and follow nearly a hump shape, falling only gradually at first. This hump shape may be due to the property income terms picking up some of the effect of wealth since the value of wealth may reflect lagged more than current property income. Equation 3 uses P2 as its definition of property income. Once again the fit is poorer than 1. In this case all of the coefficients on labor income rise with the replacement of wealth by property income - indeed the sum of the

coefficients is an improbably high 1.036. The lagged values of property income decline below zero after the second quarter. Equation 4 uses P1 and CS with separate lags as its definition of property income. The behavior of the P1 and labor income terms are similar to equation 2, with a high coefficient for current P1 and insignificant lagged values (with the inverted U lag shape), and current labor income's coefficient increasing from .285 to .379 and lagged values falling. Current corporate saving has a negative and insignificant coefficient; lagged values of CS have coefficients ranging from positive to negative after two quarters, and positive after 12 quarters. The total effect of corporate saving is estimated as being less than zero, and none of the coefficients are significantly different from zero by usual standards. The negative effect may be due to corporate saving picking up cyclical effects that were picked up by the unemployment rate term in the first chapter's regressions.

In summarizing the first part of this table we see that a specification using wealth instead of a lag on property income tends to explain consumption behavior somewhat better, and also estimates coefficients somewhat more in accord with our priors (despite the high labor income coefficients and low wealth coefficient). In choosing between property income terms P1 gives a slightly superior fit than the other definitions.

The second part of the table explores specifications with permanent labor income, permanent property income, and wealth. Equation 5 uses P1 and wealth. The overall fit of 5 is very slightly better than 1, which is some evidence that property income has a role to play in a consumption

function with wealth. The addition of property income reduces the lagged effect of labor income. The lag structure on P1 may be reasonable with a steady decline after the sharp initial impact, although the decline below zero after the third quarter is surprising - one would expect that the lag on property income would be longer than that of labor income. The addition of wealth (in comparison with 2) does reduce the effect of property income. Equation 6 uses P2 and wealth. There is no improvement in fit over the labor income and wealth specification and the property income coefficients are very small and insignificant. Equation 7 uses P1 and CS and wealth. For the first time the wealth coefficient is fairly large, and the fit of the equation is greatly superior to the others especially allowing for the lower serial correlation. The total value of the labor income terms is .772 - smaller than the other equations and more in the line of other work (Ando and Modigliani (1)). But the other coefficients argue against any blanket acceptance of the hypothesis of partly myopic consumers that this equation embodies. The current coefficient on P1 declines between 4 and 7 but the lagged values do not fall with the addition of wealth - the lag simply changes shape to one similar to that on P1 in equation 5. The addition of wealth does lower (algebraically) the corporate saving coefficients across the line. When we lump labor income and P1 together and regress consumption against the sum and wealth (equation 8) we get a consumption function essentially with disposable personal income and wealth. In comparing 8 and 5 we see that lumping the two types of income together results in the lowest standard error of any equation so far tested, but the estimated coefficient of

serial correlation is higher than 7's.

The major results of Table 3-III can be summarized as follows:

- (1) As in Table 3-II, wealth and labor income give a better explanation of consumer behavior than labor and property income.
- (2) The best explanation of consumer behavior comes from using wealth and both labor and property income. But, the coefficients of property income are subject to considerable error. While we cannot accept a hypothesis that corporate saving has the same effect on consumption as Pl, we cannot reject the hypothesis that Pl has the same effect as labor income, even when wealth is added to the equation.

While we may expect a coefficient on corporate saving smaller than Pl or even zero, the results in Table 3-III that CS has a zero or negative coefficient but improves the fit of the consumption function requires some explanation. No standard theory would lead to this result, but the high SE's on the CS coefficients may lead us to suspect that the negative coefficients are spurious. The large SE's on all the property income terms may lead us to question the advantages of using the traditional distributed lag technique of estimating MPC's out of various forms of income. Certainly some of the problems in estimating MPC's out property income is a collinearity problem of estimating the separate effects of strongly trending variables such as labor income and Pl. Corporate saving, which has a weaker trend, may have a perversely negative coefficient because the procyclical corporate saving term is

measuring some of the countercyclical behavior of consumption.

In order to more accurately measure property income effects on consumption we will need estimators of permanent property income that will not be contaminated by simultaneously estimating the weights on current and past income used to construct the permanent series and also attempting to explain consumption data, recognizing that wealth is discounted permanent property income.

The next chapter will deal with the consequences of altering the treatment of property income in the consumption function. We will directly estimate permanent property income from the definition of wealth as capitalized permanent property income, and use this estimate in the consumption function. In concluding this chapter, we note that conventional procedures do not shed much light on the role of property income in the consumption function. One result of this chapter is that some doubt has been cast on the conventional disposable income and wealth specification - which seems to rest on no firmer ground than the large standard errors of property income coefficients in equation III-5. Corporate saving does improve the fit of the consumption function, as illustrated by equation III-7, with the improvement in fit over the labor income and wealth specification. However, corporate saving does not act like a simple income variable - certainly not like  $P_1$ .

CHAPTER 4

PROPERTY INCOME, WEALTH, AND CONSUMPTION: FINAL TESTS

The results of the previous chapter indicate that the traditional method of approximating the permanent fraction of various types of income by estimating distributed lags on current and past values of realized income in consumption functions does not give us a good handle on the two chief problems of this thesis, which are estimating the role of property income in consumption functions independent of wealth's and estimating the effect of corporate saving on permanent property income. In this chapter we will derive an alternate estimator of permanent property income and apply it to the consumption function. We will also use a somewhat modified specification of the consumption function which recognizes the importance of the division of income between before and after tax income.

It was noted in the previous chapter that the property income terms did not seem to be highly correlated with wealth. The coefficients on corporate saving were negative, even when wealth was excluded from the regression, and the coefficient on the non-corporate saving component of property income did not decline greatly when wealth was added as a variable (particularly in the specification including corporate saving). The procedure to be described is an attempt to circumvent such problems.

We start with a more formal definition of permanent property income. Following the original Friedman (20) notion, we define permanent property income from an asset as that constant stream of income, which when properly discounted, gives the value of the asset. Then if we denote A

as the value of an asset, YP as the permanent income from it, and r the capitalization rate, YP is the solution to

$$(4-1) \quad A = YP/r.$$

We then have

$$(4-2) \quad \ln A = \ln YP - \ln r$$

If we assume that

$$(4-3) \quad \ln YP = \sum_0^{\infty} \alpha_1 \ln Y_{-1} + \epsilon$$

where  $\epsilon$  is a random error term and Y is the income from an asset, then

$$(4-4) \quad \ln A = \sum_0^{\infty} \alpha_1 \ln Y_{-1} - \ln r + \epsilon.$$

Equation (4-4) is the fundamental equation of this section. We note that we have, in principle, all of the data (wealth, income, and interest rates) necessary to estimate it, and we will have estimates of permanent income from non-human wealth which do not rely on consumption data - we can estimate permanent income separately from the propensity to consume out of permanent income. In addition the size and significance of the coefficient on the log of r gives a measure of changes in the capitalization rate of the asset and thus an indication of changes in the real rate of return.

It is assumed in this section that the value of an asset is determined by capitalizing gross of tax permanent income by a gross of tax discount rate. A change in tax rates should only alter the valuation of an asset if it changes relative yields among assets. While we have

some data on ex-post effective tax rates, it would be extremely difficult to measure the ex-ante effect of tax changes on relative yields, and such effects are likely to be swamped by other factors changing relative yields (changes in risk premia and changes in the term structure of interest rates, for example).

I have split the MPS aggregate net worth series into two components -- stock market and non-stock wealth. The determination of permanent income from each type of asset will be discussed in turn.

#### Stock Market Wealth.

The value of stock is determined by expected profits (net of corporate tax) and a real rate of return (or capitalization factor) appropriate to stock. It is assumed that expected profits are affected differently, in the short run, whether or not a change in profits is in the form of dividends or corporate savings. Since corporations are usually reluctant to cut dividends, it is often maintained (e.g. by Modigliani-Miller (31)) that an increase in profits in the form of dividends has a greater effect on expected profits than an increase in corporate savings. The idea is that investors form a notion of permanent profits by multiplying current dividends by a measure of the permanent profits to dividend ratio, which I take as an average of recent profits to an average of recent dividends. Hence an increase in dividends, even unaccompanied by an increase in profits, will have a sharp effect on permanent profits (even though it will depress the permanent profit-to-dividend ratio). An increase in profits not accompanied by an increase in dividends will have only a slight effect on permanent profits, since



it will merely raise the permanent profits-to-dividends ratio slightly. To capture this effect I assume that the expectation of the log of profits is the sum of two distributed lags; one on current and past values of the log of profits, and the other on the current and past values of the log of dividends.

Hence the equation to be estimated is of the form

$$(4-5) \quad S = \sum_0^{\infty} \alpha_i P_{-i} + \sum_0^{\infty} \beta_i D_{-i} + \ln r + \epsilon$$

where S is the log of real per capita stock market wealth, D is the log of real per capita dividends, and P is the log of real per capita profits.

There are two serious questions connected with estimating (4-5); that of determining the appropriate real rate of return to use for the capitalization rate and that of measuring profits.

The main problem connected with measuring the real rate of return is of course measuring the expected rate of inflation. Trying to estimate the expected rate of inflation directly in (4-5) along with the rest of the coefficients would involve complex non-linear estimation. To avoid this complication I have used a separate measure of the real rate of return from the stock market. I have used the weights on the Aaa bond rate and the rate of inflation of the implicit consumption deflator in the January 1975 (30) and the current MPS model's equation for the dividend yield (I have also included the other coefficients in the MPS equation in the real return expression - a constant which changes value after 1967 (when inflationary expectations are assumed to start), and a pair of terms which measure the effect of uncertainty (as defined by the variance

of the unemployment rate) upon the stock market, which chiefly serve to capture the differential rate of return that equity has relative to bonds), which is essentially an equation explaining the ratio of profits to equity value. The MPS equation has a 4 quarter lag on the bond yield and a 15 quarter lag on the rate of inflation. The sum of the coefficients on the nominal interest rate is 1, and the sum of those on the rate of inflation is  $-.997$ ; almost  $-1$ .

It should be mentioned that the choice of a capitalization rate (for example, feeding back the error in the MPS equation via an estimated coefficient of serial correlation) does not lead to a great change in the estimated lag weights on profits and dividends.

It has been mentioned in previous chapters that the cyclical element in profits creates great problems in estimating the MPC out of corporate savings. A similar problem arises in estimating permanent profits for determining wealth. Profits are a strongly cyclical variable, and there will tend to be a downward bias in estimating their permanent component without some adjustment being made. A simple adjustment was made to correct for this problem. Current corporate profits (dividends plus undistributed corporate profits plus inventory valuation and capital consumption adjustments) was weighted by a crude measure of the cycle. The measure of the cycle was the ratio of the current unemployment rate to the mean of the current and previous 11 quarters' rates. This measure has the desirable property that it increases when the unemployment rate increases (presumably when transitory profits are negative).

There are some additional properties we wish the lag weights on

dividends and profits to have. By the Modigliani-Miller Theorem we do not expect an increase in dividends, without a subsequent increase in profits, to have a sustained effect on expected profits. However, we may expect that an increase in dividends will have a greater short-run effect on profit expectations than an increase in corporate saving. We therefore expect to find in equation 5 that  $\sum \beta_1 = 0$  but not each  $\beta_1$  to be zero; in particular, the initial coefficients should be considerably greater than zero.

On the same basis we expect that an x% increase in profits will ultimately lead to an x% increase in the valuation of stock (given the capitalization rate). Hence we expect  $\sum \alpha_1 = 1$ .

The equation was estimated by the iterated Cochrane-Orcutt technique for the period 1955:IV-1972:IV. The expectation of the log of profits was assumed to be formed by an unconstrained eight quarter second degree polynomial distributed lag on current and past profits, each value being multiplied by the cyclical indicator. The expectation of the log of dividends was formed by a similar five quarter lag. Some experimentation with different lag lengths confirmed the notion that the distributed lag to form anticipated profits should be longer than that for the smoother dividend series. Constant terms proved to be small and insignificant when included and were omitted. It was found that the three constraints that  $\sum \beta_1 = 0$ ,  $\sum \alpha_1 = 1$  and that the coefficient on the real return is -1 could be accepted at a 99% confidence level by a likelihood ratio test.

The results of the stock market equation (Table 4-I) are quite good. The lag structure on dividends squares quite well with the

Table 4-I

Stock Market Wealth, 1955:IV-1972:IV

$$\log STK = - \log RTR + \sum_{i=0}^7 a_i \log P_{-i} + \sum_{i=0}^4 b_i \log DIV_{-i} + .707 \mu_{-1} \quad (.0855)^{-1}$$

			DW = 1.4142
$a_0$	= .1552 (.0287)	$b_1$	= 1.0734 (.2143)
			SE = .0452
			SSR = .1307
$a_1$	= .1452 (.0243)	$b_1$	= .2021 (.1650)
$a_2$	= .1358 (.0200)	$b_2$	= -.3346 (.1478)
$a_3$	= .1271 (.0143)	$b_3$	= -.5367 (.1071)
$a_4$	= .1193 (.0082)	$b_4$	= -.4042 (.2100)
$a_5$	= .1121 (.0123)		
$a_6$	= .1057 (.0270)	$\sum b_i$	= 0
$a_7$	= .0996 (.0467)		

$$\sum a_i = 1$$

- STK = Stock Market Wealth
- RTR = Real Rate of Return From MPS Model
- P = Cycle Adjusted Profits
- DIV = Dividends

informational content hypothesis, with the large initial coefficient (1.1) being offset by the later negative terms. The impact elasticity of wealth with respect to dividends being estimated as greater than one is out of line with the informational content hypothesis, which suggests one as an somewhat upper bound. The profits lag has a smaller leading coefficient (.16) than dividends, but all terms are consistently positive and significant. The estimated coefficient of serial correlation is not especially high and indicates that the RHS variables are explaining a great deal of the variance in the stock market term - the close fit is not just due to the serially correlated error. Since the equation is in log linear form the estimated standard error gives the mean percent error in the equation, which is slightly less than 5%, which, once again, does not seem too great for such a noisy variable as the stock market. The implied measure of permanent corporate income is a weighted geometric average of profits and dividends. It increases sharply in the short run when the corporate saving ratio falls, but after two years this effect disappears. Thus if permanent corporate income does positively affect consumption we will find that there will be a decline in consumption in the short run if dividends fall.

Regressing stock market value on the real return and profits amounts to accepting the notion that the MPS coefficients adequately explain the stock market capitalization rate. This was done, and the equation presented here proved to be a considerable improvement on that specification. One may wish then to consider 4-I as an improvement on the MPS equation which recognizes that the current ratio of profits to

dividends is not the permanent one.

Since the cyclical variable in multiplying profits and we are estimating a log linear specification we may separate the cyclical variable from profits in the regression to test whether or not their coefficients differ. This was done and it was found that the hypothesis that profits and the cyclical variable have a different lag structure could be rejected at a 99% confidence level.

In conclusion, we make the following observations about the stock market equation:

- (1) The lag coefficients assert that a 1% increase in the dividend payout ratio, will, in the quarter it occurs, lead to roughly a 1% increase in permanent income from stock, and assuming that the capitalization rate is unchanged, a 1% increase in the aggregate value of stock.
- (2) Inflation only affects stock values insofar as it affects the real rate of return, the level of profits, and the payout ratio. Efforts to find an independent inflation effect on the market by adding the current nominal interest rate as a variable proved unsuccessful.
- (3) Not surprisingly the equation had the most trouble tracking sharp market movements, such as the bull markets of 1961, early 1971, and 1972 and the market breaks of 1962 and 1970. The errors during these periods amounted to 10% or more of market value.

### Non-Stock Market Wealth

The same basic procedure was used for estimating the permanent income from non-stock market as from stock market wealth. However, many of these assets (which include housing, land, durables, and fixed nominal value financial assets) consist of goods and financial claims which are traded on very imperfect markets, if at all. This may imply that an increase in the productivity of capital in this sector will not lead to any change in the (posted) valuation of these assets because of the thinness of markets, high transaction costs, and similar phenomena. Changes in the real rate of return may then have had little effect on posted valuation unless they were of substantial magnitude, which seems doubtful for the post-War U.S. On the other hand, changes in the nominal interest rate will effect the income from fixed nominal claims and will effect the value of newly issued bonds.

The income from these assets consists of the NIA series on dividends, rents, personal interest income and proprietor's income. To this is added the imputed interest from durables and subtracted is the interest paid by consumers, the MPS definition of dividends, and the imputed labor income of proprietors (which is estimated by applying the average wage in an industry to the hours worked by proprietors).

A simple regression of the log of non-stock wealth on an 18 quarter second degree polynomial distributed lag on current and past income from these assets and various lags on the Aaa bond yield led to disappointing

results.\* The sum of the lag coefficients on the property income terms was only .676 - far less than the hypothesized one.

These results indicated that a different specification was needed. The specification just discussed assumes that our estimate of the imputed labor income of proprietors is a good approximation of what needs to be subtracted from total income to estimate what is capitalized in valuating assets. This may be too strong an assumption. Inspection showed that the estimated labor income of proprietors grew more slowly than the property income from non-stock wealth. This suggests that we may be overestimating imputed labor income and that some portion of this income should be treated as a return from capital (we may perhaps think of this fraction as capitalized goodwill).

After some experimentation (by scanning over various fractions of the imputed labor income series) it was found that adding one-fourth of the imputed labor income of proprietors to the property income series gave an estimate of property income which satisfied the constraint of a unitary long run elasticity of wealth with respect to income from wealth.

The estimated equation was of the form

$$(4-6) \log NS = \sum_0^{17} \alpha_1 \log (PY + .25LY)_{-1} + \sum_0^9 \beta_1 \log R_{-1} + \epsilon$$

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\* The wealth variable is beginning of quarter wealth - as contrasted with the average value used in the stock market equation. It may be argued that it is improper to include within quarter income and interest rates in the regression. However, it seems reasonable to me that the actual income from these assets and the interest rate are largely foreseen, and are reasonable proxies for the start of quarter forecasts.



where

NS = per capita real stock market wealth

R = Aaa bond rate

PY = per capita real income from non-stock market wealth

LY = per capita real imputed labor income of proprietors.

The coefficients on the nominal interest rate were estimated to lie on a 10 quarter unconstrained second degree polynomial. The lag structure on property income is assumed to follow an 18 quarter second degree polynomial, with no end constraints and the sum of the lag coefficients constrained to equal one (this constraint could be accepted at a 99% confidence level. Although the later lag coefficients proved insignificant, they were significant in the unconstrained case.

The results of the equation (Table 4-II) are moderately good. The estimated coefficient of serial correlation is quite high, but even when this is taken into account the standard error of the regression is only about 1% of the mean of the LHS variable. The coefficients on the interest rate terms sum to  $-.162$  with the lag decaying smoothly to zero.

The low interest elasticity may be justified by assuming that tangible assets have a constant real return, hence changes in the nominal rate only affect the value of the money fixed assets (other than money) in non-stock wealth. These assets have averaged approximately 30% of the value of non-stock wealth (including durables). Hence the interest elasticity of  $.165$ , while low, is not totally out of line with the fraction of wealth held in these financial assets (i.e., assuming a constant real rate on tangibles, a 1% increase in the nominal interest

Table 4-II

Non-Stock Wealth, 1955:IV-1972:IV

$$\log NS = 2.736 + \sum_{i=0}^9 a_i \log R_{-i} + \sum_{i=0}^{17} b_i \log (PY + .25LYP)_{-i} + .911 \mu_{t-1}$$

(.0570)

$a_0 = - .0297$ (.00933)	$b_1 = .0105$ (.0186)	$b_9 = .0842$ (.0493)	SE = .00409
$a_1 = - .0271$ (.00586)	$b_1 = .0274$ (.0167)	$b_{10} = .0815$ (.0542)	SSR = .001035
$a_2 = - .0243$ (.00436)	$b_2 = .0421$ (.0175)	$b_{11} = .0767$ (.0590)	DW = 1.2863
$a_3 = - .0214$ (.00450)	$b_3 = .0546$ (.0205)	$b_{12} = .0698$ (.0639)	
$a_4 = - .0183$ (.0049)	$b_4 = .0650$ (.0247)	$b_{13} = .0606$ (.0687)	
$a_5 = - .0151$ (.00483)	$b_5 = .0731$ (.0294)	$b_{14} = .0492$ (.0735)	
$a_6 = - .0118$ (.004261)	$b_6 = .0791$ (.0343)	$b_{15} = .0357$ (.0783)	
$a_7 = - .00832$ (.00391)	$b_7 = .0831$ (.0393)	$b_{16} = .0200$ (.0832)	
$a_8 = - .00471$ (.00535)	$b_8 = .0846$ (.0443)	$b_{17} = .0028$ (.0882)	
$a_9 = - .000957$ (.00888)	$\sum_{i=0}^{17} b_i = 1.0$		
$\sum_{i=0}^9 a_i = - .162$ (.0196)			

NS = Non-Stock Wealth

R = AAA Bond Yield

PY = Income From Non-Stock Wealth

LYP = Labor Income of Proprietors

rate will effect only 30% of the assets, so .30 is an upper bound on the interest elasticity). The distributed lag on the interest rate can be justified by noting that the face value of corporate bonds depends upon the coupon rate at time of issue, which for older bonds will be related to the yields at that time. Also the yields on other financial assets -- savings accounts, for example -- have tended to lag behind the bond yield because of regulatory constraints.

It should also be noted that the wealth series does not include the loss in value of older bonds as the result of higher interest rates. The income series does not include the capital losses of the fixed value claims due to inflation. To this extent it exaggerates the income from non-stock assets. At the same time the profits series estimated for corporate stock does not include the capital gains to equity owners from the loss in value of the fixed claims, and so the profits series is understated. To estimate these losses (which will effect the return from no more than 30% of non-stock wealth) we would need to decompose the non-stock wealth series into tangibles and financial assets, and estimate the expected capital loss by calculating an expected inflation rate (which would also have to be used in calculating a real rate of return to capitalize the modified income series). The consequences of ignoring these losses will be mentioned below in connection with the estimation of the consumption function.

The lag on property income is quite long, and follows an inverted U shape, with a peak occuring at 8 to 9 quarters. This long lag is probably the result of including housing and unincorporated businesses

(including farms) in the portfolio. The value of these assets are likely to be quite inelastic to current fluctuations in their (noisy) incomes.\*

Attempts were made to detect real interest rate effects by using the same real return that was used in the stock market equation, but proved unsuccessful.

The two wealth equations were projected through the end of 1976. The non-stock market equation projected with relatively little error, although it overpredicted by 100 billion dollars (about 3% of its value) at the start of 1976. The stock market equation was subject to considerably more error. This is not surprising; from early 1973 to the middle of 1974 the stock market lost one half of its nominal value and by early 1976 had gained it all back again, which was by far the most violent fluctuation in the post Korean period. The estimated stock market series (which had understated the extent of the 1972 bull market by some 10%) declined substantially less than the actual series (correcting for the error in 1972:IV by the estimated coefficient of serial correlation reduces the error in 1973 at the peak of the bull market but in raising the estimates misses the market trough in the middle of 1974 by an even greater margin than the raw forecast). The estimate rises substantially more than the true series after the middle of 1975, ultimately overstating stock market wealth by some 500 billion

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\* Durables probably should be included in with the other real assets in causing a long lag, but I have followed the MPS procedure of defining the nominal income from durables by the Aaa yield times the nominal stock, which precludes any lag.

dollars (about 50%) of value in 1976. Part of this problem is the fact that we are projecting quite a few years into the future from the end of estimation in 1972. A substantial part of the error is due to the nature of the distributed lag on the inflation rate. Most of the weight of the lag is on quarters 6 through 12. Hence from the middle of 1975 through the middle of 1976 a great deal of weight is given to the abnormal inflation of 1974, which depressed estimates of the real interest rate in this period and so inflated estimates of stock market wealth. Clearly a better measure of the real return will give a better projection of stock market behavior.

#### Estimation of the Consumption Function

We are now in position to begin to consider the use of the estimates of permanent property income implied by our wealth equations in the consumption function. Recalling equation (3-11), we have

$$C_t = A Y_{t-1} + B_1 r W_{t-1} + B_0 W_{t-1}.$$

We use our estimates of permanent income from each component of wealth to estimate  $r W_{t-1}$ . We can do this one of two ways. Either we estimate permanent income by the lag weights on each component of property income (which will amount to a geometric lag on current and past income values) or we multiply actual wealth by the estimate of the capitalization rate in each category - which is equivalent to multiplying the geometric lag on income by  $e$  raised to the power of the quarter's error in the wealth equation. The first procedure has the advantage of giving fixed weights on income (the weights are not scaled by the error in every period)

while the second method has the advantage of yielding estimates of permanent property income that are more highly correlated with wealth. Both procedures will be discussed in connection with the consumption function estimation.

The consumption function to be used in this chapter is considerably different in detail (other than the differential treatment of property income) than that used previously.\*

- (1) Taxes are treated quite differently than in previous chapters. Previously I have followed the customary practice of estimating permanent income by a distributed lag on after tax income. However, more careful consideration shows the extreme assumptions necessary for this specification. The traditional specification implicitly assumes that an estimate of permanent taxes is formed by taking a distributed lag on past taxes, with the weights equal and opposite to those on gross income. A moment's reflection should convince the reader that this procedure is inadequate to analyze consumer behavior to tax changes. In the case of a tax cut assumed to be permanent (e.g., 1964) there will be only a small fall in the permanent tax liability in the initial quarters. We are then assuming that the higher tax rates of the past are restricting consumption after the enactment of a permanent tax cut. A more appealing way to analyze the effect of tax changes on consump-

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\* The following discussion is largely taken from Modigliani-Steindel (38).

tion is to recognize that the permanent component of taxes should be proportional to income. Hence to measure permanent after tax income we simply multiply a lag on gross of tax income (constructed to approximate permanent gross of tax income) by 1 minus an estimate of the "permanent" tax rate. This procedure ties in quite well with our method for estimating permanent property income, since we merely multiply the already estimated lags on gross income by 1 minus the permanent tax rate. The permanent tax rate on a component of income is considered the average of the current and past quarter's liability divided by gross income. This technique smooths the occasional abrupt changes in tax rates from year to year, which, because of the assumption that rates are applicable for a calendar year, have been assumed to occur in the first quarter. This procedure has worked quite well in analyzing the response of consumers to the tax changes of the last 15 years (the 1964 tax cut, which was permanent, and the 1968 surcharge and 1975 rebate, which were not). It has been found that the data on consumer expenditures squares well with this theory, which predicts extremely rapid consumer response to the '64 cut and slower response to the later measures (Modigliani-Steindl (38)).

Our estimate of the permanent tax rate is the current rate. The '68 surcharge period (1968:IV -1970:II) is included in our sample period. It is not clear what the "permanent" tax rate

was in that period. In order to avoid any arbitrary imputations, and to avoid having these imputations contaminate our estimates, we simply included a dummy variable for the surcharge period.

- (2) It is doubtful that transfer payments should be lumped together with the rest of labor income. These payments are concentrated among groups whose income is below their lifetime norm. Accordingly we should expect the MPC's out of these payments to be higher than those for factor payments. Within transfers there should also be a distinction between social security payments and other transfers. There should be a high propensity to consume out of these payments by the beneficiaries, for the reason just given. There should also be a reduction in saving (and hence an increase in consumption) among non-beneficiaries when payments are increased, since increased payments to the retired of today can imply increased payments to the retired of tomorrow.\* Hence the MPC out of social security payments is not necessarily the same as that of the rest of transfers. However, other investigators (Taylor, (48), Juster and Taylor (24)), have found very high coefficients on transfer income in changes in saving equations, which implies very low estimates of the propensity to consume out of these payments.

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\* Note that this mechanism is not the sometimes advanced hypothesis that increased contributions for social insurance will stimulate consumption (Taylor (48)). I find it more reasonable to assume that these contributions are taxes on labor income.



It is my belief that these results are artifacts of data definition. It is an example of identifying a change in a component of income as a permanent change. On at least three occasions (the third quarter of 1965 and the second quarters of 1970 and 1971) the Federal Government increased social security payments and made the new levels retroactive to the first of the year. Hence the National Income Accounts record very large increases in these benefits in those quarters. One would expect that most of these windfalls would be saved, and indeed, large increases in personal saving are recorded in these quarters. It is then not surprising that such high coefficients on the change in transfers is found in changes in saving equations. I deal with this problem by separating the windfall payments from the rest of Social Security payments. The windfall payments are defined as the change in real per capita social security benefits in the quarters mentioned above. We would expect the coefficient on this variable to be very small in the consumption function.

- (3) The positive coefficients found on the unemployment rate in the use consumption equations in Chapter 2 and the effect of the cyclical variable in the stock market equation alerts us to the importance of cyclical factors in explaining consumption, especially when we are seeking to find the effect of corporate saving. The traditional specifications of the consumption function assume that the consumption of the unemployed is

given by spending out of transfer income and wealth. However, this spending may not explain all the consumption of the unemployed (many do not receive unemployment benefits; measured propensities to consume out of wealth are probably inadequate to explain the consumption of the unemployed, who probably have few assets).

The income expectations and hence the consumption of the unemployed should be related to general wage levels. Accordingly an attempt was made to capture this effect (along the lines suggested by Ando and Modigliani (1), and currently used in the latest (1977) version of the MPS model) by adding as a measure of the income expectation of the unemployed the number of unemployed times average labor income (net of tax labor income divided by the number of employed).

- (4) Wealth is separated into non-stock market wealth and the rest (which is stock market wealth and the small residual in the MPS net worth identity). The effect of stock market (actually non-non-stock) wealth on consumption is assumed to be described by a short (5 quarter) lag on current and past values.\* The justification for the lag is that there are costs involved in adjusting consumption to windfall increments in wealth so some

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\* The stock market series used in the wealth variable in the consumption function is the average of the past and current quarter's nominal aggregate value - in order to approximate beginning of quarter figures. Accordingly the calculated permanent income from stock was adjusted the same way.

lag may ensue between a change in stock market wealth (where, presumably, most windfall changes in wealth occur) and changes in consumption. Contrary to the procedure in the MPS model, the effects of the two forms of wealth are not constrained to be equal since when unconstrained the coefficients, as will be seen below, were found to be quite unequal. A justification for this inequality, with stock market wealth having the lower coefficient, is the observation that holders of stock may be heavily concentrated among consumers who have an interest in leaving an estate - in effect they have a "longer life expectancy" than other consumers and so have a lower MPC from wealth. The same argument obviously will apply to institutional holders of stock (e.g. - pension funds) who presumably have longer horizons than individuals.

With these alterations in mind we may proceed to the estimation of the consumption function. All variables (except the dummy for the surcharge period) were divided by current after tax labor income in order to reduce heteroskedacity, and all variables are in per capita 1972 dollars. Table 4-III presents the results of six regressions comparing the two specifications of permanent property income. Equations 1 and 2 repeat equations 3-III-4 and 3-III-7 with the new specification (and with 1/4 of the imputed labor income of proprietors taken from labor income and added to P1). Equations 3 and 4 are the same specifications as the first two with the previously computed (from the lags on income in 4-I and 4-II) values of permanent property income from each form of wealth used,

while equations 5 and 6 use the " $r_t W_{t-1}$ " method of calculating permanent property income.\*

Comparing 1 and 2 to 3-III-4 and 3-III-7 we immediately see the advantages of the new specification, even independently of the differing treatment of property income. The standard errors of these equations are approximately 1/2 of 1% of consumption, which is virtually the same as the standard error relative to the mean of the LHS variable of the Chapter 3 equations, but the considerably lower estimates of serial correlation (.854 for 1 vs. .951 for 3-III-4 and .186 for 2 vs. .717 for 3-III-7) indicates that the new specification succeeds in explaining more of the raw error of consumption.

The dummy variable was positive and more than twice its standard error in every case, indicating that part of the '68 surcharge was paid out of savings. The value is roughly 50% of the surcharge, which agrees with the estimates of Okun (41) and Modigliani-Steindel (38).\*\*

The behavior of the non-Social Security transfers (from now on to be referred to as just transfers) and the unemployment terms warrants some explanation. The unemployment term's coefficient is quite high in

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\* The permanent property income terms are normalized to have the same means as the actual income from the assets.

\*\* But not the conclusions of Springer, (45) whose results indicate that the surcharge had virtually no effect on consumption. The works just cited refer to consumer expenditures, not use consumption. Some of the reduced saving just mentioned could have come from reduced durable expenditures.

the specification without wealth and the transfer coefficient is unbelievably low (actually negative) while the reverse is true for the equation with wealth. A possible rationale is that these terms are both attempting to explain the consumption of the unemployed. The unemployment term was found to be negatively correlated with wealth, and so picks up some of the wealth effect in 1 and reduces the transfer effect. In equation 2 the unemployment term is "robbed" by the presence of wealth and the transfer coefficient rises.

The Social Security term is positive. It is as strong as or stronger than current labor income in all cases, but it is perhaps disappointing that it is less than unity. The Social Security windfall variable is slightly (but quite insignificantly) negative, which is undesirable, but at least it indicates that little of these windfalls were spent initially, as was hypothesized.

There is a strong difference between the wealth terms, with the non-stock market component having some 4 times the effect of stock market wealth.

The same observations on the labor and property income terms that were made in Chapter 3 apply here. The wealth terms tend largely to reduce the labor coefficients (from a total effect of 1.020 in the equation without wealth to .532 in the equation with) and raising the lagged P1 variables. The corporate saving terms are still negative, but not significantly so. The estimated coefficient of serial correlation is insignificant and small with wealth included.

Turning now to the equations with the new treatments of property

income (4-III-3 through 4-III-6) we see that the comments on the dummy variable and unemployment and transfer terms made about 1 and 2 generally apply. One exception is the stronger effect of the unemployment rate term in the equations with wealth (4 and 6). This is presumably due to the omission of a separate corporate saving term from 4 and 6. The corporate saving term in 1 and 2 probably picks up some of the cyclical effect of the unemployment term. Since the unemployment term is stronger, the transfer term is weaker (at least in 3 and 5 compared to 2-1 - in 4 and 6 it is a little weaker than in 2, but the difference is trivial).

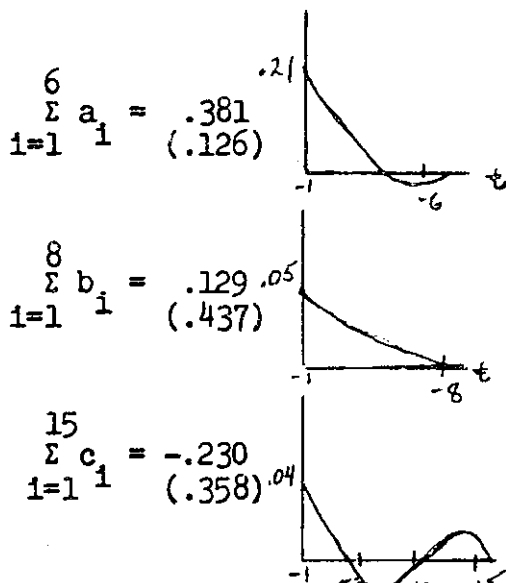
The chief contrast between the old and new treatments of property income lies in the behavior of the property income terms. In the "lagged income" equations (3 and 4) the coefficient on non-corporate income falls from .900 to .860 when wealth is added, and that on corporate income from .651 to an insignificant .09. The discrepancy between the MPC's out of the two forms of wealth is also considerably less than in 2. In the 'rW' approach equations (5 and 6) the fall in the property income coefficients when wealth is added, at least for the non-corporate part, is even more pronounced (1.058 to .684 for non-corporate income; .518 to .128 for corporate income). In this approach the income terms are more highly correlated with wealth than in the lagged income approach, and so the coefficients on property income in the equation with wealth (which are estimated with surprisingly low standard errors) are even better indicators that the coefficients on property income are measures of the effect of the rate of return on the

Table 4-III

Permanent Property Income Effects On Consumption, 1955:IV - 1972:IV

$$\begin{aligned}
 1. \quad C_t = & \frac{.639}{(.0980)} \text{LYG}_t (1-\tau_L) + (1-\tau_L) \sum_{i=1}^6 a_i \text{LYG}_{t-i} + \frac{.0121}{(.00425)} \text{D} \cdot \text{LYG}_t (1-\tau_L) \\
 & + \frac{.987}{(.331)} \text{U} \cdot \text{LYG}_t (1-\tau_L) + \frac{.639}{(.223)} \text{SS}_t - \frac{.173}{(.229)} \text{DSS}_t - \frac{.0187}{(.347)} \text{TR}_t \\
 & + \frac{.489}{(.240)} \text{PYG}_t (1-\tau_p) + (1-\tau_p) \sum_{i=1}^8 b_i \text{PYG}_{t-i} + \frac{.00809}{(.144)} \text{CS}_t + \sum_{i=1}^{15} c_i \text{CS}_{t-i} \\
 & + \frac{.854}{(.0632)} \mu_{t-1}
 \end{aligned}$$

SE = .00491  
 SSR = .001275  
 DW = 2.0080



$$\begin{aligned}
 2. \quad C_t = & \frac{.459}{(.0731)} \text{LYG}_t (1-\tau_L) + (1-\tau_L) \sum_{i=1}^6 a_i \text{LYG}_{t-i} + \frac{.00892}{(.00378)} \text{D} \cdot \text{LYG}_t (1-\tau_L) \\
 & + \frac{.0998}{(.283)} \text{U} \cdot \text{LYG}_t (1-\tau_L) + \frac{.886}{(.150)} \text{SS}_t - \frac{.0941}{(.226)} \text{DSS}_t + \frac{.835}{(.341)} \text{TR}_t \\
 & + \frac{.358}{(.202)} \text{PYG}_t (1-\tau_p) + (1-\tau_p) \sum_{i=1}^8 b_i \text{PYG}_{t-i} - \frac{.249}{(.127)} \text{CS}_t + \sum_{i=1}^{15} c_i \text{CS}_{t-i}
 \end{aligned}$$

Table 4-III

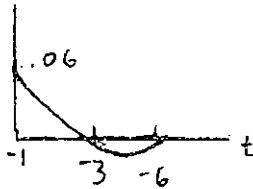
(continued)

$$+ .0853 \text{NSTK}_{t-1} + \sum_{i=0}^4 d_i (\text{WNSTK})_{t-1-i} + .186 \mu_{t-1}$$

(.0145)

$$\sum_{i=1}^6 a_i = .0728$$

(.0924)



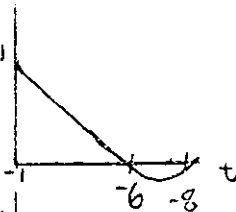
SE = .00372

SSR = .000694

DW = 1.7474

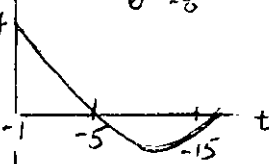
$$\sum_{i=1}^8 b_i = .538$$

(.288)



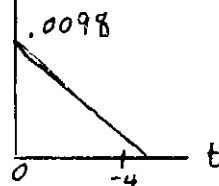
$$\sum_{i=1}^{15} c_i = -.0503$$

(.211)



$$\sum_{i=0}^4 d_i = .0211$$

(.00799)



$$3. \quad C_t = .549 \text{LYG}_{t-1} (1-\tau_L) + (1-\tau_L) \sum_{i=1}^6 a_i \text{LYG}_{t-1-i} + .0104 \text{D} \cdot \text{LYG}_t (1-\tau_L)$$

(.0831)

$$+ .760 \text{U} \cdot \text{LYG}_t (1-\tau_L) + .577 \text{SS}_t - .188 \text{DSS}_t + .289 \text{TR}_t + .900 \text{NCY}_t (1-\tau'_p)$$

(.294)      (.196)      (.212)      (.316)      (.473)

$$+ .651 \text{CY}_t (1-\tau_c) + .831 \mu_{t-1}$$

(.218)      (.0674)

SE = .00458

SSR = .001216

DW = 1.9726

$$\sum_{i=1}^6 a_i = .395$$

(.0913)

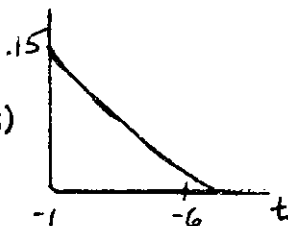




TABLE 4-III

(continued)

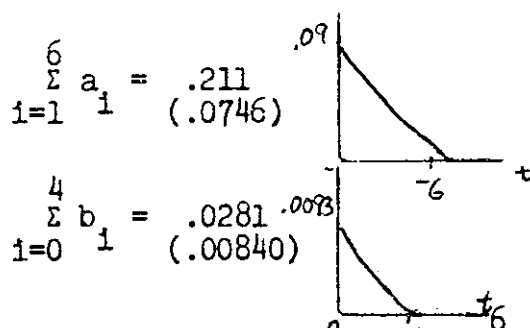
$$4. C_t = \frac{.431}{(.0776)} \text{LYG}_t (1-\tau_L) + (1-\tau_L) \sum_{i=1}^6 a_i \text{LYG}_{t-i} + \frac{.00703}{(.00313)} D \cdot \text{LYG}_t (1-\tau_L)$$

$$+ \frac{.358}{(.291)} U_t \cdot \text{LYG}_t (1-\tau_L) + \frac{.909}{(.163)} \text{SS}_t - \frac{.0395}{(.220)} \text{DSS}_t + \frac{.575}{(.324)} \text{TR}_t$$

$$+ \frac{.867}{(.429)} \text{NCY}_t (1-\tau_p) + \frac{.0983}{(.209)} \text{CY}_t (1-\tau_c) + \frac{.0664}{(.0159)} \text{NSTK}_{t-1}$$

$$\sum_{i=0}^4 b_i (W\text{-NSTK})_{t-1-i} + \frac{.465}{(.107)} \mu_{t-1}$$

SE = .00403  
SSR = .00894  
DW = 1.7308



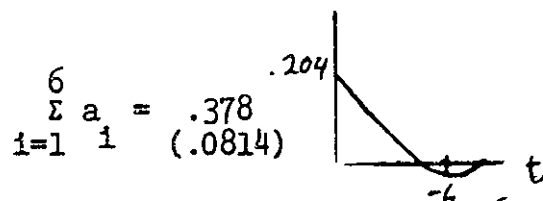
$$5. C_t = \frac{.540}{(.0782)} \text{LYG}_t (1-\tau_L) + (1-\tau_L) \sum_{i=1}^6 a_i \text{LYG}_{t-i} + \frac{.0101}{(.00348)} D \cdot \text{LYG}_t (1-\tau_L)$$

$$+ \frac{.886}{(.265)} U_t \cdot \text{LYG}_t (1-\tau_L) + \frac{.619}{(.180)} \text{SS}_t - \frac{.202}{(.207)} \text{DSS}_t$$

$$+ \frac{.137}{(.207)} \text{TR}_t + \frac{1.058}{(.351)} \text{NCY}_t (1-\tau_p)$$

$$+ \frac{.518}{(.149)} \text{CY}_t (1-\tau_L) + \frac{.803}{(.0724)} \mu_{t-1}$$

SE = .00440  
SSR = .001124  
DW = 1.9143



$$6. C_t = \frac{.442}{(.0745)} \text{LYG}_t (1-\tau_L) + (1-\tau_L) \sum_{i=1}^6 a_i \text{LYG}_{t-i} + \frac{.00728}{(.00312)} D \cdot \text{LYG}_t (1-\tau_L)$$

$$+ \frac{.368}{(.280)} U_t \cdot \text{LYG}_t (1-\tau_L) + \frac{.922}{(.175)} \text{SS}_t - \frac{.0658}{(.233)} \text{DSS}_t$$

$$+ \frac{.922}{(.175)} \text{SS}_t - \frac{.0658}{(.223)} \text{DSS}_t + \frac{.497}{(.311)} \text{TR}_t + \frac{.684}{(.318)} \text{NCY}_t (1-\tau_p)$$

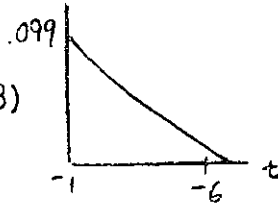
TABLE 4-III  
(continued)

$$+ \frac{.128}{(.230)} CY_t^L (1-\tau_L) + \frac{.0639}{(.0164)} NSTK_{t-1}$$

$$+ \sum_{i=0}^4 b_i (W-NSTK)_{t-1-i} + \frac{.459}{(.108)} \mu_{t-1}$$

SE = .00401  
SSR = .000885  
DW = 1.7166

$$\sum_{i=1}^6 a_i = \frac{.237}{(.0718)}$$



$$\sum_{i=0}^4 b_i = \frac{.0220}{(.0121)}$$

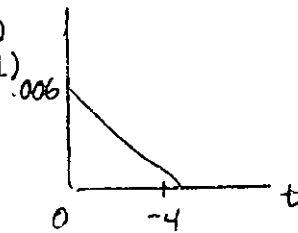


TABLE 4-III

(continued)

Definitions of New Variables

LYG	=	Labor Income (Less .25 LYP)
$\tau_L$	=	Tax Rate On LYG
D	=	Dummy for Surcharge Period
U	=	Number of Unemployed/Number of Employed
SS	=	Non-Windfall Social Security Payments
DSS	=	Windfall Social Security Payments
TR	=	Non-Social Security Transfers
PYG	=	Non-Corporate Saving Property Income (Plus .25 LYP)
$\tau_p$	=	Tax Rate on PYG
NCY*	=	Permanent Income From Non-Stock Wealth
NCY**	=	Permanent Income From Non-Stock Wealth
$\tau'_p$	=	Tax Rate on Current Income from Non-Stock Wealth (Plus .25 LYP)
CY	=	Permanent Income From Stock
CY**	=	Permanent Income From Stock
$\tau_c$	=	Tax Rate on Current Income from Stock Wealth

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\* Approach using lags on income from Tables 4-I and 4-II

\*\* Approach using capitalization rates from 4-I and 4-II multiplied by wealth.

MPC out of wealth. The point estimates on property income in 5 and 6 are similar to those of 3 and 4, especially when the fairly large error on the coefficients on non-corporate income in 3 and 4 is taken into account.

We should also notice that the permanent coefficients on labor income and wealth in equations 3 and 5 are nearly equal, which is greatly at variance with the two-class theory of consumption as exemplified by the 'P2' equations of Chapter 3. The reason for these large property income coefficients in equations without wealth is that the property income terms should pick up the effect of wealth. The sequence of models presented has shown the increasing ability of the more sophisticated models of permanent property income to pick up the effect of wealth in consumption functions without wealth. We started from coefficients on P2 (total property income) of .05 and .07 in the equations with no lag and a simple distributed lag (3-II-1 and 3-III-2). We then observed the high coefficient of the non-corporate saving component of property income (1.1 in 3-II-4, .72 in 3-III-4, and .62 in 4-III-1). Finally we estimated very high coefficients out of all components of property income using the notion of wealth as capitalized permanent property income to generate our estimates of permanent property income (coefficients in 4-III-3 and 4-III-5 of approximately 1 for non-corporate income and .5 - .6 for corporate income).

Also to be noticed is that the fits of 3 and 5 are superior to 1, while 4 and 6 are inferior to 2. Thus the new procedures for estimating permanent property income are superior to the traditional one in proxying

for wealth, but when wealth is added the traditional approach estimated better. In any event the discrepancies in errors of estimation are relatively small, and the errors of forecast for the two approaches should be compared (Table 4-IV, below).

For non-stock market wealth the estimated MPC's out of wealth and permanent property income in equations 3 through 7 are not at all inconsistent with the hypothesis that these assets are held by utility maximizing consumers with a zero elasticity of substitution (see the range of values in Table 3-I for individual consumers and recall that the aggregate coefficients would be somewhere in the middle), especially in equations 5 and 6, the ones with the "rW" formulation of permanent property income, but also in 3 and 4. For stock market wealth the standard errors of the wealth and income coefficients are high, so in this sense the results do not eliminate a zero elasticity as a possibility. However, the fact that the point estimate for stock market wealth is smaller than non-stock wealth implies these assets being held by younger consumers than non-stock wealth, while the fact that the coefficient on stock market income is less than non-stock income implies an older consumer. It seems more reasonable to assert that the coefficients estimated in 4 and 6 support the hypothesis that stock market assets are concentrated more heavily among people and institutions with strong estate motives. The estate motive is consistent with the low MPC out of stock market wealth and an investor with such a motivation may have a high elasticity of substitution between current and future consumption (and hence a low MPC out of property income) since he is laying such

an emphasis (by building an estate) on consumption far in the future.

In order to see if we are neglecting seriously any capital loss effects on consumption an estimate of the expected capital loss on fixed value assets (given by multiplying non-stock wealth by a distributed lag on the inflation rate) was added to equations 4 and 6. No significant coefficient could be detected. It seems reasonable that the proper place to attempt to detect such an effect would be the wealth equations, since we would then directly measure the effect of such losses on corporate and non-corporate property income.

Equations III-2 and III-4 were projected forward through the third quarter of 1976, and the results of the projections are presented below, in Table 4-IV. Before discussing them it must be mentioned that the tax rebate of the second quarter of 1975 has been ignored in the computation of tax liabilities. Hence a fraction of any underprediction from the second quarter of 1975 on should be laid to this account. It should also be noted that the information needed to split tax liabilities between labor and capital is increasingly fragmentary after 1973. Estimates ignoring the errors in 1972:IV have been computed. No meaningful difference would be made in the predictions if these errors were added back.\*

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\* 4-III-2 overestimated consumption by 7.7 billion dollars in 72:IV but the estimate of the coefficient of serial correlation is so low that adding back this error will not greatly alter any of the projections. 4-III-4 overestimated consumption by 2.5 billion dollars in 72:IV.

Table 4-IV

Errors of Forecast of 4-III-2 And 4-III-4, 1973:I - 1976:III

Quarter	Error (Actual - Predicted)	
	4-III-2	4-III-4
1973: I	-10.4	-1.2
II	-14.6	-2.5
III	-12.7	6.1 <sup>*</sup>
IV	-18.8	-4.1
1974: I	-14.1	.8
II	-10.0	4.2
III	- 8.9	7.2
IV	- 8.8	4.4
1975: I	- 4.6	5.3
II	.8	9.5
III	- 3.8	3.7
IV	- 7.6	1.5
1976: I	- 8.1	2.4
II	-10.9	1.6
III	-12.3	-2.0
RMSE:	10.8	4.5

---

\* Could this error imply that the brief price freeze of that quarter stimulated consumption?

It can easily be seen that there is a fundamental difference in the projections. Equation 2 consistently and sometimes greatly overestimates consumption. Only in 1975:II and III, when the estimates are probably depressed by neglecting the rebate, is the error of prediction within the standard error of estimation. It is not clear why such extreme overprediction occurs. One suspect may be the extremely high coefficient on non-stock market wealth. The estimated coefficient is possibly so high because it is picking up some of the effect of permanent property income that the distributed lags on property income do not. When projected through 1976, through a period that non-stock market wealth is growing considerably faster than stock the estimate of consumption is thus increased. On the other hand equation 4 projects extremely well. There is some overestimation of consumption in 1974 and 1975, possibly due to relatively heavy weight given to the stock market component of wealth, but the errors are fairly small. The largest error is in 1975:II, the rebate quarter, and certainly some of that error should be attributed to the rebate. The size of the error in '75:II is such as to suggest that 37% of the rebate (which amounted to 25.6 billion 1972 dollars at annual rates) was spent in that quarter, if all the error is to be attributed to it. This is somewhat higher than the estimates made by Modigliani and Steindel (38), which however,



referred to consumer expenditures, rather than use consumption.<sup>#</sup> The moderately large error in 1975:I suggests that we may be underestimating consumption in 1975 for reasons unrelated to the rebate.

The root means squared error of projection for equation 2 is 10.8 billion dollars, which is considerably greater than the error of estimate. The RMSE of projection for 4 is 4.5 billion which is comparable with the equation's standard error of fit (about 1/2 of 1 percent of consumption). Clearly the structure of 4 is more stable than that of 2, indicating that the new method of imputing permanent property income provides a more reliable way to analyze consumption.<sup>\*\*</sup>

The current after tax value of dividends was added to equations III-3 through III-6 to see if we are picking up all of the effect of

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\* The MPS model's equation for durables overestimates durable expenditures in 1975:II, even neglecting the rebate, suggesting that little if any (the point estimate is negative) of the rebate was spent on durables (the MPS projections and descriptions of the new version of the model's consumption sector equations are courtesy of Jared Enzler of the Research Division of the Board of Governors).

\*\* Equation 6's RMSE of projection was 7.4 billion dollars, slightly worse than 4's but better than 2's. None of the non-wealth equations (1, 3, and 5) projected with any accuracy after 1973. All greatly underestimated consumption. The traditional equation (1) underestimated somewhat less than the others, but the RMSE of forecast was considerably greater than its standard error.

The consumption function in the current version of the MPS model has a RMSE of 6.0 billion dollars for the same period (neglecting the rebate). This equation, estimated through 1976, overestimates in 1973 and 1974 but unlike III-2 underestimates in 1975 and 1976. This equation, like those in previous versions of the model (see (30), (36)), essentially explains consumption by disposable personal income and wealth.

dividends on consumption in the permanent corporate income terms. The coefficients on dividends were on the order of .8 to 1 in all of the equations, with t-ratios somewhat greater than one. This is some evidence against the no long-run trade-off hypothesis. However, likelihood ratio tests showed that we could reject the hypothesis of a non-zero dividend effect at a 99% confidence level in all four cases, which indicates that the dividend coefficient may be large only because of collinearity with other terms (its introduction does lower the stock and permanent corporate income coefficients). When III-4 and III-6 with the dividend terms were projected forward the RMSE's of projection were about the same as III-4's. The projection with dividends added to III-4 tended to overestimate heavily (as much as 9.7 billion dollars) in 1976, which may indicate some instability in the formulation. The projection with dividends added to III-6 did not have this tendency, but there may be some errors in the variables due to errors in the computed capitalization rates. III-6 predicted consumption values averaging 5 billion less than III-4 in 1976, suggesting the magnitude of this error. If this amount is added to the forecasts of III-6 with dividends added the error in late 1976 will be similar to III-4 with dividends. However, barring superior wealth equations, we cannot definitively say that III-4 without a separate dividends term is a superior specification to III-6 with one.

Equation 4 allows us to finally get a handle on the question of the effect of changes in corporate saving on personal saving and consumption. Since permanent income from stock is a geometric lag on

profits and dividends, the exact value of the trade-off depends on the initial conditions specified. Let us then for convenience assume that corporate profits after corporate taxes with inventory valuation and capital consumption adjustments amount to some 50 billion 1972 dollars, of which 30 billion are dividends. These figures roughly approximate current values. Let us further assume that there is no personal tax on corporate saving (which has been assumed in the estimation of the consumption function) and that the marginal personal tax on dividends is 30%. Then the marginal personal tax on income from stock is 18% ( $30 \times 3/5$ ).

Suppose dividends increase by 10% (3 billion dollars) and stay at the new high level. Then the following table indicates the increases in anticipated corporate income (at annual rates)

<u>QUARTER</u>	<u>INCREASE</u>
0	5.4
1	6.4
2	4.7
3	2.0
4	0

Column two was derived from the coefficients on the log of dividends in Table 4-I (recall that profits in general are being held constant).

Next we measure the consumption induced by the increase in dividends by multiplying the induced increase in corporate income by .82 ( $= 1 - \text{marginal tax rate}$ ) and by the estimated marginal propensity to consume out of corporate income (.0909).

The 3 billion dollar increase in dividends induces a 2.1 billion dollar increase in disposable personal income, and hence the following increases in personal saving:

<u>QUARTER</u>	<u>INCREASE IN CONSUMPTION</u>	<u>INCREASE IN PERSONAL SAVING</u>
0	.4	1.7
1	.5	1.6
2	.4	1.7
3	.2	1.9
4	0	2.1

Hence the corporate saving decline of 3 billion dollars results in a personal saving increase of only a little over 1/2 that amount in the first year after it occurs. Hence private saving falls by less than 1/2 the amount of the fall in corporate saving. However, about 2/3 of this amount will be freed for investment by the government because of increased tax revenue, so only the remainder is money now unavailable for private capital formation (including durable goods purchases).

To clarify this point consider the first quarter. Corporate saving has fallen by 3 billion dollars, personal saving has risen by 1.7 billion, hence private saving has fallen by 1.3 billion dollars. Private saving less the deficit represents the resources available for capital formation. The deficit has fallen by .9 billion, because that is the amount tax revenue has risen, so there will only be .4 (1.3 - .9) billion taken from capital formation.

There will be a greater decline in private saving if we do not

hold wealth constant. We can measure this effect either by using the coefficients of III-4 to alter stock market wealth, given some initial conditions, or by using the coefficient on permanent income from stock estimated in equation III-3, where the income coefficient picks up the effect of changes in stock value from changes in permanent income from stock. Both methods will give virtually the same results. Using the coefficient on CY from III-3, which allows us to evade the question of what to do about the lag on stock market wealth in III-4 (which reflects the effect of windfall gains\* - revaluations due to changes in the rate of return - on consumption), we get the following induced increases in

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\* The lag mainly acts to reduce the estimated coefficient of serial correlation of III-4 from .601 to the estimated .465. Also, in the absence of the lag on the stock market the coefficient on CY is trivially negative (-.0232). If we lag CY the same way as stock market wealth the fit of the equation is unaltered, but the coefficients on both forms of property income are considerably reduced in both III-3 and III-4, and the sum of the lags on CY in III-4 is -.15 (SE of .21), with a leading coefficient of .13. These coefficients imply that an increase in dividends, wealth held constant, will first increase personal saving, and then reduce it, with the effects ending (except for the residual effect of the tax) after two years. I find the results less creditable than those reported, since the notion of a lagged effect of a permanent variable seems odd to me. Using the alternate form of estimating permanent property income - that is, multiplying wealth by the estimated capitalization rates, - we can measure the effect of the current capitalization rate on the MPC from "permanent" stock wealth. Some limited scanning over  $b_1$  showed that the estimated coefficient of .1 found by neglecting the lag<sup>1</sup> is more acceptable than higher or lower positive values and the fit with the rate of return multiplying the lag on stock wealth was inferior to III-6's indicating that the procedure of neglecting the lag on wealth in calculating the MPC out of permanent corporate income is acceptable.

consumption and personal saving from the increase in dividends:

<u>QUARTER</u>	<u>INCREASE IN CONSUMPTION</u>	<u>INCREASE IN PERSONAL SAVING</u>
0	3.5	-1.4
1	3.4	-1.3
2	3.1	-1.0
3	1.1	1.0
4	0	2.1

In this case a decline of corporate saving is matched by no increase in personal saving for a year. Hence, if we assume that changes in dividend policy do have an effect on the valuation of wealth, there is a considerable lack of a short run tradeoff between personal and corporate saving. The implication of this result for government tax policy is clear: Integration of the corporate and personal income taxes, which, if done on a "partnership" basis (all corporate profits assumed to accrue to shareholders) will eliminate the tax incentives for corporations not to pay dividends, and which should then result in an increase in the level of dividends, will reduce private saving in the short run, primarily by increasing the value of stock by increasing consumers' perception of permanent income from stock (the increase in permanent income will be less the more consumers perceive the increase in dividends as being the result solely of tax considerations). There will be some secondary increases in consumption to the extent that stock prices do not rise in response to increases in permanent income, thus raising the rate of return on stock and causing a shift in the intertemporal allocation of consumption to the present. This reduction

of private saving will only be temporary; the bulk of it will disappear approximately one year after the new equilibrium payout ratio is reached by corporations (any residual reduction in private savings would be solely the effect of any differential taxation on dividends vs. corporate saving).

In this chapter we have constructed estimates of permanent property income from wealth, interest rate, and property income data, and used these estimates in the consumption function, and shown that these estimates yield consumption functions with fits at least competitive (and in the case of prediction superior) to more traditional formulations, and estimated propensities to consume out of property income and wealth which are broadly consistent with the life cycle hypothesis when the heterogeneity of wealth holders is taken into account. These estimates of permanent property income and the propensity to consume from it provide some evidence that personal and corporate saving are not "perfect substitutes" in the short run, if the short run is defined as less than a year, but they are if we expand the horizon slightly.

CHAPTER 5

CONCLUSION

This thesis has attempted to demonstrate that the empirical estimation of consumption is an intricate matter. The stock assumption that when all is said and done, all that the permanent income and life cycle theories have implied for the empirical consumption function is the addition of wealth and/or distributed lags on disposable personal income is shown to be severely flawed. The final model of consumption in Chapter 4 shows us that the nature of an income disturbance is of crucial importance in estimating its effect on consumption. It makes a great deal of difference as to whether or not an increase in disposable personal income comes from a reduction in taxes, an increase in labor income, an increase in transfers, an increase in non-corporate property income or an increase in dividends (especially whether or not the increase in dividends is simultaneous with a general increase in profits). While I do not think many economists will differ with these assertions, I do believe that this thesis is one of the first to provide support for them which is broadly consistent with accepted theory. Also constructed are estimates for permanent income from non-human wealth consistent with the notion of the value of wealth as the present value of a stream of property income.

The early Feldstein conclusion that consumers see through the corporate veil is upheld by equations 4-III-3 through 4-III-6, which assume no long run trade-off between corporate and private saving, and which succeed in estimating or forecasting consumption better than



their traditional counterparts (4-III-1 and 4-III-2) which estimated a long run trade-off (it is possible, though, that 4-III-6's specification leaves some room from an additional dividend effect, which would violate this conclusion). Policies encouraging corporations to increase their saving will increase private saving (including durables purchases) in the short run, the exact amount depending upon the ability of stockholders to detect the increase in corporate saving as induced by the government or by the reduced earnings expectations of management. But there will be no long run increase in the private saving national income ratio as a result of this action. Consumption will return to its normal level fairly quickly - perhaps as soon as a year after the change in corporate saving policy. Therefore, the evidence suggests that full integration of the corporate and personal income taxes should not be opposed on the grounds of discouraging saving.

The empirical results indicate that the effects of policies to alter consumption are quite intricate. Consider the simple problem of a government desiring to design a tax program to give a rapid stimulus to consumption. One problem in forecasting the effect of the tax policy is the well known one of whether or not a tax cut is perceived as temporary or permanent. The final model suggests that permanent tax cuts will have extremely rapid effects upon consumption, transitory tax cuts very little or none since consumption is assumed to depend on gross of tax income multiplied by one minus the permanent tax rate. This is just the opposite of conventional models which explain consumption by income after taxes. In these models, a comparison of a tax rebate with a tax cut which costs the government just as much

revenue in the first year will conclude that the rebate will have much greater immediate effect on consumption, simply because it implies four times the increase in disposable personal income in the quarter of enactment that the permanent cut does.

There are a number of areas in which the work of this thesis can be extended. One obvious area is the estimation of consumer expenditures - which is usually the area of interest to policy makers - as opposed to use consumption. This implies extending our treatment of taxes and property income to the demand for durable goods. We would then need a model of the stock demand for durables which relates the demand to total lifetime resources, perhaps along the lines of Mishkin (32), who separates asset and liability effects on the timing of durables purchases.

Another area this work can be extended is the analysis of the channels of policy in large macro models. The extension to fiscal policy analysis should be obvious. But it is also true that monetary policy analysis would be affected. For example, it is possible that increases in interest rates have some effect in lowering dividend payments, as in the 1975 version MPS model (30). In our model an increase in interest rates will not only have a direct effect on stock prices and consumption by raising the yield on alternative assets and thus lowering stock values, but will also have a secondary effect by lowering dividends and thus lowering permanent income from equity in the short run (if the public assumes dividend policy is unchanged).\*

A number of elements of the empirical results warrant further investigation. The non-stock market wealth equation gives the most

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\* It might be kept in mind that current models (e.g. the MPS) have a similar implicit channel by relating consumption to disposable personal income, including dividends, and ignoring any effects of corporate saving, other than any possible effects on stock market value.

cause for concern, because of the lack of real interest rate and capital loss effects and the extremely long lag on income. It may be that further disaggregation of this component of wealth may help matters. The inability of the stock market equation to project very well is no real surprise, considering the turbulent area it is asked to forecast, but a superior real interest rate series (which will estimate more realistic changes in expected inflation in late 1975 and 1976) would improve matters. The concept of a "permanent tax rate" merits further investigation. Perhaps cross sectional data would be suitable to measuring the effective tax rate that consumers respond to.

One final recapitulation: This thesis has shown that at least two popular models of consumption - those that relate consumption to disposable personal income and wealth and those that relate consumption to labor and property income - are subject to considerable doubt. The more general model which relates consumption to labor and property income and wealth appears to explain the facts better. The coefficients on property income in equations estimated using this specification and separately estimating permanent property income (4-III-4 and 4-III-6) are consistent with the generalized life cycle notion that the coefficients on property income in such a function measure the effect of changes in the rate of return on the propensity to consume from wealth. The point estimates, which are positive and hence indicate the increases in the rate of return induce consumers to shift their intertemporal allocation of consumption towards the present, suggest that the elasticity of substitution between present and future consumption is between zero and one.

Finally, the actions of the government must be carefully diagnosed to make sensible predictions about their effect on consumption. Not only the aggregate level of taxes matters but also the differential taxation of different forms of income, by altering the composition of income, makes a difference to consumption. Any analysis of consumption which ignores the composition of income is likely to be subject to considerable instability.

APPENDIX I

ALLOCATION OF TAXES

The basic procedure used in allocating taxes between labor and property income is a modification of that used by Ando and Brown (1). The average Federal income tax rate on labor income was calculated from each year's Statistics of Income (from 1952 to 1972). The procedure was as follows:

The average income tax rate for each adjusted gross income class (for taxable returns) was taken as the income tax liability (before refunds and credits) of the class, divided by the adjusted gross income of the class. The figure was adjusted for the payment of alternate tax on capital gains. One-half the long term gains less the short term losses was subtracted from AGI for returns with alternate tax, and one-half of that total (or whatever the alternate tax rate on capital gains was for the year; the Statistics of Income do give the rates and their breakdown by return) subtracted from the tax. The average tax rate for each class and the resulting amounts are then summed to yield federal income taxes on salaries and wages.\* The figure for federal taxes on salaries and wages is then divided by the National Income Accounts figure for salaries and wages for that year to get the federal income

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\* A more elaborate procedure, following that of Kahn (25), was used for 1952 and 1953 to eliminate the compensation of income on returns paying only self-employment tax.

tax rate on labor income. A good deal of proprietor's income should be regarded as labor income, and the gross labor income of proprietors is determined by multiplying the average compensation per employee hour by industry the hours worked by proprietors ( = number of hours worked by production workers less the number of hours worked by employees).<sup>\*</sup> Federal income taxes on proprietor's labor income are estimated by applying the previously estimated tax rate on salaries and wages to the estimated labor income of proprietors. State income taxes on labor income are calculated to be the same fraction of state income taxes as federal income taxes on labor are of total federal income taxes.<sup>\*\*</sup>

A number of further assumptions must be made to derive quarterly series. Income tax rates on labor and property income were assumed constant throughout the calendar year except for 1968 and 1970 when adjustments are made for the enactment and repeal of the surcharge, and 1975 when a tax cut takes place in the second and third quarters (the rebate of the second quarter is ignored). This assumes that changes in the tax laws (and what is especially important for recent years, inflation, which tends to drive up tax rates in a graduated system) are foreseen by consumers at the beginning of the calendar year. State and local estate and gift taxes were allocated quarterly in the

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\* Following Ando and Brown (1) the figure for agriculture was multiplied by 1.5 to partially reflect the labor of household members and the income in kind of farmers. All income of unincorporated service industries was allocated to labor.

\*\* The figure for the annual federal income tax liability comes from the Statistics of Income, the figure for State Income tax receipts from the National Income Accounts.

same fractions as the federal tax. State and local property taxes (and non-labor non-dividend income taxes - dividend taxes are described below) were assumed to accrue to rental and interest income plus proprietor's property income (less interest paid by consumers) at a constant annual rate. Motor vehicle license fees were assumed to accrue to the implicit rental income of durable goods at a constant annual rate.

The federal income tax on dividends was calculated the same way as the taxes on salaries and wages. Dividends after taxes were assumed to equal gross dividends less federal dividends taxes less the dividend tax credit of 1954-1963 and state dividend taxes, which were assumed to be the same fraction of state income tax liability as they were of federal. As mentioned above, the definition of dividends is that used by the MPS model to calculate stock wealth - it includes the dividend income of private non-insured pension funds.

Clearly a great many of these assumptions may be questioned. Among them will be the assumptions accruing labor income to proprietors, the assumption that the tax rate on labor income of proprietors is the same as that on their employees, that the division of income tax revenue between labor and property income is the same for states and the federal government, that taxes on capital gains should be included in taxes on property income when the gains are not, that the proper tax aggregate is used in either the federal or state case, that consumption taxes and fees are equivalent to consumption, and that tax rates can be considered constant throughout the year. Obviously other, equally arbitrary, assumptions can be made.

APPENDIX II:

CORPORATE SAVING AND CAPITAL GAINS

The framework for analyzing corporate returns in this note is a modification of that of Modigliani and Miller (31), taking into account the personal tax structure. It is assumed throughout that accounting equals true economic depreciation so no attention will be paid to depreciation as a factor affecting corporate income or stockholders' returns. Corporate borrowing policy is assumed to be fixed so it will be ignored as a factor affecting returns. A world of certainty is assumed. The basic working hypothesis is that shareholders achieve a fixed rate of return after tax upon their investments. Some notation:

$r$	- after tax rate of return on investment in corporate equity
$X(t)$	- corporate profits after corporate tax in period $t$
$I(t)$	- net corporate investment in period $t$
$D(t)$	- dividends in period $t$
$CS(t)$	- corporate saving in period $t$
$d(t)$	- dividends per share to stockholders at the start of period $t$
$G(t)$	- capital gains on corporate stock in period $t$
$S(t-1)$	- market value of corporate stock at the beginning of period $t$
$P(t-1)$	- price of a share of corporate stock at the beginning of period $t$
$N(t-1)$	- number of shares of corporate stock outstanding at the start of period $t$
$t_d$	- marginal and average tax rate on dividend income



$$(6) \quad S(t) = \sum_{i=1}^{\infty} \frac{(1-t_g)^i}{(1+r-t_g)} X(t+1) - \sum_{i=1}^{\infty} \frac{(1-t_g)^i}{(1+r-t_g)} I(t+1) \\ + \frac{(t_g - t_d)}{1-t_g} \sum_{i=1}^{\infty} \frac{(1-t_g)^i}{(1+r-t_g)} D(t+1).$$

Capital gains in period t+1 (gross of capital gains tax) are equal to  $(P(t+1)-P(t))N(t) = P(t+1)N(t)-S(t)$ . Substituting (4) into (3) and then subtracting (5) from (4) we find

$$(7) \quad G(t+1) = X(t+1) \left(1 - \frac{(1-t_g)}{(1+r-t_g)}\right) - D(t+1) \left(1 + \frac{(t_g - t_d)}{(1+r-t_g)}\right) \\ + (S(t+1)-I(t+1)) \left(1 - \frac{(1-t_g)}{(1+r-t_g)}\right).$$

$CS(t+1) = X(t+1)-D(t+1)$ , so

$$(8) \quad G(t+1) = X(t+1) \left(1 - \frac{(1-t_g)}{(1+r-t_g)}\right) - (CS(t+1)-X(t+1)) \left(1 + \frac{(t_g - t_d)}{(1+r-t_g)}\right) \\ + (S(t+1)-I(t+1)) \left(1 - \frac{(1-t_g)}{(1+r-t_g)}\right).$$

We can now calculate the change in capital gains from a change in corporate saving (investment policy is assumed to be given, and the value of the firm at the end of period t+1, is by formula (6), a function of profits, investment, and dividends in period t+2 and later, not of these variables' values in period t+1):

$$(9) \quad \frac{\partial G(t+1)}{\partial CS(t+1)} = 1 + \frac{(t_g - t_d)}{1+r-t_g}.$$

$t_g$  - marginal and average tax rate on capital gains income (This is an effective rate on accrued capital gains. It can be deduced from the rate on realized capital gains and the holding period of corporate stock, Bailey (5)).

At the start of period  $t+1$  the after tax rate of return on corporate stock is equal to the after tax capital gain plus the after tax dividend divided by the initial price:

$$(1) \quad r = \frac{\{P(t+1)-P(t)\}(1-t_g) + d(t+1) (1-t_d)}{P(t)} \quad .(1) \text{ can be solved for } P(t):$$

$$(2) \quad P(t) = \frac{1}{1+r-t_g} (P(t+1) (1-t_g) + d(t+1) (1-t_d)).$$

$S(t) = P(t)N(t)$ , and  $D(t+1) = d(t+1)N(t)$ ,\* so

$$(3) \quad S(t) = \frac{1}{1+r-t_g} (P(t+1)N(t) (1-t_g) + D(t+1) (1-t_d)).$$

The corporation's sources and uses of funds (after operating expenses have been met) must be equal. The source of funds are profits and net sales of stock. Total funds available in period  $t+1$  is then equal to  $X(t+1) + P(t+1) (N(t+1) - N(t)) = X(t+1) + S(t+1) - P(t+1)N(t)$ . The corporation uses its funds to pay for investments and dividends, so total uses of funds is equal to  $D(t+1) + I(t+1)$ . Equating the expressions for the sources and uses of funds we can solve for  $P(t+1)N(t)$ :

$$(4) \quad P(t+1)N(t) = X(t+1) - I(t+1) - D(t+1) + S(t+1).$$

substituting (4) into (3) gives

$$(5) \quad S(t) = \frac{1}{1+r-t_g} ((1-t_g)X(t+1) - (1-t_g)I(t+1) + (1-t_g)S(t+1) + (t_g - t_d)D(t+1)).$$

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\* Recall that dividends are paid to start of period shareholders.

This expression is equivalent to Feldstein's  $\lambda$ . It is a function of the tax rates on dividends and capital gains and the interest rate.

Sufficient conditions for it to be less than one are  $t_d$  greater than  $t_g$  and  $r$  greater than  $t_g$ .

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BIOGRAPHICAL NOTE

Charles Steindel was born in Brooklyn, New York on November 17, 1951. He graduated from Briarcliff High School in DeKalb County, Georgia, in 1969. He received a Bachelor of Science degree in Mathematics from Emory University in 1973, graduating Phi Beta Kappa with Highest Honors in Economics. In the Fall of 1973 he enrolled in the Economics Doctoral Program at M.I.T. with a National Science Foundation Graduate Fellowship. In the summer of 1974 he was a Student Assistant National Bank Examiner in Georgia. In the 1975-76 and 76-77 academic years he was a teaching assistant in the Economics Department at M.I.T. He is a co-author (with Professor Franco Modigliani) of "Is a Tax Rebate an Effective Tool for Stabilization Policy?" (Brookings Papers on Economic Activity, 1: 1977). In September 1977 he will begin work in the Research Division of the Board of Governors of the Federal Reserve System in Washington, D.C.