THE CONSUMPTION FUNCTION

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ABSTRACT

Keynes held that, mainly, it was current income that determined the demand for consumer goods and services. He also suggested wealth, interest rates, and taxes may have smaller effects. Later theories by Modigliani and Friedman, based on long term average income as the income variable determining consumption, reach pointedly different conclusions about the effectiveness of Keynesian stimulus than Keynes suggested. Little systematic testing has occurred in recent decades to determine what really is in the consumption function, and what the relative importance of different variables is; Macroeconomics textbooks are decidedly ambiguous in answering these questions, presumably for lack of adequate testing. This paper econometrically tests the relative impact on consumption of different variables in Keynes original hypothesis and compares Keynes to the Friedman/Modigliani hypotheses as well. The paper also tests a “crowd out” variable to measure the effect of government deficits on the availability of consumer credit, and an exchange rate variable, which other studies have found important. Using U.S. data for 1960 - 2000, this study concludes that current income is by far the most important single determinant of consumption, explaining 68% of variance. It is followed in importance by the “crowd out” variable, which explains an additional 14%. Next in terms of explaining additional variance, the study finds wealth (5%), consumer interest rates (2%) and exchange rate changes (1%). Using a Friedman/Modigliani income average instead of the Keynesian income variable markedly reduces the model’s explanatory power. However, adding the same income average to the model, in addition to the Keynesian variable, raises explanatory power slightly, from 92% to 93%, and the variable is statistically significant. From this the study concludes that the consumption behavior of Americans is overwhelmingly Keynesian in nature, but that a small, separate, portion of the populace is Friedman/Modigliani in consumption behavior, creating a far smaller, but still systematic additional impact on consumption in the same direction as the Keynesian impact. JEL C51, C52, E20, E21, E62

Keywords: Consumer Behavior, Consumption Function, Keynes, Kuznets, Friedman, Modigliani, Econometric Modeling, Fiscal Policy

1. INTRODUCTION

What variables are the determinants of U.S. consumer demand? Is it current income, as Keynes suggested, or is it some longer term average income as suggested by Friedman and Modigliani? Do changes in consumer wealth, taxes and interest rates also systematically affect consumer? To what extent does the government deficit “Crowd Out” phenomenon, which seems to affect investment, also affect consumer demand by reducing consumer credit availability? How systematically does the exchange rate affect consumer spending? What is the relative importance of these variables in determining consumer behavior?

This study econometrically tests U.S. data on consumption 1960 -2000 to answer these questions. Little work seems to have been done in recent decades to address these questions and resolve disputes in a comprehensive manner using the same data set and method of analysis to test competing notions of what is in the consumption function, one against the other. Even in large scale econometric models, consumption is largely predicted from its prior period value, not its determinants.

A number of benefits should accrue from obtaining more precise estimates of what is in the function and how important its individual components are relative to each other. First, one could better understand what causes shifts in the Keynesian IS curve. We cannot estimate a Keynesian IS curve without a clear understanding of the variables in the consumption function and their coefficients, since most of the determinants of consumption shift the intercept of this curve whenever they change.
Second, a more empirical, rather than just conjectural, understanding of the consumption function will allow textbook authors to be less indecisive in their teaching to students as which variables actually are in the function, and what their relative importance is. A good example of this indecisiveness is the ambiguity with which most macroeconomics textbooks answer the following question: What’s the right income variable to include in the consumption function? The Keynesian current income variable, or the Friedman/Modigliani multiyear income average used in the Permanent Income and Life Cycle hypotheses? Which explains changes in consumption better than the other? Does a properly specified consumption function require both? Neither? It is hoped that the exhaustive statistical testing of these functions in this study, one against the other, will allow us to know with more certainty which income formulation drives overall consumer demand in the U.S.

We can ask the same questions about the relative importance of interest rates, wealth or other variables sometimes postulated as determinants (or as not being determinants) of consumption. But first, a review of previous major theories of consumption is in order.

2. THE KEYNESIAN CONSUMPTION FUNCTION:

Keynes argues in chapter 8 of the General Theory of Employment, Interest and Money (1936) that income, wealth, taxes (fiscal policy) and possibly the rate of interest might influence consumption. However, he felt

...income...is, as a rule, the principal variable upon which the consumption-constituent of the aggregate demand function will depend....(p.96)

though

...windfall changes in capital-values will be capable of changing the propensity to consume, and substantial changes in the rate of interest and in fiscal policy may make some difference (pp.95-96)...

where “fiscal policy” is a reference to tax levels and capital values a reference to wealth. In chapter 9 he also notes other factors that might affect the level of consumption spending: precautionary, saving for known future needs (like retirement), and saving to finance improvements in future standards of living.

Keynes also argued (p. 97) that the proportion of total income saved would grow as income grew, resulting in falling average propensity to consume as income grew.

Typical tests in the late 30’s and early 40’s, using cross-sectional data, seem to verify this. For example, Ruggles & Ruggles described the Keynesian function in their classic text on national income accounting, (1956, p.306). They used the income and consumption patterns of almost 40 million U.S. families in 1935-36 to illustrate a declining average propensity to consume/increasing average propensity to save as income increased. Their data are shown in Table 1. Note that about half of all personal saving was done by the top ½% of all income recipients – those families earning $15,000 or more, and that the bottom two income groups had negative savings, i.e., average propensity’s to consume greater than one. Data like this have provided our standard, though somewhat oversimplified (no provision for wealth or interest rate effects), interpretations of the Keynesian consumption function.

Note that for the nation as a whole, consumption was 84% of personal income. This suggests total consumption may have been about 88% of national income in 1935-36, assuming the 96% ratio of national income to personal income that prevailed in the U.S. during 1960-2000 is at least roughly applicable to 1935-36. This cross sectional data estimate of consumption at 88% of national income becomes an percentage of some importance when we discuss the work of Simon Kuznets, because of its consistency with his findings using longitudinal data.
Table 1  
Consumers’ Income and Expenditure, by Income Group, 1935-36  
(in millions, unless otherwise noted)

<table>
<thead>
<tr>
<th>Income Group (in dollars)</th>
<th># of Families (000)</th>
<th>Personal Income</th>
<th>Personal Taxes</th>
<th>Disposable Income</th>
<th>Consumption Expenditures</th>
<th>Personal Saving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under $780</td>
<td>13,153</td>
<td>$6,190</td>
<td>171</td>
<td>$6,019</td>
<td>$7,226</td>
<td>-1,207</td>
</tr>
<tr>
<td>$780-1,450</td>
<td>13,153</td>
<td>14,154</td>
<td>616</td>
<td>13,638</td>
<td>13,890</td>
<td>-252</td>
</tr>
<tr>
<td>1,450-2,000</td>
<td>5,974</td>
<td>10,035</td>
<td>409</td>
<td>9,626</td>
<td>9,164</td>
<td>462</td>
</tr>
<tr>
<td>2,000-3,000</td>
<td>4,494</td>
<td>6,777</td>
<td>465</td>
<td>10,112</td>
<td>9,043</td>
<td>1,069</td>
</tr>
<tr>
<td>3,000-5,000</td>
<td>1,818</td>
<td>6,644</td>
<td>343</td>
<td>6,301</td>
<td>5,125</td>
<td>1,176</td>
</tr>
<tr>
<td>5,000-15,000</td>
<td>749</td>
<td>5,839</td>
<td>413</td>
<td>5,426</td>
<td>3,529</td>
<td>1,897</td>
</tr>
<tr>
<td>$15,000 &amp; Over</td>
<td>178</td>
<td>5,820</td>
<td>750</td>
<td>5,070</td>
<td>2,237</td>
<td>2,833</td>
</tr>
<tr>
<td>Total…………..</td>
<td>39,458</td>
<td>$59,259</td>
<td>$3,067</td>
<td>$56,192</td>
<td>$50,214</td>
<td>$5,978</td>
</tr>
</tbody>
</table>

Source: Huggles & Huggles, 1956, p.306

Hence, as aggregate income grew over the years, the cross-sectional Keynesian data suggested that the average propensity to consume would fall, raising questions about whether the growth rates of investment and/or government spending could be counted on to increase enough to fill the gap and sustain the higher income levels. As this discussion developed, Simon Kuznets (Kuznets, 1942) entered the foray with an NBER paper containing longitudinal data that suggested the APC may stay constant, not decline, as income grows, eliminating this issue.

3. THE KUZNETS CONSUMPTION FUNCTION: A THEORY THAT OFFERS AN EXPLANATION WHY THE U.S. SAVINGS RATE WAS CONSTANT 1869-1948

Kuznets developed this finding further in a paper (Kuznets, 1952) in which he indicated that in real (or nominal) terms, saving as a percent of national income was about 13-14% during the period 1869-1929, and about 12% for the 1869-1948 period, which includes the depression/WWII period. Kuznets asked:

…What factors explain this secular level in the rate of national saving? Why has it averaged 12 to 14 rather than 25 or 5 percent?... (p.507)

i.e., why has consumption stayed essentially constant as a per cent of national income at 86-88% over an 80 year period in which income growth in the U.S. was enormous? Clearly the percent of income one chooses to save is a key determinant of the level of consumption, and drives the peculiar constancy of the savings rate over much of U.S. history needs to be examined here. Kuznets offered two possible explanations, one of which was technical, related to the capital output ratio, the other related to (Keynesian) savings for known future needs – retirement.

The technical argument noted that the average growth rate of the economy was 3.6% during the 1869-1938 period, and that the data suggested an average capital output ratio of about 3.5 during the same time. This implies an average annual growth of the capital stock (i.e., a savings rate, if financed domestically) of 12.6% during the period. In Kuznets words:

…For 1869-1938, the average rate of growth in net national product in 1929 prices was about 3.6 per cent per year; the ratio of reproducible wealth to national income, also in 1929 prices, ranged from 3 to almost 4 to 1. If we set the latter at about 3.5 to 1 and multiply it by 3.6, the annual rate of growth, we get an average proportion of net capital formation to national product (in 1929 prices) of 12.6 per cent... (pp.507-8)

Kuznets was hesitant to embrace this theory because it implied economic (income) growth was independent of capital stock growth, and in fact determined it vis-a-vis a technical constant, the capital output ratio. It seemed to Kuznets that this ignored the fact (from a Keynesian perspective) that demand for capital was one of the determinants of the level of income as well as vice-versa, and hence the implied theory of investment leaned too exclusively on endogenous determination of the demand for these goods.
He also argued the capital output ratio could fluctuate for the same reason, since not every increase in output (in a Keynesian world of less than fully employed resources) required an increase in the capital stock.

However, advances in both the economic growth literature and investment demand literature since Kuznets wrote in 1952 make this theory more plausible.

First, the empirical literature on the accelerator variable as early as 1971 (Jorgenson, 1971) seemed to establish that economy growth rates may be the single most important determinant of investment, i.e., capital growth.

Second, the work of Solow and others has led many economists today to agree that long term growth of market economies is governed by what governs the economy in the classical long term, not the Keynesian short term, i.e., price and wage flexibility that ensures approximately full employment of available labor. Long run changes in output are the result of subsequent profit maximizing equal proportionate changes in capital as well. By this we mean that, because of long run wage flexibility, in part, growth in national output in market economies progresses at the rate of population (or workforce) growth. This raises the marginal product of capital, and in the long run (which is what Kuznets’ longitudinal data measure), one can show that profit maximization causes the level of capital to grow comparably, since comparable – sized growth is needed to drive capital’s marginal product back down to its profit maximizing point: the cost of capital! Hence the reason why, in a constant returns to scale economy, the capital output ratio \((K/Y)\) stays constant over time.

The other factor causing income growth is technological progress, i.e., increased mechanical efficiency or productivity, which increases the price of a unit of capital, since its price is pegged to the services it can perform. Therefore capital "grows", i.e., is driven, over the classical long run, more in tandem with income growth due to population and productivity growth – the 3.6% Kuznets talks about – than may have been obvious with our more limited understanding of growth in 1952. Today, Kuznets might not have been as skeptical of this theory’s ability to explain why longitudinal data did not show the Keynesian cross-sectional data’s drop in the APC as income grew, but instead showed a reasonably constant average.

Kuznets second explanation for why the APC might stay constant over time was akin to what later became known as the "Life Cycle" Hypothesis, and like it, is drawn from earlier work by Irving Fisher. Kuznets conjectures that individuals must save for things like retirement, and many may also save to leave bequests to children. He theorizes that in a worker’s 40 year work life, he or she might have 25 years when income is high enough to allow serious savings for these purposes. He notes, as one hypothetical plan for meeting these needs that 13% saving out of income for 25 years would provide a perpetual annuity for retirement equal to half the income level enjoyed during the 25 high income/saving years. Note that even if the income level of individuals varies, the savings percent \((APS)\) stays constant as long as the desired retirement stays half the level of income during those working years.

4. THE FRIEDMAN/MODIGLIANI CONSUMPTION FUNCTIONS

Kuznets data showing 80 years of relatively constant APS, and therefore APC, prompted a variety of theories to reconcile it with the falling APC cross-sectional data. The best known of these today are the “Life Cycle” hypothesis (Ando and Modigliani, 1963) and the “Permanent Income” hypothesis (Friedman, 1957). Both are heavily dependent on the notion that current consumption spending is dependent not on current income, per Keynes, but on a person’s sense of what their average annual income will be over a longer time horizon. The desire to maintain reasonably constant living standards, i.e., levels of consumption, sensibly determined by prudent assessment of average long term income prospects, creates the appearance in the cross-sectional data of low consumption in atypically high income individual years, and high consumption in atypically low income individual years. This gives us our Keynes-consistent cross-sectional result, even if relative to an individual’s longer term expectations for annual average income, consumption stays pegged at a constant level. Changes over time in cultural attitudes regarding “responsible” levels of savings for retirement and bequests could of course change this constant. In another study (Heim, 2007), we have looked at the evidence as to whether it appears
consumption fluctuates more with current income, or with some average of past and/or anticipated future income. The results may help us evaluate whether Kuznets’ more Keynesian theory of the APS is constant, or the more Life Cycle oriented explanation seems best to explain the secular APC’s relative constancy, since Kuznets’ “Annuity” theory of the APC holds even if the empirical evidence shows only Keynesian current income drives consumption, whereas the Friedman/Modigliani theories do not.

5. DO KUZNETS 1869-1948 FINDINGS HOLD FOR THE 1960-2000 PERIOD?

Using the Council of Economic Advisor’s (CEA) data from the Economic Report of the President,2002, hereafter referred to as (CEA, 2002), we can reexamine the relationships discussed above and see if they remained the same in most of the period since 1948, the last year covered by Kuznets’ data.

For the period 1959-2000, we have the following averages for aggregate real U.S. consumption and income statistics:

<table>
<thead>
<tr>
<th>Consumption/Personal Income</th>
<th>79%</th>
<th>(vs. Ruggles’ 84% for 1935-36, which = Kuznets’ 88% of National Income, if Personal Income in 35-36 was 104.2% of National Income, as it was 1960-2000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumption/National Income:</td>
<td>82%</td>
<td>(vs. Kuznets 86-88%)</td>
</tr>
<tr>
<td>1959-69:</td>
<td>76-78%</td>
<td></td>
</tr>
<tr>
<td>1970-85:</td>
<td>80-83%</td>
<td></td>
</tr>
<tr>
<td>1986-00:</td>
<td>83-85%</td>
<td></td>
</tr>
</tbody>
</table>

During the 1960’s, the APC, the ratio of consumption to national income, was lower, than the 86% - 88% level Kuznets found for 1869-1948, but returned to something closer to those levels from 1970-00. Overall, real National Income per capita in 1996 dollars almost tripled from 1960-2000. It grew from $10,410 to $27,076. There was a drop in APC from the 86-88% Kuznets found for 1869-1929/48, to 82%, but the drop is small considering the large change in income. Judging from the fluctuation of the ratio during the 1960-2000 period, part of this apparent difference may just be statistical noise, though this was not formally tested. Even if not, it suggests it will be a long time before the APC drops a lot.

Hence, the data from the last four decades of the twentieth century offer some slight support to Keynesian notion of a declining APC as income grows (since there was a drop), but one could also plausibly argue a non-Keynesian cause: availability of the U.S. Social Security program to American workers, reducing the need for retirement savings. Either way, the drop in savings rate is relatively small compared to the almost tripling of income. Hence, on balance the 1959-2000 period seem largely consistent with Kuznet’s findings of a reasonably constant APC over long periods of time, and at roughly the levels Kuznets found for 1869-48.

Regression estimation of the consumption/national income relationship gives a very tight fitting linear curve with a slightly negative intercept. This shows the slightly increasing APC found in the 1959-2000 period, and is presented in Graph 1 below. Graph 2 presents the same information, but using the GDP rather than national income as the income definition. In Graph 2 the coefficient on $Y = (.8*.88) = .69$, is predictable from knowing the .80 ratio of National Income to GDP during the 1960-2000 period. In other words, there is no significant substantive difference between these graphs; they are just different ways of showing the Kuznets function, i.e., the general constancy of the ratio of C to Y. Graph 2A provides consumption/income for disposable income, using the GDP income definition and total government receipts minus transfer payments as the taxes definition. When the national income and disposable income functions are estimated (in levels) without intercepts, the coefficient on the disposable income variable is 1.01 times the coefficient on the national income variable, the ratio of their average values over the period, again showing the strong similarity between Kuznets’ income variable and the one we most commonly use in this study. See Graphs 2B and 2C.
Graph 1
Real C = f(Real National Income)
Cₜ = -221.4 + .88(RealNatInc)ₜ  \( R^2 = .99 \)

Graph 2
Real C = f(Real GDP)
Cₜ = -173.6 + .69 Yₜ  \( R^2 = .99 \)

(All Graphs: Billions of 1996 dollars; Left Scale for Residuals, Right for Actual/Predicted Values)

Graph 2A
\[ \Delta (C)ₜ = 171.3 + .78 \Delta (Y-T_G)ₜ \quad \text{R}^2 = .99 \]
\( (t=3.4) \quad (t=54.2) \)

Graph 3
\[ \Delta (\text{RealNatInc})ₜ = .85 \Delta (\text{Real Y})ₜ \quad \text{R}^2 = .92 \]
\( (t=46.0) \)

Graph 2B
\[ (C)ₜ = .82 (Y-T_G)ₜ \quad \text{R}^2 = .99 \]
\( (t=150.8) \)

Graph 2C
\[ (C)ₜ = .83 (\text{RealNatInc})ₜ \quad \text{R}^2 = .99 \]
\( (t=161.6) \)
However, statistical results on longitudinal data are usually misleading due to the non-stationarity or autocorrelation (joint drift) problems commonly found with them, and the extent to which one variable explains variation in another is often overstated. These same relationships are shown below for the same data, but estimated in first differences to help reduce these problems. Graph 3 is used to establish the comparability of Kuznets’ National Income variable and the GDP – the variable used for income in most subsequent analysis in this study.

Graph 3 shows that in general, when we see changes in GDP, we see changes in the National Income in the same direction and of proportional magnitude, as would be expected since the one is over 80% comprised of the other. Graphs 4 and 5 again show the essential interchangeability of the two variables: the regression coefficient (marginal propensity to consume out of Y) in Graph 5 below is nearly perfectly predictable from knowledge of the MPC out of national income and the regression coefficient scaling National income to the GDP. In short, they can be used as substitutes for each other.

\[
\Delta C_t = f(\Delta \text{Real National Income})
\]

\[
\Delta C_t = .75 \Delta (\text{RealNatInc}_t) = (.75) \Delta (.85 Y_t) = .64 \Delta Y_t
\]

\[
(t=21.6) \quad R^2=.65
\]

Graph 4

\[
\Delta C = f(\Delta \text{GDP})
\]

\[
\approx \Delta C_t = .65 \Delta Y_t
\]

\[
(t=23.8) \quad R^2=.80
\]

Graph 5

However, as we see in Graphs 6 and 7, real government receipts net of amounts collected to finance transfer payments (hereafter referred to as “taxes”, or \( T_o \)) do not completely change in lock step with changes in the GDP, though in part they do, as we will see later in the paper. As a result disposable income (\( Y-T_o \)) is not quite as systematically related to consumption or real national income as is the GDP (\( Y \)) alone, nor does it explain as much variance! However, that said, the remaining relationship is still substantial, confirming Keynes’ assertion that “fiscal effects”, as well as income, affect consumption levels. It also again indicates that Kuznets’ 1869-48 relationship of consumption to national income (86-88%) stayed largely the same from1960-2000 (83%), testing it the same way Kuznets did: without controlling for other, and perhaps collinear, variables such as interest rates and wealth which may also affect consumption.

It also indicates that the disposable income definition used in empirical testing throughout the remainder of this study is, on average, close in value to Kuznets’ National Income variable, providing additional continuity with his work, and at least approximately, showing how his earlier results for the income variable might have varied had he been able to control for other variables that influence the consumption function, as we are able to do.
\[ \Delta C_t = .82 \Delta (Y-T_G)_t = .83 \Delta (\text{RealNatInc})_t \]

\( R^2 = .68 \) \( (t=12.6) \)

\[ \Delta (\text{RealNatInc})_t = 1.01 \Delta (Y-T_G)_t \]

\( R^2 = .60 \) \( (t=11.1) \)

Additional testing below shows that “Y”, our definition of pre-tax income, appears to explain more variance in consumption than disposable income (actual purchasing power), despite the seeming illogic of this finding. Statistical results later in this study will show the reason appears to be that Y is partially collinear with a number of variables, such as wealth and interest rates, which, as mentioned by Keynes, have smaller, but independent, effects on consumption. Thus, in their absence, Y tends to be assigned their contribution to explaining variance in consumption, overstating Y’s real effect. In addition, “Crowd Out” effects will prove to be an additional variable in this category not mentioned by Keynes.

As noted above, part, but not all of government receipts levels are tied to fluctuations in the GDP. The 1960-2000 CEA data, in first differences, show this relationship to be

\[ \Delta T_{G(i)} = .26 \Delta Y_t + e_t \]

\( R^2 = .47; \) D.W. = 1.4 \( (t=7.7) \)

We will define the non-income related, or exogenous, real tax receipts, as those which are determined by policy action, as T_{EXOGENOUS}, or T_EX for short, and set it equal to “e” in the equation above, recognizing that it unavoidably not only contains our conceptual T_EX, but the regression’s error term “e” as well.


Just how similar the findings above for the 1960 - 2000 period are to Kuznets’ findings for 1869 – 1948 depends on how reliable the regression coefficients above are likely to be. It would be useful if there was a way to check whether the statistical results, particularly the regression coefficients, for the two consumption functions above, \( \Delta C = f(\Delta Y) \) and \( \Delta C = f(\Delta Y-T_G) \) are fundamentally accurate indicators of underlying relationships in the data, or merely spurious results caused by less than perfect compliance of the data with the underlying assumptions necessary for regression to provide proper results.

If the results are spurious, they are not likely to be replicable in another data set, or good for predicting what tests of other, theoretically deducible economic relationships are likely to show. However, if the individual regression equation results are accurate representations of the underlying relationships in the data set, we should be able to use one of these two consumption functions’ regression coefficients (MPC) to predict what the other equation’s regression coefficient (MPC) should be.

Using the disposable income function \( C_t = f_i (Y-T_G)_t \) to predict, we get:

\[ \Delta C_t = .82 \Delta (Y-T_G)_t = .82 \Delta Y - .82 \Delta T_G = .82 \Delta Y - .82(\Delta Y - .82 \Delta T_{EX}) = .61 Y - .82 T_{EX} \]
This .61Y prediction of what MPC we should find in the regression \( \Delta C = f(\Delta Y) \) is close to what we actually obtained when running that regression test: .65 (see Graph 5). This strengthens our confidence that neither result for Y was mostly spurious or severely distorted by imperfections in data or method used, or in this particular case, by adding an additional variable (\( T_{EX} \)) to the Graph 5 model. This technique of using the results of one regression to predict the coefficients that should be found when we test another, related hypothesis will be used extensively in this paper. It is one way of assessing what is sometimes referred to as the “robustness”, or likely reliability and replicability of our regression coefficients in other tests. It is not as strong a test as replicating results using another data set, but this is often not practical with macroeconomic time series data. (Having now tested for APC for almost all years between 1869-2000, what’s large period of time is left for further tests of different time periods?)

7. THE JUSTIFICATION FOR INCLUDING A "CROWD OUT" VARIABLE IN THE KEYNESIAN CONSUMPTION FUNCTION

When we actually do the regression \( \Delta C = f(\Delta Y, \Delta T_{EX}) \), we find that though our exercise above predicts Y’s coefficient very well, the coefficient for \( T_{EX} \) appear substantially different than the (-.82) coefficient predicted. Instead, we actually get (.27). The full regression results are

\[
\Delta C_i = .65 \Delta Y_i -.27 \Delta T_{EX(i)} \quad R^2=.83, \quad D.W. \, 1.8
\]

(t=20.1) (t=-2.4)

Such unpredicted and seemingly inconsistent results with what seemed to be a logical inference, of course, occur all too often in regression work, and leave us shaken and worried that the set of regression results that we used to make the prediction, or the ones we used to check the prediction (or both), are spurious, caused by problems in the data set that distort regression results.

Fortunately, however, this does not seem to be the cause of our problem here. Rather, our problem seems to be a specification error, namely, not allowing for the fact that there may be two separate ways in which changes in taxes affect consumption. The first way is through a negative effect, reducing disposable income, and therefore consumption when taxes are raised. The other effect on consumption may be positive, occurring because when taxes increase (holding government spending constant), it reduces the demand for private savings by government to cover deficits, thereby increasing the amount of loanable funds available to consumers (and investors) to use to finance desired purchases. (The effect works as well during periods of government surplus, usually by application of the surplus to paying off debt, rather than just rolling it over.)

Note, for example, the tax coefficient that results when we add to the tested consumption function the hypothesis that tax increases, buy reducing government borrowing to finance deficits, have a separate, positive effect: they reduce “crowd out”, i.e., they increase the loanable funds available to finance consumer goods. This effect is in addition to the negative effect of taxes to consumption through their effect on disposable income. Our new relationship is

\[
\Delta C = f(\Delta Y-T_{EX}, \Delta T_{EX}),
\]

This regression yields the following results:

\[
\Delta C = .654(\Delta Y-T_{EX}) + .387 \Delta T_{EX} + e \quad R^2=.83; \, D.W. \, 1.8
\]

(t=20.1) (t=2.9)

\[
= .654 \Delta Y -.654 \Delta T_{EX} + .387 \Delta T_{EX} + e \\
= .65 \Delta Y -.27 \Delta T_{EX} + e
\]

which matches perfectly our unexpected result above and our previous finding for Y, and may provide powerful evidence that the “Crowd Out” problem caused by government deficits is real and may have previously unrealized effects on consumer spending as well as investment spending. Its effects on investment will be discussed later in this paper. It is virtually impossible to explain the discrepancy in
these coefficients without adding to our consumption function the notion that crowd out is one of its determinants.

Similarly, when we consider the consumption function that has all real tax receipt changes, not just those exogenously generated, we get

$$\Delta C = f(\Delta Y, \Delta T_G),$$

This regression yields the following results:

$$\Delta C = .72 \Delta (Y-T_G) + 0.455 \Delta T_G + e \quad R^2 = .83; \ DW = 1.8$$

(Same as $T_E$'s $R^2$, DW above)

$$\Delta C = .72 \Delta Y -.72 \Delta T_G + 0.455 \Delta T_G + e \quad R^2 = .83; \ DW = 1.8$$

(Same $R^2$, DW again!)

$$\Delta C = .72 \Delta Y -.27(0.26 \Delta Y + \Delta T_E) + e \quad R^2 = .65; \ DW = 1.7$$

(Same as above)

which again matches perfectly our unexpected result for $T$ and our predicted value for $Y$, and may provide powerful evidence that the "Crowd Out" problem caused by government deficits is real and may affect consumer spending. It is also sometimes asserted that it affects investment spending, but examining that hypothesis is beyond the scope of this paper.

8. APPROPRIATLY SPECIFYING THE CROWD OUT VARIABLE: SHOULD WE USE (T-G) OR T AND G SEPARATELY?

In the discussion immediately above, only the government receipts ("taxes") part of the government deficit was used. Below, we present two models of consumption as a function of both disposable income and crowd out. One uses the $T_G$ form of the tax variable, the other the $T_E$ version. Both test the deficit's effect on consumption, via crowd out, in the most intuitively obvious way: by using one variable ($T_G$), to represent the deficit. Tests are also run entering each of the two variables $T$, $G$ separately in the regression, to see if they have differential effects on the availability of consumer credit when they change, and by doing so, change the deficit.

8.1. USING A SINGLE VARIABLE ($T_G - G$) TO MEASURE CROWD OUT EFFECTS

Baseline Model:

$$\Delta C = .82 \Delta (Y-T_G) \quad R^2 = .68$$

(DW = 1.3)

Hypothesis:

$$\Delta C = f[\text{Disposable Income, Deficit Induced Crowd Out}] = f[\Delta(Y-T_G), \Delta T_G]$$

Results of Regression Test of the Hypothesis:

$$\Delta C = .79 \Delta (Y-T_G) + 0.395 \Delta T_G - G \quad R^2 = .78$$

(DW=1.7)

Implication (a):

$$= .79 \Delta (Y-T_G) + 0.395 \Delta T_G - 0.395 \Delta G$$

(Not equal to actual regression results for same hypothesis:

$$\neq .70 \Delta (Y-T_G) + 0.43 \Delta T_G + 0.25 \Delta G \quad R^2 = .84$$

(DW=1.7)
Implication (b):
\[
= .79 \Delta Y - .79 \Delta T_G + .395 \Delta T_a - .395 \Delta G \\
= .79 \Delta Y - .395 \Delta T_a - .395 \Delta G
\]
(Not equal to actual regression results for same hypothesis, i.e.:
\[
\neq .70 \Delta Y - .27 \Delta T_G + 25 \Delta G \\
R^2 = .83 \\
(t=21.7) (t=2.6) (t=1.2) \\
DW=1.7
\]

Implication (c):
\[
= 79 \Delta Y - .395 \Delta(T_G + G) \] (Inferred)
(Not equal to actual regression results for same hypothesis, i.e.:
\[
\neq .72 \Delta Y - .17 \Delta(T_G + G) \\
R^2 = .81 \\
(t=23.6) (t=1.8) \\
DW=1.8
\]

Adding this form of the crowd out variable, i.e., (T_G-G) to the basic \( \Delta C = f(\Delta(Y-T_G)) \) equation increases explained variance from 68% to 78%, strongly consistent with the hypothesis that crowd out problems can adversely affect consumer spending. However, our confidence in the estimates of marginal effects of a change in the government deficit or surplus must be viewed as suspect, since none of the three simple, straightforward inferences from our initial regression results could be confirmed by testing them, even using the same pool of data, i.e.,

a) Implication (a): each of the crowd out’s constituent variables’ marginal effect on consumption is the same, except for sign at .395 of each dollar change, and

b) Implication (b): when we collect our \( T_G \) terms, and express the estimated marginal effect of a change in \( T_G \) or \( G \) separately, both the sign and the magnitude should be the same (-.395) for both variables.

c) Implication (c): when we collect our \( T_G \) terms, the estimated marginal effect of a change in \( (T_G + G) \) should be -.395.

This failure to confirm our initial findings leaves open the possibility that they are spurious and suggests we try other formulations of the crowd out variable, to see if we can find one that more successfully predicts clear implications of its own results. Since all the above results suggest that, for some (as yet unclear) reason, the marginal effects of tax changes and government spending changes are different, it is perhaps not surprising that developing predictions based on the assumption they were the same led to erroneous predictions of the coefficients in closely related economic relations.

To deal with this, let us specify the crowd out hypothesis for initial testing by entering each as a separate variable in the regression:

### 8.2. USING THE SEPARATE VARIABLES (T_G), (G) FORM OF CROWD OUT

**Hypothesis:** \( \Delta C = f(\Delta(Y-T_G), \Delta T_a, \Delta G) \)

**Results of Regression Test of Hypothesis:**
\[
\Delta C = .70 \Delta(Y-T_G) + .43 \Delta T_a + .25 \Delta G \\
R^2 = .84, \ DW=1.7
\]

**Implication (a):**
\[
= .70 \Delta(Y-T_G) + .43 \Delta T_a - (.43)(.58G) \]
(Equal to actual regression test results of same hypothesis, i.e.:
\[
= .70 \Delta(Y-T_G) + .43 \Delta T_a + .43(.58 \Delta G) \\
R^2 = .84 \\
(t=21.7) (t=3.9) (t=1.2) \\
DW=1.7
\]
Implication (b):
\[ \Delta C = .70 \Delta (Y - T) + .43 \Delta T + .58 G \]  
(Approximately equal to actual regression results for same hypothesis, i.e.:
\[ = .76 \Delta (Y - T) + .44 \Delta T - .58 G \]  
\( R^2 = .81 \)  
(t=21.0)  
(t=3.6)  
DW = 1.8

Implication (c):
\[ \Delta C = .70 \Delta Y - .70 \Delta T + .43 \Delta T + .25 \Delta G \]  
(Exactly equal to actual regression results for same hypothesis, i.e.:
\[ = .70 \Delta Y - .27 \Delta T + .25 \Delta G \]  
\( R^2 = .84 \)  
(t=21.7)  
(t=3.9)  
(t=1.2)  
DW = 1.7

Implication (d):
\[ \approx 70 \Delta Y - .27 \Delta (T + G) \]  
(Exactly equal to actual regression results for same hypothesis, i.e.:
\[ = .70 \Delta Y - .27 \Delta (T + G) \]  
\( R^2 = .84 \)  
(t=22.8)  
(t=2.5)  
DW = 1.7

The results seem clearly to support the notion that there are differential effects on crowd out of increasing the government's deficit by tax cuts compared to spending increases. Inferences from this hypothesis are more likely to correctly predict actual regression tests of the inferences than is the case if we treat the deficit as one variable whose marginal effect (coefficient) is the same for both taxes and government spending. Hence, we conclude that specifying the two deficit variables separately is the more appropriate specification of the crowd out effect.

8.3. Testing for Differential Effects in Deficit Increase and Non-Increase Years

Recall from earlier, that without any deficit-increase-year dummy variables, our two-variable method of specifying the crowd out effect yielded the following test results:

Hypothesis: \( \Delta C = f(\Delta (Y - T), \Delta T, \Delta G) \)

Results of Regression Test of Hypothesis:
\[ \Delta C = .70 \Delta (Y - T) + .43 \Delta T + .25 \Delta G \]  
\( R^2 = .84 \)  
(t=21.7)  
(t=3.9)  
(t=1.2)  
DW = 1.7

Let \( T \) be divided into two separate variables,\( [T, 0] \) ("deficit-increase-year" dummy variable) = \( T \times \) and \( [T, 0] \) (a "no deficit increase this year" dummy variable) = \( T \times \). These two new variables, when added together and averaged precisely equal \( T \). Retesting the hypothesis using these two tax variables, we get

Results of Regression Test of Hypothesis:
\[ \Delta C = .70 \Delta (Y - T) + .45 \Delta T + .45 \Delta T + .20 \Delta G \]  
\( R^2 = .84 \)  
(t=22.3)  
(t=4.0)  
(t=4.1)  
(t=1.1)  
DW = 1.7

Here we see that the effect of rising taxes is constant regardless of whether the deficit is rising, falling or staying constant at the time the rise in taxes takes place. Similarly, if we look to see if there is a differential effect of a growth in government spending in years when the deficit is increasing compared to years in which it is constant or declining, we again see that this does not seem to matter

\[ \Delta C = .70 \Delta (Y - T) + .46 \Delta T + .19 \Delta G + .19 \Delta G \]  
\( R^2 = .84 \)  
(t=22.5)  
(t=4.2)  
(t=1.1)  
(t=1.1)  
DW = 1.7

The result very closely approximates the results we obtained when we did not distinguish between deficit increase and non-increase years, where it is reasonable to expect the coefficient on the tax or
government spending variable would be some weighted average of its effects in both types of years. Our results above are generally consistent with this implication, when compared to the .43 and .25 coefficients on the tax and government spending variables when estimated with out adjustment for deficit growth years.

We conclude our discussion of the effect of adding a crowd out variable(s) to the Keynesian consumption function by again noting that the crowd out variable’s effect on consumer spending is so substantial it raises explained variance in consumption from 68%, when only disposable income was used as an explanatory variable, to 84% when the crowd out variables (in separate form) are added. As we will see in the next section, where we also test the effects of interest rates and wealth on consumer demand, nothing except disposable income explains as much variance in consumer demand as does crowd out, i.e., limitations on availability of consumer credit caused by government budget deficits.

Summarizing our results so far we have

\[ \Delta C = .82 \Delta (Y - T_G) \]  
(\(t=12.6\))  
\[ R^2 = .68 \]  
\[ DW = 1.3 \]

\[ \Delta C = .70 \Delta (Y - T_G) + .43 \Delta T_G + .25 \Delta G \]  
(\(t=21.7\))  
(\(t=3.9\))  
(\(t=1.2\))  
\[ R^2 = .84 \]  
\[ DW = 1.7 \]

Note that our results suggest that disposable income is somewhat collinear with the deficit variables, and therefore able to partially proxy for them. As a result disposable income (inappropriately) picks up part of their effect when they are left out of the consumption function, as indicated by the higher regression coefficient for disposable income when it is used alone.

9. ADDING WEALTH, INTEREST RATE AND EXCHANGE RATE VARIABLES TO THE CONSUMPTION FUNCTION:

Keynes also indicated that interest rates and wealth have an effect on consumption, though he argued they were relatively minor influences compared to income effects. There is also strong evidence that the exchange rate may effect consumer demand (Heim, 2007). We now add these additional variables to our previous most successful hypothesis concerning the determinants of consumption, i.e.,

\[ \Delta C = f(\Delta (Y - T_G), \Delta T_G, \Delta G) \]

As a measure of interest rates, we will use the real prime interest rate, defined as the nominal prime rate (CEA 2002, Table B73) minus the average of the prior two years CPI inflation rates (CEA 2002, B60). As a measure of consumer wealth, we will use the Dow Jones Composite Average (CEA 2002, Table B95). The exchange rate used is the G-10 exchange rate (CEA 1997, Table B108 and CEA 1999, Table B110)

9.1. DETERMINING THE APPROPRIATE TIME LAG TO USE WITH VARIABLES

Below, we have taken the basic consumption function \( \Delta C = f(\Delta (Y - T_G)) \) and in four separate sets of regressions, added one additional explanatory variable to the basic equation: either crowd out (actually two for crowd out: T and G), interest rates (PR), wealth (DJ), or a trade weighted U.S. exchange rate index (XR). For each of these new models, the current year value of the new variable or one of the four prior year values were tested. Which ever year’s value explained the most variance in consumption was taken to be the appropriate lagged value for use in the consumption function in any further tests. The exchange rate used is the average of the current and past three years exchange rates (\(XR_{AV0123}\)). Other studies (Heim 2007b) had shown that partial effects of an exchange rate change on consumption were felt for several years, and perhaps best represented by a four year average exchange rate. This was because several current and past single year rates, when used alone in the consumption function, were found to be statistically significant, suggesting incomplete adjustment in a single period to an exchange rate change. However, when more than one of these lagged variables were entered as separate
variables in the same regression, some would become insignificant due to the high level of multicollinearity among them, and their individual marginal effects (regression coefficients) proved highly unreliable, varying widely when yet another exchange rate variable was added to the model with a different lag. However, it was noticed that the sum of the individual coefficients of the several different exchange rate variables tended to add precisely or approximately to the coefficient obtained when the individual rates were averaged and entered as a single variable. And the average variable was statistically significant. For these reasons, in further testing below, we used the average exchange rate for the current and past three years as our exchange rate variable.

For the crowd out variables (T, G), and the prime interest rate (PR), the regressions indicated that the current year value was most associated with variance in consumption. Hence, when testing the crowd out and interest rate variables against each other or other variables below, we will use their current year values. For the wealth variable, the Dow Jones Composite Average (DJ) was used. The two year lagged value added the most to explained variance, and will be used in subsequent tests.

9.2 WHICH VARIABLES ADD MOST TO EXPLAINED VARIANCE IN CONSUMPTION?

As indicted in Table 5.1, the crowd out variables for the current period added the most to explained variance. It was added to the basic model, and the additional variance explained when wealth and interest rates were added to this new basic model were calculated (Table 5.2)

<table>
<thead>
<tr>
<th>Basic Model</th>
<th>Add Only Δ Crowd Out To Basic Model</th>
<th>Add Only Δ Wealth To Basic Model</th>
<th>Add Only Δ Interest rate To Basic Model</th>
<th>Add Only ΔXR_{AV0123} To Basic Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΔC = f Δ(Y-T_{G0})</td>
<td>R^2 = 68% (T,G)_0 = 84%</td>
<td>DJ_0 = 74%</td>
<td>PR_0 = 66%</td>
<td>XR_{AV0123} = 68%</td>
</tr>
<tr>
<td>Add Only Δ Crowd Out To Basic Model</td>
<td>R^2 = 68% (T,G)_1 = 73%</td>
<td>DJ_1 = 79%</td>
<td>PR_1 = 65%</td>
<td>NA</td>
</tr>
<tr>
<td>Add Only Δ Wealth To Basic Model</td>
<td>R^2 = 68% (T,G)_2 = 67%</td>
<td>DJ_2 = 80%</td>
<td>PR_2 = 65%</td>
<td>NA</td>
</tr>
<tr>
<td>Add Only Δ Interest rate To Basic Model</td>
<td>R^2 = 68% (T,G)_3 = 66%</td>
<td>DJ_3 = 72%</td>
<td>PR_3 = 65%</td>
<td>NA</td>
</tr>
<tr>
<td>Add Only ΔXR_{AV0123} To Basic Model</td>
<td>R^2 = 68% (T,G)_4 = 66%</td>
<td>DJ_4 = 72%</td>
<td>PR_4 = 65%</td>
<td>NA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Modified Basic Model (MBM)</th>
<th>Add Only Δ Wealth To MBM</th>
<th>Add Only Δ Interest rate To MBM</th>
<th>Add Only ΔXR_{AV0123} To MBM</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΔC = f[Δ(Y-T_{G0}), Δ(T,G)_0]</td>
<td>R^2 = 84%</td>
<td>DJ_2 = 89%</td>
<td>PR_0 = 87%</td>
</tr>
</tbody>
</table>

Wealth adds the most to the MBM, providing this wealth – augmented regression:

\[
\Delta C = .65 \Delta (Y-T_{G}) + .32 \Delta T_{G} + .21 \Delta G + .81 DJ_{2} \quad R^2 = .89
\]

\(t=21.1\) \(t=3.5\) \(t=1.0\) \(t=4.5\) \(DW=1.9\)

In Table 5.3 we separately add each of the remaining possible explanatory variable, interest rates and exchange rates, to see which adds the most additional explanatory power to the 89% provided by the wealth augmented model above.
Table 5.3
Additional Variance Explained by Stepwise Addition of the Prime Interest Rate or Exchange Rate Variable To the (Further) Modified Basic Model

<table>
<thead>
<tr>
<th>(Further) Modified Basic Model (FMBM)</th>
<th>Add PR₀</th>
<th>Add Only ΔXR_{AV0123}</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΔC = f[Δ(Y-T_G)₀, Δ (T,G)₀, Δ DJ₂]</td>
<td>R² = 89%</td>
<td>DJ₂ = 91%</td>
</tr>
</tbody>
</table>

The prime interest rate add the most to the FMBM, providing this interest rate -augmented regression:

ΔC₀ = .65 Δ(Y-T_G)₀ + .48 ΔT_G(0) + .07 ΔG₀ + .72 ΔDJ₂ - 6.72 ΔPR₀,  
R² = 91%  
DW = 1.8

Finally, we again modifying the basic model, this time to add the remaining possible determinant of consumption, the trade weighted exchange rate, averaged over four years;

Table 5.4
Additional Variance Explained by Stepwise Addition of An Exchange Rate Variable To the (Further) Modified Basic Model

<table>
<thead>
<tr>
<th>(Further) Modified Basic Model</th>
<th>Add Only ΔXR_{AV0123}</th>
</tr>
</thead>
<tbody>
<tr>
<td>ΔC = f[Δ(Y-T_G)₀, Δ (T,G)₀, Δ DJ₂, ΔPR₀]</td>
<td>R² = 91%</td>
</tr>
<tr>
<td>XR_{AV0123} = 92%</td>
<td></td>
</tr>
</tbody>
</table>

And the final tested consumption function model becomes

ΔC₀ = .66 Δ(Y-T_G)₀ + .48 ΔT_G(0) + .06 ΔG₀ + .69 ΔDJ₂ - 6.81 ΔPR₀ + 1.39 ΔXR_{AV0123} R² = 92%  
(t) (28.0) (5.2) (0.5) (5.1) (-3.2) (2.3) DW = 2.0

or, when crowd out is tested as one variable

ΔC₀ = .72 Δ(Y-T_G)₀ + .43 Δ(T_G-G)₀ + .83 ΔDJ₂ - 6.49 ΔPR₀, + 1.69 ΔXR_{AV0123} R² = 89%  
(t) (25.8) (4.6) (6.7) (-2.8) (3.2) DW = 1.8

Clearly, the former model is preferred since it allows us to see that the two deficit variables have different impact on crowd out, and for that reason, when entered as separate variables, explain more variance.

Except for the crowd out and exchange rate variables, this model provides, we think, a reasonable approximation of what Keynes had in mind when he talked about the consumption function, and the model seems to support Keynes' thinking about the major importance of current after tax income, and a possible smaller additional effect of wealth and interest rates. The crowd out variables are added because they seem systematically and powerfully related to consumption, particularly crowd out problems stemming from tax cuts. The exchange rate is added because it also appears systematically related to consumption, though its influence appears smaller during the 1960 -2000 period than that of the other variables in the function.

We summarize our model building efforts by repeating our earlier econometric results at each stage of the model building process:

ΔC = .82 Δ(Y-T₀) R² = 68%  
(t=) (12.6) DW=1.3

ΔC = .70 Δ(Y-T₀) + .43 ΔT₀ + .25 ΔG R²=84%  
(t=21.7) (t=3.9) (t=1.2) DW=1.7
\[ \Delta C = 0.65 \Delta(Y - T_G) + 0.32 \Delta T_G + 0.21 \Delta G + 0.81 \Delta DJ_2 \]
\[ (t=21.1) \quad (t=3.5) \quad (t=1.0) \quad (t=4.5) \]
\[ R^2 = 89\% \quad DW = 1.9 \]

\[ \Delta C_0 = 0.65 \Delta(Y - T_G) + 0.48 \Delta T_G + 0.07 \Delta G + 0.72 \Delta DJ_2 - 6.72 \Delta PR \]
\[ (t=31.8) \quad (t=4.8) \quad (t=0.4) \quad (t=5.1) \quad (t=-3.9) \]
\[ R^2 = 91\% \quad DW = 1.8 \]

\[ \Delta C_0 = 0.66 \Delta(Y - T_G)_0 + 0.48 \Delta T_G(0) + 0.06 \Delta G_0 + 0.69 \Delta DJ_2 - 6.81 \Delta PR_0 + 1.39 \Delta XR_{AV0123} \]
\[ (t=28.0) \quad (t=5.2) \quad (t=0.5) \quad (t=5.1) \quad (t=-3.2) \quad (t=2.3) \]
\[ R^2 = 92\% \quad DW = 2.0 \]

**Graph 8**

**THE KEYNESIAN CONSUMPTION FUNCTION: 1962 - 2000**

Augmented by Credit Availability (Crowd Out) and Exchange Rate Variables

\[ \Delta C = f(\Delta \text{DISPOSABLE INCOME}, \Delta \text{CONSUMER CREDIT AVAILABILITY}, \Delta \text{WEALTH}, \Delta \text{PRIME INTEREST RATE}, \Delta \text{G-10 EXCHANGE RATE}) \]

\[ \Delta C_0 = 0.66 \Delta(Y - T_G)_0 + 0.48 \Delta T_G(0) + 0.06 \Delta G_0 + 0.69 \Delta DJ_2 - 6.81 \Delta PR_0 + 1.39 \Delta XR_{AV0123} \]

(Left and Right Scales in Billions of 1996 Dollars)

Data From the *Economic Report of the President, 2002*
Notice that the first differencing process has reduced multicollinearity in the data sufficiently so that most key coefficient estimates stay remarkably stable, though not perfectly so, when additional variables are added to the model.

10. ADAPTIVE AND RATIONAL EXPECTATIONS ALTERNATIVES TO KEYNES’ CURRENT YEAR INCOME VARIABLE

Friedman (1957) and Modigliani (1963) argued that consumer demand is driven by expectations of one’s average income over an extended period of time, not just current year income as Keynes argued. One sees little head-to-head testing of these competing hypotheses in the literature, particularly in recent decades. This is surprising since many have noted (e.g., Mankiw 2006) that the current year impact of a Keynesian policy change, particularly tax changes, is much smaller if average income is the driving force. A given change in current year income changes average income for a number of years by a smaller amount because of the averaging process. Further the average income models suggest consumer spending may not change at all, or hardly at all, if tax changes are temporary. “Current income only” models, the normal interpretation of the Keynes income variable, would predict larger changes in consumption in both cases, since current year income changes alone are taken to be the driving income force in the consumption function.

This paper will now attempt to see if consumer spending patterns can be better explained by the average of several past years’ income history, or some combination of past year and current year average income. It may be that consumers adapt their spending habits not (or not only) to changes in current year income, but also to averages of past year income levels they have come to see as typical of their long term earning power. This average income model will be tested as the “adaptive expectations” version, in which the only change the consumer sees that changes consumption behavior, is the change in their long term average income that occurs when current income changes. This will tested as one type of “Life Cycle” average income variable, after Modigliani, or equivalently, a “Permanent Income” average income variable, after Friedman.

Subsequent to this effort, a rational expectations formulation of the average income hypothesis will also be tested. Here, the averaging process will include expectations of income to be earned in future years. To do this, we will use actual income earned in the future as a proxy for incomes one might rationally (but imperfectly) deduce will prevail then, based on current circumstances, such as recent performance evaluations, likely hood of promotions due to impending retirements of coworkers, etc. Modifications of this model will combine this with past income to find an average of lifetime income, at least from the perspective of what’s been happening in the recent past and likely to happen in the near future. This will tested as another possible type of “Life Cycle” average income variable, after Modigliani, or equivalently, a “Permanent Income” average income variable, after Friedman.

In the models below, the subscript(s) on the disposable income variable refer to the particular years entered into the income average, e.g., (Y-TG)0,-1,-2 means the average of current and last two years’ disposable income. The regression with the income variable subscripted “Keynes” repeats our earlier results obtained for the Keynesian consumption function. They are presented here to facilitate ease of comparison Keynesian and Friedman/Modigliani models.

10.1. ADAPTIVE EXPECTATIONS MODELS: STATISTICAL RESULTS

10.1.A. TESTS OF CONSUMPTION FUNCTIONS USING ONLY MODIGLIANI/FRIEDMAN AVERAGE INCOME

\[
\Delta C_0 = .66 \Delta (Y-TG)_{Keynes} + .48 \Delta T_{G(0)} + .06 \Delta G_0 + .69 \Delta DJ_{-2} - 6.81 \Delta PR_0 + 1.39 \Delta XR_{AV0123} R^2=92% \\
(t=28.0) (t=5.2) (t=0.5) (t=5.1) (t=3.2) (t=2.3) DW=2.0
\]
\[ \Delta C = 0.58 \Delta(Y-T_G)_{-1} + 0.49 \Delta T_{G(0)} + 0.10 \Delta G_{0} + 0.85 \Delta DJ_{-2} - 10.30 \Delta PR_{0} + 2.19 \Delta XR_{AV0123} R^2 = 39\% \]

\[ \Delta C = 0.65 \Delta(Y-T_G)_{-2} + 0.74 \Delta T_{G(0)} - 0.55 \Delta G_{0} + 0.69 \Delta DJ_{-2} - 6.76 \Delta PR_{0} + 4.76 \Delta XR_{AV0123} R^2 = 40\% \]

\[ \Delta C = 0.76 \Delta(Y-T_G)_{0,1} + 0.46 \Delta T_{G(0)} - 0.28 \Delta G_{0} + 0.54 \Delta DJ_{-2} - 9.54 \Delta PR_{0} + 2.32 \Delta XR_{AV0123} R^2 = 83\% \]

\[ \Delta C = 0.76 \Delta(Y-T_G)_{1,2} + 0.61 \Delta T_{G(0)} - 0.66 \Delta G_{0} + 0.52 \Delta DJ_{-2} - 9.55 \Delta PR_{0} + 4.32 \Delta XR_{AV0123} R^2 = 54\% \]

\[ \Delta C = 0.76 \Delta(Y-T_G)_{2,3} + 0.71 \Delta T_{G(0)} - 0.61 \Delta G_{0} + 0.48 \Delta DJ_{-2} - 5.66 \Delta PR_{0} + 6.44 \Delta XR_{AV0123} R^2 = 50\% \]

\[ \Delta C = 0.81 \Delta(Y-T_G)_{0,1,2} + 0.56 \Delta T_{G(0)} - 0.71 \Delta G_{0} + 0.40 \Delta DJ_{-2} - 9.09 \Delta PR_{0} + 3.79 \Delta XR_{AV0123} R^2 = 81\% \]

\[ \Delta C = 0.80 \Delta(Y-T_G)_{1,2,3} + 0.62 \Delta T_{G(0)} - 0.64 \Delta G_{0} + 0.44 \Delta DJ_{-2} - 7.91 \Delta PR_{0} + 5.56 \Delta XR_{AV0123} R^2 = 56\% \]

\[ \Delta C = 0.85 \Delta(Y-T_G)_{0,1,2,3} + 0.58 \Delta T_{G(0)} - 0.69 \Delta G_{0} + 0.35 \Delta DJ_{-2} - 7.92 \Delta PR_{0} + 4.95 \Delta XR_{AV0123} R^2 = 77\% \]

\[ \Delta C = 0.85 \Delta(Y-T_G)_{0,1,2,3,4} + 0.59 \Delta T_{G(0)} - 0.56 \Delta G_{0} + 0.33 \Delta DJ_{-2} - 6.20 \Delta PR_{0} + 5.25 \Delta XR_{AV0123} R^2 = 76\% \]

The above regressions above indicate that when the Keynesian income variable \( \Delta(Y-T_G)_{0} \) is removed and replaced by a multi period past income average, the equation explains considerably less variance, dropping from 92% to between 39% and 83%, depending on the average model used. In general, only average models that contained the Keynesian current year income variable explained anything close to the amount of variance explained by the Keynesian model. The best model not including current income only explained 56% of the variance in consumption over the forty year period tested. Of those including the current income variable, only the ones that contained the least number of past year incomes to dilute the current year income variable’s effect did the best. Hence, the data do not seem to better support an explanation of the consumer’s behavior based on a strictly (adaptive expectations version of) Friedman’s Permanent Income or Modigliani’s Life Cycle hypotheses. The Keynesian version alone always explains more variance in consumption spending, and usually far more. Another reason to reject the average income only consumption function model is that slight changes in the specification of the income variable in the equation seriously change the estimated marginal effects of most of the other variables, making their estimated marginal impact on consumption unreliable. This, of course, makes any one version of the model unreliable. Adding more than four past year incomes to the average did not seem to improve the performance of the model significantly.

10.1.8. TESTS OF CONSUMPTION FUNCTIONS USING BOTH MODIGLIANI/FRIEDMAN AVERAGE INCOME AND KEYNES CURRENT INCOME VARIABLES

If we test the hypothesis that some Americans may be Keynesian, while others are more Friedman/Modigliani in their behavior, we find that the data support such a theory, as noted below in eleven additional regressions, most exactly the same as those tested above, except that an additional (Keynesian income) variable has been added. Separate equations are tested for a number of different current and past income averages, up through four past years, as was the case earlier. Adding more than four past years to the average did not seem to improve the performance of the model significantly, leading to the rejection of the hypothesis that our Friedman/Modigliani consumer used more than four past years income in formulating his permanent income upon which to base consumption decisions. Adding a Friedman/Modigliani income variable to the Keynesian model adds, at best, only one percent
more to explained variance than the simple Keynesian model alone explains. Only two of the average variables used were significant at the one percent level: the (0,-1,-2) average and the (-1,-2) average, though most other average income formulations were significant at the 5% level. However, in any of these, if you drop the Keynesian current disposable income variable from the joint hypothesis, leaving only the average income variable in, R² falls from 92-93% to at least 83%, and if you also drop the current year income variable from the average, the R² drops to a high of 56%. Hence, it is difficult not to conclude that the Keynesian current income variable is the most significant income variable systematically related to consumption.

Shown another way, if we drop the Friedman/Modigliani variable from the joint income hypothesis, leaving only the Keynesian income variable in, explained variance drops a maximum of one percent. Hence, the evidence would seem to suggest that most consumers are Keynesian, whose behavior dominates the consumption function data. Nonetheless, the persistence of statistically significant coefficients (5% level or better) on the average income variables suggests that a small fraction of consumers also systematically behave in a Life Cycle/Permanent Income Hypothesis manner, or at least adaptive expectations version thereof. However, based on how little their apparent behavior raises explained variance (1%), it seems unlikely their behavior is likely to significantly distort fundamentally Keynesian conclusions about how the economy responds to changes in current income. We would further, and importantly, add that in these joint Keynes and Friedman/Modigliani equations, marginal effects estimates stay quite stable when changes are made to the model tested, enhancing our sense that the results may be more reliable, and therefore more powerful scientific indicators of underlying relationships in the U.S. consumption function.

\[ \Delta C = 0.66 \Delta (Y_T - G_T) \text{ (Keynesian)} + 0.48 \Delta G_{0(t)} + 0.06 \Delta G_0 + 0.61 \Delta P_{R0} + 0.69 \Delta DJ_2 + 1.39 \Delta XR_{AV0123} \]

\[ R^2 = 92\% \quad \text{DW} = 2.0 \]

\[ \Delta C = 0.61 \Delta (Y_T - G_T) + 0.10 \Delta (Y_T - G_T)_1 + 0.47 \Delta G_{0(t)} - 0.07 \Delta G_0 - 0.75 \Delta P_{R0} + 0.62 \Delta DJ_2 + 1.68 \Delta XR_{AV0123} \]

\[ R^2 = 93\% \quad \text{DW} = 1.9 \]

\[ \Delta C = 0.62 \Delta (Y_T - G_T) + 0.08 \Delta (Y_T - G_T)_2 + 0.50 \Delta G_{0(t)} - 0.12 \Delta G_0 - 0.59 \Delta P_{R0} + 0.62 \Delta DJ_2 + 1.93 \Delta XR_{AV0123} \]

\[ R^2 = 92\% \quad \text{DW} = 2.1 \]

\[ \Delta C = 0.51 \Delta (Y_T - G_T) + 0.19 \Delta (Y_T - G_T)_3 + 0.47 \Delta G_{0(t)} - 0.07 \Delta G_0 - 0.75 \Delta P_{R0} + 0.62 \Delta DJ_2 + 1.67 \Delta XR_{AV0123} \]

\[ R^2 = 93\% \quad \text{DW} = 1.9 \]

\[ \Delta C = 0.50 \Delta (Y_T - G_T) + 0.21 \Delta (Y_T - G_T)_4 + 0.49 \Delta G_{0(t)} - 0.19 \Delta G_0 - 0.74 \Delta P_{R0} + 0.58 \Delta DJ_2 + 2.06 \Delta XR_{AV0123} \]

\[ R^2 = 93\% \quad \text{DW} = 1.9 \]

\[ \Delta C = 0.59 \Delta (Y_T - G_T) + 0.14 \Delta (Y_T - G_T)_5 + 0.49 \Delta G_{0(t)} - 0.19 \Delta G_0 - 0.74 \Delta P_{R0} + 0.58 \Delta DJ_2 + 2.06 \Delta XR_{AV0123} \]

\[ R^2 = 93\% \quad \text{DW} = 1.9 \]

\[ \Delta C = 0.61 \Delta (Y_T - G_T) + 0.19 \Delta (Y_T - G_T)_6 + 0.50 \Delta G_{0(t)} - 0.12 \Delta G_0 - 0.67 \Delta P_{R0} + 0.60 \Delta DJ_2 + 2.17 \Delta XR_{AV0123} \]

\[ R^2 = 92\% \quad \text{DW} = 2.1 \]

\[ \Delta C = 0.58 \Delta (Y_T - G_T) + 0.19 \Delta (Y_T - G_T)_7 + 0.50 \Delta G_{0(t)} - 0.16 \Delta G_0 - 0.73 \Delta P_{R0} + 0.57 \Delta DJ_2 + 2.23 \Delta XR_{AV0123} \]

\[ R^2 = 93\% \quad \text{DW} = 2.0 \]

\[ \Delta C = 0.59 \Delta (Y_T - G_T) + 0.14 \Delta (Y_T - G_T)_8 + 0.50 \Delta G_{0(t)} - 0.17 \Delta G_0 - 0.73 \Delta P_{R0} + 0.57 \Delta DJ_2 + 2.23 \Delta XR_{AV0123} \]

\[ R^2 = 93\% \quad \text{DW} = 2.0 \]

\[ \Delta C = 0.54 \Delta (Y_T - G_T) + 0.18 \Delta (Y_T - G_T)_9 + 0.50 \Delta G_{0(t)} - 0.13 \Delta G_0 - 0.67 \Delta P_{R0} + 0.57 \Delta DJ_2 + 2.29 \Delta XR_{AV0123} \]

\[ R^2 = 93\% \quad \text{DW} = 1.9 \]

\[ \Delta C = 0.58 \Delta (Y_T - G_T) + 0.15 \Delta (Y_T - G_T)_10 + 0.50 \Delta G_{0(t)} - 0.13 \Delta G_0 - 0.67 \Delta P_{R0} + 0.57 \Delta DJ_2 + 2.30 \Delta XR_{AV0123} \]

\[ R^2 = 93\% \quad \text{DW} = 1.9 \]

### 10.2 Rational Expectations Models: Statistical Results

If consumers are average income-driven, and have rational expectations about their incomes, they are using all available information about the future as well as the present and the past to determine their likely average income. If we assume that consumers either know with certainty, or at least approximately, their...
likely future year income, and use their actual future income data as an imperfect proxy for it, we can view the rational expectations variant of the average income hypothesis. To the extent our tests explain more variance than adaptive expectations alone (or Keynesian models alone), we can conclude that the data are consistent with the rational expectations version of the Life Cycle/Permanent Income hypothesis.

10.2.A. TESTS OF CONSUMPTION FUNCTIONS USING ONLY MODIGLIANI/FRIEDMAN AVERAGE INCOME

\[
\Delta C = 0.66 \Delta (Y - T_G)_{\text{Keynes}} + 0.48 \Delta T_G(0) + 0.06 \Delta G - 6.81 \Delta PR_0 + 0.69 \Delta DJ_{-2} + 1.39 \Delta XR_{AV0123}^2 = 92\% \quad DW = 2.0
\]

\[
\Delta C = 0.54 \Delta (Y - T_G)_{+1} + 0.65 \Delta T_G(0) + 0.46 \Delta G - 5.9 \Delta PR_0 + 0.15 \Delta DJ_{-2} + 2.5 \Delta XR_{AV0123}^2 = 46\% \quad DW = 2.8
\]

\[
\Delta C = 0.50 \Delta (Y - T_G)_{+2} + 0.67 \Delta T_G(0) + 0.41 \Delta G - 1.63 \Delta PR_0 + 0.45 \Delta DJ_{-2} + 4.7 \Delta XR_{AV0123}^2 = 29\% \quad DW = 2.8
\]

\[
\Delta C = 0.69 \Delta (Y - T_G)_{0,+1} + 0.57 \Delta T_G(0) + 0.07 \Delta G - 3.2 \Delta PR_0 + 1.6 \Delta DJ_{-2} + 9.2 \Delta XR_{AV0123}^2 = 82\% \quad DW = 2.7
\]

\[
\Delta C = 0.70 \Delta (Y - T_G)_{0,+1,2} + 0.62 \Delta T_G(0) + 0.01 \Delta G - 2.23 \Delta PR_0 - 0.23 \Delta DJ_{-2} + 6.6 \Delta XR_{AV0123}^2 = 75\% \quad DW = 2.2
\]

\[
\Delta C = 0.17 \Delta (Y - T_G)_{0,+1,2,3} + 0.62 \Delta T_G(0) + 0.11 \Delta G - 1.37 \Delta PR_0 - 0.88 \Delta DJ_{-2} + 1.3 \Delta XR_{AV0123}^2 = 56\% \quad DW = 1.8
\]

\[
\Delta C = 0.74 \Delta (Y - T_G)_{-1,0,1} + 0.53 \Delta T_G(0) - 0.13 \Delta G - 6.05 \Delta PR_0 + 1.17 \Delta DJ_{-2} + 1.59 \Delta XR_{AV0123}^2 = 77\% \quad DW = 3.0
\]

\[
\Delta C = 0.79 \Delta (Y - T_G)_{-1,2,0,1,2} + 0.63 \Delta T_G(0) - 0.41 \Delta G - 5.08 \Delta PR_0 - 0.3 \Delta DJ_{-2} + 2.11 \Delta XR_{AV0123}^2 = 71\% \quad DW = 2.3
\]

\[
\Delta C = 0.79 \Delta (Y - T_G)_{-2,3,0,1,2,3} + 0.62 \Delta T_G(0) - 0.36 \Delta G - 3.96 \Delta PR_0 - 0.67 \Delta DJ_{-2} + 2.67 \Delta XR_{AV0123}^2 = 55\% \quad DW = 2.0
\]

\[
\Delta C = 0.71 \Delta (Y - T_G)_{0,1,2,3,4} + 0.71 \Delta T_G(0) - 0.15 \Delta G - 4.76 \Delta PR_0 - 0.5 \Delta DJ_{-2} + 1.47 \Delta XR_{AV0123}^2 = 58\% \quad DW = 1.9
\]

\[
\Delta C = 0.78 \Delta (Y - T_G)_{1,2,3,4,0,1,2,3,4} + 0.69 \Delta T_G(0) - 0.35 \Delta G - 5.28 \Delta PR_0 - 0.44 \Delta DJ_{-2} + 3.22 \Delta XR_{AV0123}^2 = 51\% \quad DW = 2.0
\]

Here again, there is little support for the hypothesis that only the average income variable instead of an current income - only variable explains variation in consumer demand. No rational expectations variant of the average income variable explained as much variance as the Keynesian current income variable alone. The best, which averaged current and next years income, only explained 82% of the variance compared to the 92% explained by current income alone. Those averages with no current income variable in them proved the worst at explaining variance, again suggesting that current income is the driving economic force in the consumption function. Also, again we find marginal impact estimates for the other variables fluctuate substantially when slight changes to the income variable are made, reducing our confidence in any one of these point estimates substantially.

10.1.B. TESTS OF CONSUMPTION FUNCTIONS USING BOTH MODIGLIANI/FRIEDMAN AVERAGE INCOME AND KEYNES CURRENT INCOME VARIABLES

If we test the hypothesis that some groups of Americans may be Keynesian, while others are more oriented toward a rational expectations version of the Life Cycle or Permanent Income in their behavior,
we find that the data do not support such a theory, as shown in the eleven additional regressions below.
In this new formulation, both the Keynesian current income variable and the Friedman/Modigliani average income variable are entered as separate variables. We use separate equations for a number of different past and future income averages, using up to four past or future years. Adding more than four years did not seem to improve results, suggesting again that the Friedman/Modigliani consumer does not use more than four past years income in formulating permanent income upon which to base consumption decisions. This rational expectations formulation when added to the Keynesian model, actually reduces explained variance one to three percent, from 92% to 89-91%. By comparison, we found earlier that adding an adaptive expectations average income variable in our earlier tests tended to add about 1% to explained variance.

\[
\Delta C_0 = .66 \Delta(Y-T_0) \quad (\text{keynes}) + .48 \Delta T_{G(0)} + .06 \Delta G_0 - 6.81 \Delta PR_0 + 69 \Delta DJ_2 + 1.39\Delta XR_{AV0123} \quad R^2=92\% \\
(\lambda) = (28.0) \\
\Delta C_0 = .59\Delta(Y-T_0) + .09 \Delta(Y-T_0) - 1 + .50 \Delta T_{G(0)} + .02 \Delta G_0 - 5.91 \Delta PR_0 + 50\Delta DJ_2 + 1.29\Delta XR_{AV0123} \quad R^2=91\% \\
(\lambda) = (11.4) \\
\Delta C_0 = .61\Delta(Y-T_0) + .07 \Delta(Y-T_0) - 2 + .50 \Delta T_{G(0)} + .01 \Delta G_0 - 6.22 \Delta PR_0 + 47\Delta DJ_2 + 1.27\Delta XR_{AV0123} \quad R^2=89\% \\
(\lambda) = (15.1) \\
\Delta C_0 = 4.9\Delta(Y-T_0) + .19 \Delta(Y-T_0) - 0.1 + .50 \Delta T_{G(0)} + .02 \Delta G_0 - 5.91 \Delta PR_0 + 50\Delta DJ_2 + 1.29\Delta XR_{AV0123} \quad R^2=91\% \\
(\lambda) = (4.8) \\
\Delta C_0 = .50\Delta(Y-T_0) + .20 \Delta(Y-T_0) - 0.1 + .52 \Delta T_{G(0)} + .01 \Delta G_0 - 5.63 \Delta PR_0 - 31 \Delta DJ_2 + 1.18\Delta XR_{AV0123} \quad R^2=90\% \\
(\lambda) = (7.3) \\
\Delta C_0 = .54\Delta(Y-T_0) + .16 \Delta(Y-T_0) - 0.1 + .50 \Delta T_{G(0)} - .01 \Delta G_0 - 5.55 \Delta PR_0 + 13 \Delta DJ_2 + 1.17\Delta XR_{AV0123} \quad R^2=88\% \\
(\lambda) = (9.3) \\
\Delta C_0 = .51\Delta(Y-T_0) + .19 \Delta(Y-T_0) - 0.1 + .49 \Delta T_{G(0)} - .05 \Delta G_0 - 6.72 \Delta PR_0 + 49\Delta DJ_2 + 1.49\Delta XR_{AV0123} \quad R^2=92\% \\
(\lambda) = (7.0) \\
\Delta C_0 = .51\Delta(Y-T_0) + .22 \Delta(Y-T_0) - 1.2 + .52\Delta T_{G(0)} - .14 \Delta G_0 - 6.45 \Delta PR_0 - 27 \Delta DJ_2 + 1.60\Delta XR_{AV0123} \quad R^2=91\% \\
(\lambda) = (8.4) \\
\Delta C_0 = .55\Delta(Y-T_0) + .18 \Delta(Y-T_0) - 1.2 + .50\Delta T_{G(0)} - .10 \Delta G_0 - 6.08 \Delta PR_0 + 13 \Delta DJ_2 + 1.62\Delta XR_{AV0123} \quad R^2=88\% \\
(\lambda) = (10.1) \\
\Delta C_0 = .56\Delta(Y-T_0) + .14 \Delta(Y-T_0) - 1.2 + .57 \Delta T_{G(0)} - .07 \Delta G_0 - 7.55 \Delta PR_0 + 47 \Delta DJ_2 + 1.52\Delta XR_{AV0123} \quad R^2=89\% \\
(\lambda) = (12.0) \\
\Delta C_0 = .56\Delta(Y-T_0) + .15 \Delta AV(Y-T_0) - 1.2 - 3.4 + .56\Delta T_{G(0)} - 12 \Delta G_0 - 7.66 \Delta PR_0 + 46\Delta DJ_2 + 1.87\Delta XR_{AV0123} \quad R^2=89\% \\
(\lambda) = (13.2) \\
\]

### 10.3. CONCLUSIONS: THE IMPORTANCE OF THE KEYNES VS. MODIGLIANI/FRIEDMAN CONSUMPTION FUNCTIONS

It would seem that most consumers are Keynesian, whose behavior in response to Keynesian stimuli, dominating the consumption data. But our data also are consistent with the hypothesis that the consumption function, though dominated by Keynesian income behavior, cannot be fully understood without realizing that a small fraction of the population exhibits Life Cycle/Permanent Income Hypothesis behavior traits. The group of people behaving this way appears to be so small that at best they add 1% to explained variance when an average income variable is added to a set of explanatory variables which already includes the Keynesian income variable. The average income models that do the best are those with current income in the average, and with current income weighted most heavily in the average. By comparison, adding the Keynesian current income variable to a set of explanatory variables that already includes the average income variable increases explained variance considerably more; from 9% to 53% depending on the average income model tested. The findings also suggest that those who are Friedman/Modigliani in their behavior, determine their long-term Permanent or Life Cycle income average.
on the basis of adaptive, i.e., backwards- looking expectations, only, perhaps mixed with expectations based on current year income.

Combining regression coefficients on the two combined Keynesian and Adaptive Expectations Friedman/Modigliani models with the most statistically significant Friedman/Modigliani income variables, the (0,-1-2) and the (-1,-2) year average models, we find a total current year marginal propensity to consume of .58 or .65, compared to the Keynesian variable – only model estimate of .66. i.e., coefficients from our earlier results are

\[
\Delta C_0 = .66 \Delta(Y-T_G) \text{ Keynes} + \ldots \quad R^2=92\% \\
(\text{t=}(28.0) \quad \text{DW}=2.0)
\]

\[
\Delta C_0 = .51 \Delta(Y-T_G)_0 + .21 \Delta AV(Y-T_G)_{0,1,2} + \ldots + .R^2=93\% \\
(\text{t=}(10.0) \quad (3.4) \quad \text{DW}= 1.9)
\]

\[
\Delta C_0 = .58 \Delta(Y-T_G)_0 + .14 \Delta AV(Y-T_G)_{1,2} + \ldots + \ldots \quad R^2=93\% \\
(\text{t=}(17.9) \quad (3.4) \quad \text{DW}= 1.9)
\]

When the prior and two-year ago year effects on consumption through the Friedman/Modigliani variable are added in, the total marginal effect for both income variables rises up to .72 (.58+.14). the other adaptive expectations joint models provide essentially the same result, suggesting that when used alone (.66 estimated marginal effect), the current income variable proxies a bit current year changes in consumption due to prior year income changes, which are shown in the decline of the estimated effect of the current year variable to (.58) when the Friedman/Modigliani variable is added. Nonetheless, the test results for the Keynesian income variable are still very strong compared to the Modigliani/Friedman variable. This lead us to conclude that most, but not all, of the variation in consumption is related to current income alone, but that the Life Cycle/Permanent income hypothesis may also explain an additional, but much smaller part of consumer behavior.

Bibliography


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