Permanent Income Hypothesis and the Demand for Durable Goods

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I

An important aspect of Friedman's Permanent Income Hypothesis is that the durable goods are consumed out of permanent income. There is, however, some dispute on this point. The purpose of this paper is to verify empirically whether the consumption of durable goods is related more closely to permanent or transitory income. Paul E. Smith, in an interesting article, attempted to answer this question with reference to the following simple econometric model:

1) \[ Y = C_s + C_d + I \]
2) \[ C_s = A_0 + A_1 Y_d^p + A_2 Y_c + U_1 \]
3) \[ C_d = B_0 + B_1 Y_d^p + B_2 Y_d^c + U_2 \]
4) \[ Y_d = G_0 + G_1 Y + G_2 t + U_3 \]
5) \[ I = H_0 + H_1 Y + H_2 Y_{-1} + H_3 r_{-1} + U_4 \]
6) \[ Y_d^p = 0.330Y_d^p + 1.000Z \]
7) \[ Y_d^c = Y_d - Y_d^p \]

where

- \( Y \) = real per capita GNP
- \( C_d \) = real per capita private expenditure on durable consumer goods
- \( C_s \) = real per capita private expenditure on non-durable consumer goods
- \( I \) = gross private domestic investment, government expenditures on goods and services, and net foreign investment, all adjusted for price and population changes
- \( Y_d \) = real per capita disposable personal income
- \( Y_d^p \) = real per capita expected income
- \( Y_d^c \) = real per capita transitory income
- \( r_{-1} \) = rate of interest on corporation Aaa bonds, lagged one period
- \( t \) = effective federal income tax rate for a married taxpayer with $ 5,000 income and two dependents
- \( Z \) = that proportion of permanent income estimated by assigning the Cagan-Friedman weights to lagged, but not the current, values of real per capita disposable income

All variables except interest and tax rates were adjusted by a GNP deflator (1954 = 100) and domestic population as of July 1 of the current year. The time series cove-
erred the years 1947 through 1960. Since all of the equations are overidentified two-stage least-squares estimation was utilized.

Smith concluded that permanent income alone determined the demand for non-durable goods, and that both permanent income and transitory incomes are significant determinants of the demand for durable goods. This conclusion seems not entirely inconsistent with the Permanent Income Hypothesis. From the size of the regression coefficients Smith stated, however, that transitory income appears to be the crucial determinant of the demand for durable goods.

It may be noted here that Smith did not use the definition of consumption as required by the Permanent Income Hypothesis (consumption of non-durable goods plus the rental value of durable goods). Smith's approach is dictated by the extreme difficulty of estimating the rental value of durable goods. In the absence of a better technique, however, we follow Smith in his paper.

The rationale of the model is basically sound. Equation 1) is an identity. Equations 6) and 7) are definitions. Equations 2) and 3) are concerned with finding out whether and to what extent the distribution of disposable income between its permanent and transitory components determines the level and allocation of consumer expenditures. Since these equations were designed to meet the problems of the study, only their interpretation is a relevant consideration. Equation 4) states that per capita disposable income is a function of real per capita GNP and taxes. By definition in equation 6) $Y^p_d$ is a function of real per capita GNP and taxes. However, the problem involved is the definition of the variables. The relevance of using the effective federal income tax rate fixed at the $5,000 level implies that this variable will be as pertinent in 1947 as in 1960. This means that the income level, birth rates, the effect of inflation on marginal tax rates (even with constant real income), and tax structures have been averaged by some unknown means. One alternative would be to utilize the effective tax rate based on an appropriate income figure for each given year for a taxpayer with the average number of dependents. But the problem would then become one of multicollinearity since the new variable would tend to be highly correlated with $Y$. Equation 5) relates the per capita $I$ to real per capita GNP, lagged real per capita GNP, and the interest rate on corporate Aaa bonds. An attempt to break down the multicollinearity inherent from including $Y$ and $Y_{-1}$ (one period lagged real per capita GNP) in the same equation will be made in Parts II and III. An attempt also was made to replace $r$, the interest variable on corporate Aaa bonds, with bank interest on business loans in 19 cities, and prime commercial-paper rate (both taken from the Survey of Current Business), the results did not vary significantly.

Before presenting our findings additional remarks are in order. Smith's interpretation that transitory income appears to be the crucial determinant of the demand for durable goods is based on the size of the regression coefficients only and fails to take into account the possible range of variations of both $Y^p_d$ and $Y^t_d$. The apparently volatile nature of $Y^t_d$ in equation 3) is diminished when it is noted that in Smith's study the range of variation of $Y^t_d$ is 29 units (from -11 in 1960 to 17 in 1955) whereas $Y^p_d$ varied a total of 244 units (from 1468 in 1947 to 1711 in 1960).
Concerning the problem of serial correlation, Smith wrote that the Durbin-Watson statistic was calculated for the 2nd, 3rd, 4th, and 5th equations and that no conclusive evidence of serial correlation was found at the 5% level. This is not an unusual result. A denial of the absence of serial correlation cannot be presented for his study even though serial independence was assumed in employing two-stage least-squares procedure. That refinement due to the inclusion of additional variables is possible both on theoretical and statistical grounds is evident. The problem is largely one of workability of the model. Finally, the use of two-stage least-squares yields asymptotically unbiased, asymptotically efficient and consistent estimators. But asymptotic properties are not necessarily applicable to small samples. In Smith’s case there are 14 observations.

The models that we present do not attempt to correct many of the deficiencies as noted above. In particular, multicollinearity and serial correlation will continue to be problems.

Our first model attempts to show that lengthening of the sample period produces results that are significantly different from Smith’s.

II

While the desire to utilize the entire model as presented above with only the inclusion of additional years led to this project, the availability of data forced the slight changes of employing a GNP deflator of 1957–1959 = 100 and using the domestic population as of January 1 of the current year. The years of the study were 1947 through 1966. The resultant equations 2) through 5) become:

\[
\begin{align*}
2) & \quad C_s = -242.078 + 0.950Y_d^* + 0.769Y_d^c \\
& \quad \quad \quad \quad (0.010) \quad (0.049) \quad R = 0.999 \\
3) & \quad C_d = -123.197 + 0.205Y_d^* - 0.181Y_d^c \\
& \quad \quad \quad \quad (0.014) \quad (0.067) \quad R = 0.964 \\
4) & \quad Y_d^p = 684.910 + 0.460Y_d - 11.303t \\
& \quad \quad \quad \quad (0.026) \quad (8.483) \quad R = 0.978 \\
5) & \quad I = -438.098 + 0.559Y + 0.056Y_{-1} - 64.658r_{-1} \\
& \quad \quad \quad \quad (0.072) \quad (0.093) \quad (20.396) \quad R = 0.990
\end{align*}
\]

Therefore, the computed T values show that the t coefficient in equation 4) and the \(Y_{-1}\) coefficient in equation 5) are not significantly different from zero at the 5% level. Of particular interest are equations 2) and 3). The interpretations based on this model must be that both permanent and transitory income are determinants of both durable and non-durable expenditures.

Before we conclude that the change in the results was due mainly to the inclusion of the years 1961 through 1966, we must examine the possible consequences of using a different GNP deflator and different population figures. That these changes affected the data is not disputed, but raw data comparisons showed the variance to be extremely small.
A study of the multicollinearity problem yields the following pairwise correlations:

<table>
<thead>
<tr>
<th></th>
<th>$Y_{-1}$</th>
<th>$I$</th>
<th>$t$</th>
<th>$r_{-1}$</th>
<th>$C_s$</th>
<th>$C_d$</th>
<th>$Y_d^p$</th>
<th>$Y_d^r$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Y$</td>
<td>0.973</td>
<td>0.982</td>
<td>-0.364</td>
<td>0.929</td>
<td>0.982</td>
<td>0.936</td>
<td>0.976</td>
<td>0.872</td>
</tr>
<tr>
<td>$Y_{-1}$</td>
<td>0.946</td>
<td>-0.294</td>
<td>0.947</td>
<td>0.977</td>
<td>0.860</td>
<td>0.978</td>
<td>0.775</td>
<td></td>
</tr>
<tr>
<td>$I$</td>
<td>-0.260</td>
<td>0.868</td>
<td>0.932</td>
<td>0.904</td>
<td>0.923</td>
<td>0.897</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$t$</td>
<td>0</td>
<td>-0.440</td>
<td>-0.418</td>
<td>-0.515</td>
<td>-0.419</td>
<td>-0.360</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$r_{-1}$</td>
<td>0.967</td>
<td>0.826</td>
<td>0.973</td>
<td>0.672</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$C_s$</td>
<td>0.907</td>
<td>0.998</td>
<td>0.790</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$C_d$</td>
<td>0.893</td>
<td>0.926</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$Y_d$</td>
<td></td>
<td>0.764</td>
<td></td>
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</tbody>
</table>

The high degree of multicollinearity detracts from the reliability of the regression coefficients. Greater emphasis is possible from a detailed study of the above correlations, this is deferred until Part III.

The serial correlation problem must be examined due to the assumption of the serial independence. The Durbin-Watson statistics of 1.290, 1.860, 0.666, and 0.797 for equations 2) through 5), respectively, yield the interpretation that equation 3) doesn't have positive serial correlation, equation 2) is in the indeterminate range, and that equations 4) and 5) both have positive serial correlation. Therefore, the apparent refutation of the study conducted by Smith must be interpreted as the result of several factors. Both studies, i.e., Smith’s study as well as our own, have problems with multicollinearity and serial correlation. These are considered to have been more significant in influencing the divergence between the two studies than the use of different time periods. While this does not disprove the Permanent Income Hypothesis, Smith’s findings are tarnished by the existence of serial correlation in the Model.

III

Our next model results from an attempt to control the serial correlation by removing the multicollinearity from equation 5). By excluding the variable $Y_{-1}$ such that equation 5) becomes

$I = H_0 + H_1 Y + H_2 r_{-1} + U_4$

and then changing any interpretation of the variables $Y$ and $r_{-1}$ as including the effects of $Y_{-1}$, the pertinent equations 2) and 3) are:

2) $C_s = -242.152 + 0.950 Y_d^p + 0.770 Y_d^r$
   $(0.010)$  $(0.049)$  $R = 0.999$

3) $C_d = -123.419 + 0.205 Y_d^p - 0.180 Y_d^r$
   $(0.014)$  $(0.066)$  $R = 0.965$
The Durbin-Watson statistics also are almost identical to the results of Part II, being 1.282 and 1.851 respectively. The statistic for equation 5) was 0.916, again pointing out that positive serial correlation is present.

Another variation of the model was conducted wherein the variable Y was excluded from equation 5). Equation 5) then was:

5) \[ I = H_0 + H_1 Y_{-1} + H_2 r_{-1} + U_4 \]

Equations 2) and 3) became:

2) \[ C_s = -242.403 + 0.950Y_d^p + 0.760Y_d^z \]
   \[ (0.010) \quad (0.049) \quad R = 0.999 \]

3) \[ C_d = -122.917 + 0.205Y_d^p - 0.170Y_d^z \]
   \[ (0.014) \quad (0.070) \quad R = 0.963 \]

All of which appear strikingly similar except that the Durbin-Watson statistic for equation 5) is 1.461. Since this is in the indeterminate range, as far as being able to test for positive serial correlation is concerned, the interpretation that one had been successful in removing both the multicollinearity and the serial correlation would have been tempting. This, however, is not the case.

IV

In summary, the assumption of serial independence necessary to employ two-stage least-square has been shown to be erroneous. This false assumption allows this model to support empirically whatever claim one desires with regard to the Permanent Income Hypothesis. Furthermore, though the lengthening of the time period has been a factor, the existence of multicollinearity and serial correlation are considered to have been more significant in influencing the divergence between the two studies.

Notes

1 The authors are respectively Associate Professor and graduate student at Northern Illinois University.

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3 Permanent income was estimated by Friedman’s method. It is estimated by considering it as the weighted average of the past values of measured income, with the weights declining exponentially through time. Both the weights and the number of years are allowed to be determined by the data — the weights by multiple correlation, and the number of years by adding years succes-
sively until an additional year produces no significant increase in correlation. The following function was fitted:

\[ Y_p(T) = \beta \int_0^T e^{(\delta - \alpha)(t - T)} Y(t) \, dt, \]

where \( Y_p \) is permanent income, \( Y \) is measured income, \( T \) is the date for which estimate is constructed, and \( t \) covers the whole range of earlier dates. \( 1/\beta \) gives the horizon of the consumers. \( \alpha \) is the 2% rate of increase in income (also used by Friedman). For further details of this method of computing permanent income, see Milton Friedman, *A Theory of Consumption Function* (Princeton, N.J., Princeton University Press, 1957). This method of computing permanent income is now in common use. See, for example, G.R. Morrison, *Liquidity Preference of Commercial Banks* (Chicago, University of Chicago Press, 1966), and Prem S. Laumas and Gurcharan S. Laumas, "Interest Elasticity of Demand for Money", *Southern Economic Journal*, July, 1969, and Prem S. Laumas and Khan A. Mohabbat, "Permanent Income Hypothesis: Evidence from Time Series Data", *The American Economic Review* (September, 1972).

For the sake of clarity we present Smith’s regression coefficients for durable and non-durable goods:

\[ C_d = 67 + 0.086 Y^p_d + 1.002 Y^e_d \]

\[ (0.021) \quad (0.216) \]

\[ C_n = 177 + 0.693 Y^p_n - 0.539 Y^e_n \]

\[ (0.033) \quad (0.338) \]

The symbols are as before.

**Permanent Income Hypothesis and the Demand for Durable Goods**

**Summary**

The purpose of this paper is to empirically verify whether the demand for durable goods is more closely related to permanent or transitory income. Friedman’s Permanent Income Hypothesis implies that durable goods are consumed out of permanent income. Paul E. Smith (*Journal of Political Economy*, 1962) concludes that transitory income is the more crucial determinant of the demand for durable goods. Our results seem to be at variance with Smith’s conclusion. Though the lengthening of the time period has been a factor, the existence of multicollinearity and serial correlation are considered to have been more significant.

**Die Hypothese des permanenten Einkommens und die Nachfrage nach dauerhaften Gütern**

**Zusammenzug**


L'hypothèse du revenu permanent et la demande de biens durables

Résumé

Le but de cet article est de vérifier empiriquement si la demande de biens durables dépend plus fortement du revenu permanent ou transitoire. L'hypothèse du revenu permanent de Friedman admet que les biens durables sont consommés du revenu permanent. Paul E. Smith (Journal of Political Economy, 1962) déduit cependant que le revenu transitoire est la déterminante plus cruciale de la demande de biens durables. Les résultats de l'article précédent semblent contredire la conclusion de Smith. Quoique le rallongement de la période de temps ait été un facteur, on considère l'existence de multicollinearité et corrélation sérielle comme étant plus significative.