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MONEY AND PERMANENT INCOME: SOME EMPIRICAL TESTS

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MONEY AND PERMANENT INCOME: SOME EMPIRICAL TESTS*

by

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According to an increasingly influential school of thought, centered in this city, variation in the money supply is the principal determinant -- indeed virtually the exclusive determinant -- of variation in money income. The supporting arguments have been more empirical than theoretical. The empirical evidence has included careful historical narrative [6], systematic investigation of cyclical leads and lags among relevant time series [7], and single-equation regression analyses [4]. Less attention has been given to the task of providing a theoretical rationale of the empirical findings, a monetary theory of income determination to set against the neo-Keynesian models of many macro-economics textbooks. However, Friedman and Schwartz (FS) have presented an explicit model in [7]. Their "permanent income" theory of money demand has testable implications, and in this paper we test some of them.

The Friedman-Schwartz Model. First, a brief outline of the "permanent income" theory: FS hypothesize that per capita demand for

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real money balances is related to permanent real income as follows:

$$(1) \qquad M/P_p = \gamma y_p^{\delta}$$

where M = nominal money stock (Currency + Demand Deposits + Time Deposits), per capita

P_p = permanent price index of consumer goods

y_p = permanent real income, per capita

The money stock M is taken to be exogenous; demand must adapt to the supply. Equation (1) is, as a first approximation, always satisfied; the economy is always on its money demand curve.

The "permanent" value of a variable -- price or income -- is a weighted average of its current and past actual values, with account taken of trend. For a variable, $X(t)$, permanent $X_p(t)$ is defined as follows:

$$(2) \qquad X_p(t) = (1 + \alpha_X)^t \prod_{i=0}^{\infty} \left[X(t-i)/(1 + \alpha_X)^{t-i} \right]^{w_i}$$

where α_X is the trend rate of growth of X

w_i is the exponential weight of actual X_{t-i} ; $\sum_{i=0}^{\infty} w_i = 1$.

With several substitutions and simplifications, (2) can be expressed in a more manageable form. First, taking the logarithms of (2) yields

$$\log X_p(t) = t \log\left[1 + \alpha_X\right] + \sum_{i=0}^{\infty} w_i \{\log X(t-i) - (t-i)\log(1 + \alpha_X)\}$$

which can be rewritten as:

$$(3)\quad \log X_p(t) - t\log(1+\alpha_X) = \sum_{i=0}^{\infty} w_i\{\log X(t-i) - (t-i)\log(1+\alpha_X)\}$$

Second, FS assume that the w_i can be characterized as a simple geometrically declining series of weights which sum to unity, i.e., $w_i = w_o(1-w_o)^i$. It is convenient to note that

$$(4)\quad \sum_{i=0}^{\infty} w_o(1-w_o)^i = (1-w_o)\sum_{j=0}^{\infty} w_o(1-w_o)^j$$

This property of the lag structure makes possible the following substitution in (3):

$$\log X_p(t) - t\log(1+\alpha_X) = w_o\left[\log X(t) - t\log(1+\alpha_X)\right] + (1-w_o)\left[\log X_p(t-1) - (t-1)\log(1+\alpha_X)\right]$$

or

$$(5)\quad \log X_p(t) = w_o \log X(t) + (1-w_o)\log X_p(t-1) + (1-w_o)\log(1+\alpha_X)$$

Taking logarithms of equation (1), the equality of supply and demand for real money balances, gives

$$(6)\quad \log M(t) = \log \gamma + \delta \log y_p(t) + \log P_p(t) .$$

FS assume that the w_i associated with y_p and P_p are identical. Using (5) to calculate y_p and P_p gives:

$$(7)\qquad \log M(t) = \log \gamma + \delta w_o \log y(t) + w_o \log P(t) + (1 - w_o)\left[\log(1 + \alpha_p) + \delta \log(1 + \alpha_y)\right] + (1 - w_o)\left[\delta \log y_p(t-1) + \log P_p(t-1)\right]$$

Since FS assume that the economy is always on its demand curve for money, they can use (6) for period $t-1$ to eliminate the unobserved "permanent" variables in (7) and get

$$(8)\ \log M(t) = w_o \log \gamma + (1 - w_o)\left[\log(1 + \alpha_p) + \delta \log(1 + \alpha_y)\right] + \delta w_o \log y(t) + w_o \log P(t) + (1 - w_o) \log M(t-1)$$

Equation (8) can then be solved for $\log y(t)$:

$$(9)\ \log y(t) = -\frac{1}{\delta} \log \gamma - \frac{(1 - w_o)}{\delta w_o}\left[\log(1 + \alpha_p) + \delta \log(1 + \alpha_y)\right] + \frac{1}{\delta w_o}\left[\log M(t) - \log P(t)\right] - \frac{1 - w_o}{\delta w_o}\left[\log M(t-1) - \log P(t)\right] .$$

Equation (9) is an expression for real per capita income. It could be converted into an expression for money per capita income by adding $\log P(t)$ to both sides. This would leave $\log P(t)$ on the right with a coefficient of $1-1/\delta$. For purposes of estimation, equation (9) has the advantage of being identified.[1] It can be used to derive estimates of δ , the elasticity of money demand with respect to permanent income, and w_o , the weight of current information in

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[1] However, there are problems in using equation (9). First, as indicated below the price level is not really exogenous; there is another structural relationship concerning the division of increases in aggregate demand between real income and prices. Single equation treatment of equation (9) ignores this other relationship. Second, it is by no means obvious that the stochastic elements in the model produce a well-behaved additive error term in equation (9).

estimating permanent values. An equation for money income would be over-identified. Although equation (9) concerns real income, there is no implication that the effects of an increase in the money supply will affect real income to the exclusion of prices. Actually FS, like other economists, expect short-run changes in money income to be divided between output and prices.

Estimates from Annual and Quarterly Regressions 1951-66. Equation (9) was fitted to annual and quarterly data from 1951 through 1966. Results of level and first difference forms of the regression are reported in Table 1.

On the basis of his study of the consumption function and other work, Friedman estimates the weight of current year income in permanent income at 1/3. (This would imply a value of w_o of .096 in the quarterly regressions.) Friedman also estimates δ, the elasticity of money demand with respect to permanent income, to be 1.8. (See [7].)

Our estimates of w_o are higher than the estimates Friedman has reported and our estimates of δ are considerably lower than Friedman's own in [1]. Friedman's estimates referred to a longer time period. Virtue does not necessarily lie with long time periods; structural changes have occurred. Commercial banks have in recent decades faced much stronger competition for savings from other financial intermediaries than they did in the late 19th and early 20th century. (See [8], p. 105.) It is not surprising, therefore, that Friedman's

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Suppose that (1) were $M/P_p = \gamma y_p^{\delta} \cdot \exp^{\epsilon}$ where ϵ is a normally distributed error. The error in (9), call it $\eta(t)$, will then be $\epsilon(t)-(1-w_o)\epsilon(t-1)$. For $\eta(t)$ to be serially independent, $\epsilon(t)$ would have to be positively serially correlated in a specific manner. If $\epsilon(t)$ is serially independent, then $\eta(t)$ will show negative serial correlation (not the high positive serial correlation shown in the residuals from the level regression).

TABLE 1

ANNUAL AND QUARTERLY REGRESSIONS OF INCOME ON MONEY
1951-1966

Equation	Intercept	Coefficient of:[1] $\log \frac{M(t)}{P(t)}$	$\log \frac{M(t-1)}{P(t)}$	R^2	DW	n	w_o	δ
Annual								
Levels	.74	1.43 (.530)	-.61 (.709)	.76	.74	16	.57	1.23
First Differences		.27 (.320)	.62 (.364)	.32	2.44	15	3.30	1.12
Quarterly								
Levels	.73	1.31 (.707)	-.35 (.743)	.74	.11	64	.73	1.04
First Differences		.12 (.239)	.61 (.238)	.25	1.18	63	6.08	1.37

[1]Standard errors of the coefficients are reported in parentheses.

R^2 - Coefficient of determination

DW - Durbin-Watson Statistic

n - number of observations

For data sources see Data Appendix

estimates of δ, the long-run income elasticity of money demand are higher than ours. Furthermore, the major financial reforms of the 1930's might well have changed these parameters.

The Durbin-Watson statistics suggest that the level regressions show high positive serial correlation of the residuals. Use of first differences meets this problem, but the explanatory power of the model then becomes very low, and in terms of the theory the estimates of w_o become absurd. (Indeed, they suggest an opposite model, in which "permanent" money holdings are related to current income.) A tempting interpretation is that the correlation exhibited in the level regressions reflects common trends in income and money rather than a causal relationship between the variables, and that there are important, serially persistent non-monetary determinants of income.

A low value of w_o plays an important part in FS's explanation of the observation that short-run fluctuations in income are larger in amplitude than the monetary fluctuations that cause them. The income velocity of money moves pro-cyclically, and the "permanent income" model is supposed to explain this fact, among others. When money supply increases exogenously, faster than the permanent price level, permanent income must increase sufficiently to absorb the new money. If δ is 1.8, as FS estimate, then permanent income must rise .55% to create demand for an addition of 1% to the real stock of money. But the only component of permanent income that can rise is current income; the past incomes that enter the weighted average are irrevocably fixed. With $w_o = 1/3$

for annual incomes, current year's income must rise 3% to raise permanent income 1%, or 1.65% to raise permanent income the necessary .55%. The calculation illustrates how the model reconciles FS's finding that velocity declines in the long run ($\delta > 1$) with their finding that short-run changes in money stock cause more than proportionate changes in income.

FS recognize in [7] that the model proves too much if it is applied literally to quarterly data. As already noted, the 1/3 estimate for w_o for annual data implies a weight of .096 for the income of the current quarter. If the entire income adjustment to

a change in money stock must occur within a quarter, then it will be more than three times as large as indicated in the previous paragraph. It will take a 5.7% rise in current income for the quarter to raise permanent income .55%. As Table 1 indicates, our quarterly regressions indicate much larger values of w_o than the FS model, literally applied, would imply. As FS themselves suggest, perhaps we should relax the assumption that money demand adjusts so rapidly as to keep the community on its demand curve every quarter.

In this spirit we introduce the following modification: Assume people do not adjust their current money balances to income andprices but rather adjust a weighted average of the current and preceding quarters' money balances. Consequently we define $M^*(t)$ as $(1 - \beta)M(t) + \beta M(t-1)$ and recompute the quarterly regressions with $M^*(t)$ substituted for $M(t)$. Results for $\beta = .25, .5, .75$ and 1.0 are reported in Table 2. The quarterly results in Table 1 are equivalent to $\beta = 0$. While estimates of w_o decline as β rises, they are still large. They imply a much larger response of the demand for money to changes in current income than the FS model.

Interest rate effects? An alternative explanation of observed pro-cyclical movements of velocity is sensitivity of money demand to interest rates. Given such sensitivity, short-run fluctuations in income can have non-monetary as well as monetary causes. If the monetary authorities "lean against the wind," then money supply, interest rates, and velocity will all increase in booms and decline in recessions.

TABLE 2

QUARTERLY REGRESSIONS OF INCOME ON CURRENT AND LAGGED MONEY STOCKS
1951.1-1966.4

Equation	Intercept	Coefficient of: $\log\left(\frac{M^*(t)}{P(t)}\right)$	$\log\left(\frac{M^*(t-1)}{P(t)}\right)$	R^2	DW	w_o	δ
Levels							
$\beta = .25$	.73	1.69 (.778)	-.74 (.821)	.74	.11	.56	1.05
$\beta = .5$	.73	2.03 (.817)	-1.09 (.865)	.74	.11	.46	1.06
$\beta = .75$	.73	2.20 (.806)	-1.26 (.856)	.74	.12	.43	1.06
$\beta = 1.0$	.73	2.14	-1.20	.74	.15	.44	1.06
First Differences							
$\beta = .25$		.01 (.313)	.76 (.311)	.28	1.21	77.0	1.30
$\beta = .5$		-.01 (.365)	.82 (.364)	.29	1.21	-81.0	1.23
$\beta = .75$		.20 (.311)	.62 (.310)	.29	1.20	4.10	1.21
$\beta = 1.0$		.34 (.233)	.47 (.233)	.29	1.21	2.38	1.23

This would be a Keynesian interpretation of the same observations that the FS model is designed to explain. It would of course have very different policy implications, leaving room for fiscal policy and exogenous changes in private spending, as well as monetary events, to affect income.

While Friedman has doubted the empirical significance of interest rates, other than expected changes in the value of money, on the demand for money [1], other researchers have found evidence of such influence. (See, for example, [9], [10].) Certainly there is ample theoretical reason to suppose that the holding of money is influenced by its own real yield -- which for the FS definition of money depends both on the rate paid by commercial banks on time deposits and on the expected rate of price change -- and by the real yields on substitute assets such as Treasury bills.

These effects can be built into the FS equation (1) as follows:

$$(10) \qquad \frac{M(t)}{P_p(t)} = \gamma y_p(t)^{\delta} \left(\frac{P_p(t)}{P_p(t-1)} \right)^{\upsilon} R_{TD}(t)^{\eta} R_T(t)^{\varepsilon}$$

where R_{TD} = rate paid by commercial banks on time deposits,

R_T = market yield on new issue Treasury bills.

$\left(\frac{P_p(t)}{P_p(t-1)} \right)$ is a measure of the change in the permanent price level; it is also, as can be shown by application of equation (5) letting X equal $P(t)/P(t-1)$, the permanent value of price change. Sub-

stitution similar to those previously made in equation (1) yield the following formulation:

$$(11)\quad \log y(t) = -\frac{1}{\delta}\log\gamma - \frac{1-w_o}{\delta w_o}\left[\log\alpha_P + \delta\log\alpha_y\right]$$

$$-\frac{\upsilon}{\delta}\left[\log P(t) - \log P(t-1)\right]$$

$$+\frac{1}{\delta w_o}\left\{\left[\log M(t) - \log P(t)\right] - (1-w_o)\left[\log M(t-1) - \log P(t)\right]\right\}$$

$$-\frac{\eta}{\delta w_o}\left\{\log R_{TD}(t) - (1-w_o)\log R_{TD}(t-1)\right\}$$

$$-\frac{\epsilon}{\delta w_o}\left\{\log R_t(t) - (1-w_o)\log R_t(t-1)\right\}$$

It is easily seen that equation (11) is over-identified; aside from constants, there are seven coefficients to determine five parameters. But by fixing w_o it is possible to combine terms for $M(t)$ and $M(t-1)$, $R_{TD}(t)$ and $R_{TD}(t-1)$, and $R_T(t)$ and $R_T(t-1)$ and to regard (11) as an equation involving four coefficients to determine four parameters other than w_o. Equation (11) was then estimated by varying w_o in steps between 0 and 1.0 and choosing that value of w_o which maximized the R^2.[1] Results are presented in Table 3.

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[1] In fact w_o was first varied from .1 to .9 in increments of .1. w_o was then varied by .01 in the region of the previous maximum.

TABLE 3

ANNUAL AND QUARTERLY REGRESSIONS OF INCOME ON MONEY AND RATES OF RETURN

Coefficient of:

	Intercept	$\log \frac{M(t)}{P(t)} - \log \frac{M(t-1)}{P(t)}$	$\log P(t) - \log P(t-1)$	$\log R_{TD}(t) - \log R_{TD}(t-1)$	$\log R_{T}(t) - \log R_{T}(t-1)$
Annual	.70	.66 (.050)	-.18 (.230)	.05 (.012)	.05 (.013)
Quarterly	.70	.66 (.025)	-.29 (.339)	.05 (.005)	.05 (.005)

	R^2	DW	w_o	δ	ν	η	ϵ
Annual	.98	1.62	.99	1.52	.27	-.08	-.08
Quarterly	.98	.68	.97	1.52	.44	-.08	-.08

ν elasticity of demand for real money balances with respect to permanent price increase

η elasticity of demand for real money balances with respect to the rate paid on time deposits

ϵ elasticity of demand for real money balances with respect to the yield on new issue treasury bills

The estimates of δ in this more general version, equation (10), are larger than before. Perhaps the exclusion of relevant interest rate terms biased downward the earlier estimates of δ. High income may have served as a proxy for high market interest rates, which have a predominantly negative effect on money holdings. More surprising is the positive coefficient on the R_{TD} term. This result may be in part explained by the strong correlation between the time deposit rate and the Treasury bill rate and by shifts within M between demand and time deposits. Most surprising, however, is the apparent positive elasticity of money holdings with respect to price changes. Perhaps people do not in fact extrapolate current and past price trends. Finally, these results do not confirm the hypothesis that behavior will be better explained by relating it to "permanent" values of income, price, and price change. The estimates of w_o are so close to one as to eliminate almost all difference of permanent from current values.

Prediction tests. Another test of the basic structure of equation (1) is to see how good a predictor it is. Friedman has expressed the view that "the only relevant test of the validity of a hypothesis is comparison of its predictions with experience." ([27, pp. 8-9.) Correspondingly, a variant of (9) was used to predict annual and quarterly changes in money income from 1959 through 1968. Expressing log y(t) as log Y(t) - log P(t) and taking first difference of (9) yields:

$$(12) \qquad \Delta \log Y(t) = \frac{1}{\delta w_o} \Delta \log M(t) - \frac{1 - w_o}{\delta w_o} \Delta \log M(t-1)$$

$$- \frac{w_o(1-\delta)}{\delta w_o} \Delta \log P(t)$$

Let each first difference be expressed as a deviation from its average value; if X is subject to a geometric trend $X(0)(1 + \alpha_X)^t$, this contributes a constant, $\log(1 + \alpha_X)$, to growth of $\log X$ each period. Thus, let

$$\tilde{Y}(t) = \Delta \log Y(t) - \log(1 + \alpha_Y)$$

$$\tilde{P}(t) = \Delta \log P(t) - \log(1 + \alpha_P)$$

$$\tilde{M}(t) = \Delta \log M(t) - \log\left[1 + \delta(\alpha_Y - \alpha_P) + \alpha_P\right]$$

For the present tests, α_Y and α_P were measured as the actual average compound rates of change of money income and prices from 1950 to 1960. Substituting these definitions into (12) yields

$$(13) \qquad \tilde{Y}(t) = \frac{1}{\delta w_o} \tilde{M}(t) - \frac{1 - w_o}{\delta w_o} \tilde{M}(t-1) - \frac{w_o(1-\delta)}{\delta w_o} \tilde{P}(t)$$

Use of (13) yields predictions of deviations of money income per capita from its trend. Predictions of actual percentage changes in aggregate money income can then be obtained by adding population change and trend change in income. FS estimates of w_o and δ,

.33 and 1.81 respectively, were used. For quarterly predictions w_o was set equal to .096.

In [7] FS indicate that one might expect prices and money income to move together systematically. They consider the elasticity of the measured price level with respect to measured income and assign it a value of .2. Substituting $.2\Delta \log Y(t)$ for $\Delta \log P(t)$ in (12) yields another predictor of changes in money income,

$$(14) \qquad \tilde{Y}(t) = \frac{1}{(.2 + .8\delta)w_o} \tilde{M}(t) - \frac{1 - w_o}{(.2 + .8\delta)w_o} \tilde{M}(t - 1)$$

Results of these predictions are presented in Tables 4 and 5. FS13 indicates predictions based on equation (13) and FS14 indicates predictions based on equation (14). Three simple-minded modes of prediction are presented for comparison, in the last three columns of Tables 4 and 5. Figure 1 illustrates actual quarterly percentage changes in money income and the predictions of those changes based on equation (13). The dashed line, FS13 is a graph of the figures reported in Table 5. The dotted line, FS13', uses estimates of w_o and δ -- .73 and 1.04 -- from our original quarterly regression. (See Table 1.)

A theory that leads to worse error than the naive hypothesis that last year repeats itself is of questionable reliability. The quarterly predictions are even worse than the annual; see Table 5 and Figure 1. This may be partly due to the problems of lag structure discussed above. As our own experiment indicated, quarterly results can be somewhat improved by relaxing the requirement that current

TABLE 4

PREDICTIONS OF ANNUAL PERCENTAGE CHANGES IN MONEY INCOME
1959-1967

Year	Actual	FS13	FS14	Naive*	Trend**	Adjusted Trend***
59	8.3	3.2	3.6	1.1	5.6	5.5
60	4.1	-2.9	-3.1	8.3	5.6	5.8
61	3.2	10.8	11.8	4.1	5.6	5.6
62	7.5	6.8	7.6	3.2	5.6	5.4
63	5.4	7.0	7.6	7.5	5.6	5.6
64	7.0	5.2	5.7	5.4	5.6	5.6
65	8.0	6.1	6.6	7.0	5.6	5.7
66	8.8	8.1	8.2	8.0	5.6	5.8
67	6.6	5.4	4.7	8.8	5.6	6.0
Average Absolute Change	8.7					
Average Absolute Error		3.1	3.2	2.7	1.9	1.8

* Actual change last period taken as forecast

** Average annual rate of change, 1950-1960

*** Predicted change for year t is found by solving for r

$$Y(t-1) = (1+r)^{(t-1-1950)} Y(1950)$$

TABLE 5

PREDICTIONS OF QUARTERLY PERCENTAGE CHANGE IN MONEY INCOME
1959.1-1968.2

Quarter	Actual	FS13	FS14	Naive*	Trend**	Adjusted Trend***
59.1	2.1	1.1	1.1	3.1	1.6	1.6
2	2.7	-.7	-.7	2.1	1.6	1.6
3	-.8	-1.1	-1.2	2.7	1.6	1.6
4	1.2	-5.4	-5.8	-.8	1.6	1.5
60.1	2.6	-.6	-.7	1.2	1.6	1.5
2	.4	3.1	3.4	2.6	1.6	1.5
3	-.1	8.2	9.1	.4	1.6	1.5
4	-.2	1.4	1.5	-.1	1.6	1.5
61.1	-.1	2.5	2.7	-.2	1.6	1.4
2	2.3	1.9	2.2	-.1	1.6	1.4
3	1.8	.8	1.0	2.3	1.6	1.4
4	2.7	1.9	2.0	1.8	1.6	1.4
62.1	1.5	3.6	4.0	2.7	1.6	1.5
2	1.8	.1	.3	1.5	1.6	1.5
3	1.3	-5.7	-6.1	1.8	1.6	1.5
4	1.4	12.0	13.0	1.3	1.6	1.5
63.1	.9	.1	.1	1.4	1.6	1.5
2	1.1	1.0	1.1	.9	1.6	1.5
3	1.9	.4	.5	1.1	1.6	1.5
4	1.9	2.4	2.5	1.9	1.6	1.5
64.1	1.8	-.5	-.6	1.9	1.6	1.5
2	1.8	-1.5	-1.6	1.8	1.6	1.5
3	1.6	8.5	9.4	1.8	1.6	1.5
4	.9	-.6	-.7	1.6	1.6	1.5

TABLE 5 (Continued)

Quarter	Actual	FS13	FS14	Naive*	Trend**	Adjusted Trend***
65.1	2.7	2.9	3.1	.9	1.6	1.5
2	1.8	-.6	-.8	2.7	1.6	1.5
3	2.0	-.7	-.7	1.8	1.6	1.5
4	2.8	13.9	15.3	2.0	1.6	1.5
66.1	2.5	-7.2	-8.0	2,8	1.6	1.5
2	1,5	2,6	2.6	2,5	1.6	1.5
3	1.8	-4.8	-5.4	1.5	1.6	1.5
4	1.9	-2.9	-3.3	1.8	1.6	1.5
67.1	,4	12.4	13.5	1,9	1.6	1.5
2	.9	5.7	6.1	.4	1.6	1.5
3	1.9	3.8	3.9	.9	1.6	1.5
4	2.0	-3.1	-3.7	1.9	1.6	1.5
68.1	2.6	-3,0	-3,5	2.0	1.6	1,5
2	2.4	2,0	1,8	2.6	1.6	1,5
Average Absolute Change	1.6					
Average Absolute Error		3.7	3.9	:8	.7	:7

* Actual change last period taken as forecast

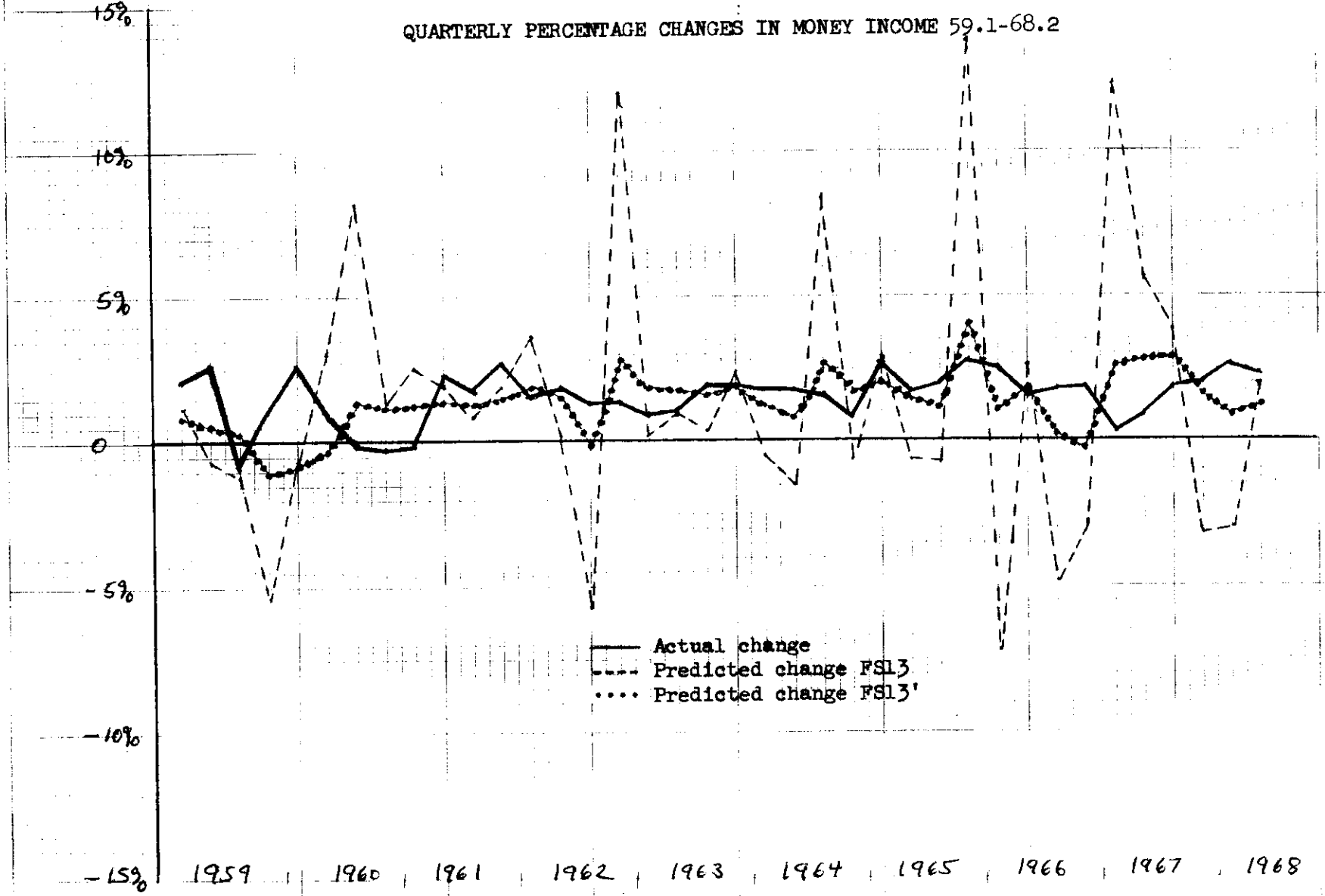
** Average annual rate of change, 1950-1960

*** Predicted change for year t is found by solving for r

$$Y(t-1) = (1+r)^{(t-1-1950)}Y(1950)$$

FIGURE 1

QUARTERLY PERCENTAGE CHANGES IN MONEY INCOME 59.1-68.2



income adjust enough to create demand for all the new money, requiring instead that only a fraction of the new money supply be immediately matched by permanent new demand. This can be done, but only at some expense to the power of the FS hypothesis to produce a large money multiplier and to explain how short-run variations in money creation induce reinforcing changes in velocity.

The moral of the exercises of estimation and prediction that we have presented here is simple. Contrary, perhaps, to much popular belief, the evidence does not support the view that there is a simple, direct relationship of income to money. Policy-makers and forecasters would not have much luck in trying to infer movements of money income from changes in money stock. The permanent income hypothesis is an interesting theoretical rationale for certain qualitative features of observed fluctuation of income and money. But it does not fit postwar data very well, and our results certainly provide no reason to prefer the FS model to a Keynesian interest-rate interpretation of short-run fluctuations in the demand for money.

DATA APPENDIX

M Demand deposits + time deposits + currency per capita (thousands)

From: Federal Reserve Bulletin, June 1964; September 1966

and Survey of Current Business, January 1967

Y Net National Product per capita (thousands of current dollars)

From: National Income and Product Accounts of the U.S. 1929-1965
Table 1.9, pp. 12-13

and Survey of Current Business, January 1967

P GNP deflator (1958 = 100)

From: National Income and Product Accounts of the U.S. 1929-1965
Table 8.1, pp. 158-159

and Survey of Current Business, January 1967

POP Total Population (millions)

From: Current Population Reports, Population Estimates, Census Series P-25
No. 331 March 22, 1966

No. 357 January 18, 1967

Population for year defined as population on July 1.

Population for quarter defined as average of population for first day of second and third month of quarter.

y Net National Product per capita (constant 1958 dollars)

Y/P

R_{TD} Rate paid by commercial banks on time deposits

From: U.S. Savings and Loan League Fact Book, 1968.

Published figures assumed to represent rate paid on June 30. Quarterly figures from linear interpolation to mid-quarter.

R_T Market yield on new issue 3-month Treasury bills

From: Business Statistics, 1967 (pp. 90 and 237)

Data for predictions through 1968.2 came from the Survey of Current Business, July 1968 or from more recent sources as listed above. In order to eliminate the problem of data revisions, values for 66.4 were altered in proportion to the more recent data.

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