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A Note on Inflation and the Saving Rate

IN AN EARLIER PAPER FOR *Brookings Papers on Economic Activity,* we presented findings on the relation between price inflation and consumer saving in the context of examining the role of expectational variables in consumer spending and saving decisions.[1] The paper focused primarily on durable goods expenditure models, and presented evidence on the usefulness of explicitly expectational variables in such models. We also looked briefly at a relatively simple saving function to see if the same expectational variables that were associated with durable goods expenditure decisions also had an impact on saving decisions. This report focuses entirely on saving, and is concerned primarily with models that can be used to predict the personal saving rate.

In this report, we examine three sets of variables for their impact on the saving rate. The first is personal taxes and transfer payments, which the evidence suggests have a strong initial impact on observed saving behavior. Second, we include both the levels of and changes in the unemployment

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1. "Inflation and the Consumer," *Brookings Papers on Economic Activity* (1:1972), pp. 71–114.

rate; the former represents the effect of diminished actual resources, the latter the effect of uncertainty about income prospects. Third, we measure the influence of inflation, both anticipated and unanticipated, and ask whether consumer expectations and attitudes, as measured by household surveys, have any net influence on saving behavior after these other factors have been taken into account.

The predictive ability of the model developed using these explanatory variables, referred to as the forecast model, is then compared with that of a model developed by Houthakker and Taylor that is more typical of the recent literature.[2] The Houthakker-Taylor model also incorporates a stock adjustment or distributed lag process, and emphasizes the influences of tax changes and the composition of personal income changes on saving behavior.

The Forecast Model

Before turning to a more detailed examination of empirical results, a summary of the variables used in the forecast model, and the reasons for their inclusion, may be useful.

TAXES AND TRANSFERS

The role of both taxes and transfers in the model is straightforward. Increases in personal income taxes reduce disposable income relative to personal income. The same is true of payroll taxes, which we combine with personal income taxes because of the absence of any strong evidence that the influence of the two is different. The question is how much of the impact of tax changes falls on saving and how much on consumption. We find, as others have before us, that changes in transfer payments have a very large and positive initial impact on saving, suggesting that people receiving transfers have a very high short-run marginal propensity to save.[3] Since most transfer payments are social security benefits, which accrue to lower-income individuals with, presumably, high marginal propensities to

2. H. S. Houthakker and Lester Taylor, *Consumer Demand in the United States, 1929–1970: Analyses and Projections* (2nd ed., Harvard University Press, 1970).

3. Lester Taylor, "Saving out of Different Types of Income," *Brookings Papers on Economic Activity* (2:1971), pp. 383–407.

spend, this finding presents a continuing puzzle. However, a variation of the forecast model that allows for lag effects indicates that this high propensity to save out of transfer income does not exist in the long run.

UNEMPLOYMENT RATES

When the unemployment rate is high, a relatively large fraction of the population is receiving substantially less income than normal. Given the stickiness of consumption patterns, one would anticipate a reduction in the aggregate rate of personal saving as a result. Thus the direct influence of high unemployment in reducing disposable income suggests that the unemployment rate will have a negative sign in a saving equation. But changes in unemployment rates may play an entirely different role. If unemployment is rising, the fear of becoming unemployed is probably rising too. For people who continue to hold jobs and therefore suffer no actual decline in disposable income, this fear implies a retrenchment on spending and a building up of reserves via saving. When unemployment rates are declining, concern about job security will also be declining, and with it the need to build financial reserves. In the empirical work we find evidence for both a direct negative influence of the unemployment level on saving and an indirect positive influence of unemployment change on saving.

PRICE INFLATION

In our previous paper, we argue that there has been a marked difference between the effects of anticipated and unanticipated inflation.[4] Traditional economic theory suggests that a fully anticipated rate of inflation has no effect on real economic behavior in the long run. For unanticipated inflation, our basic argument is that it generates an increased variance of expected real income that has asymmetrical effects on behavior; that is, a rise in the rate of price inflation above the anticipated rate tends to mean that consumers will be less certain than before about prospective changes in their real income. In decisions about whether to spend or save, the probability that real income will be improved is not accorded the same weight as the probability that real income will deteriorate. The reason is that the consequences of guessing wrong are not symmetrical: If consumers retrench on spending and it turns out that real income rises because money

4. "Inflation and the Consumer."

income rises more rapidly than prices, nothing is lost except an opportunity to consume now at favorable prices rather than later at less favorable ones. But if people act on the assumption that real income will rise and, in fact, it does not because prices outstrip money incomes, the financial consequences can be unpleasant. The argument that the increased variance in real income expectations leads to increased saving can be made for anticipated as well as unanticipated inflation if the variance of inflation expectations increases with the level. The empirical evidence associates positive saving effects only with unanticipated inflation. However, comparison of the actual and expected series reveals that periods of high inflation in the United States have never been fully anticipated.

An alternative explanation, which is consistent with the same empirical results, is that consumer expectations are biased: Because people do not generally anticipate money income increases to the same extent as they anticipate price increases, a rapid rate of inflation is taken to be synonymous with a decline in expected real income by the majority of consumers. The expected decline in real income induces increased saving as the expectations are not realized. Survey data provide some evidence that a bias toward pessimistic mean expectations about real income when prices rise relatively rapidly is not characteristic of consumers; hence the first interpretation seems more consistent with the available evidence, although unfortunately, no direct evidence exists to support it.

EXPECTATIONS AND ATTITUDES

There are several direct survey measures of consumer expectations and attitudes that are often alleged to have an influence on saving behavior. The question is whether these measures simply duplicate the information on plans and perceptions already reflected in the economic variables discussed above, or capture information that these variables fail to pick up.

Empirical Estimates

Estimates of the forecast model for the period 1954:1–1972:3 are shown in Table 1. The dependent variable is the ratio of personal saving to personal income. Personal rather than disposable income is used because the effects of tax changes on saving are included in the equation. Estimates for four versions of the model are shown: equation (1) is the basic model;

equation (2) drops the interest rate term from the basic model; equation (3) adds a survey index of expected purchases; and equation (4) repeats the variables of equation (1) but uses a serial correlation adjustment in estimation. All the coefficients of the basic model, equation (1) in the table, have the expected signs and all but the interest rate are significant at the 5 percent level. The equation explains over 70 percent of the variance in saving rates over a nineteen-year period. The equation does exhibit positive serial correlation of the residuals. In general, the saving rate model is relatively robust in the specification of income composition and unemployment effects, but the role of both expected and actual price inflation is much less satisfactory. When the equation is estimated for time spans beginning later than 1954 and continuing through 1972, the role of prices becomes erratic: The effect of interest rates is larger, and the effect of actual price inflation becomes smaller and in some cases disappears entirely. The interest rate coefficients seem implausibly large. When the equation is estimated for the period through 1967, the inflation effects are unchanged. Actual, as well as expected, price inflation should be correlated with long-term interest rates, and we have not been able to devise a structure that is not sensitive to the time period of estimation.

The partial effects of unemployment, U, unemployment change, ΔU, and interest rates, R, are all sizable: The implied unemployment elasticity of the saving rate from equation (1) is -0.6, while the interest rate elasticity is $+0.28$. An interest rate elasticity of this size seems implausible to us, but the standard error of the coefficient is also large. The unemployment elasticity also seems large, but the change in U is being held constant; when U is rising or falling, the net effects on saving are muted because ΔU has the opposite sign. The effects of transfer income and tax and social security payments, while powerful, tend to be offsetting.

In equation (2) of Table 1, the interest rate is dropped from the basic model on the grounds that there is little a priori reason to expect any effect of interest rates on saving, net of inflation effects.[5] Doing this raises the

5. The interest rate variable in equation (1) is actually a nominal rate, but the coefficient is exactly the same as if it were a real rate. It can be shown that an equation including the real rate ($R - CPI$) and CPI has the same R coefficient as that shown in Table 1, and a larger CPI coefficient. An equation using the real rate of interest

$$S = a_1 (R - CPI) + a_2\, CPI + \ldots$$

(where S = saving) implies

$$S = a_1 R + (a_2 - a_1)\, CPI + \ldots,$$

which is our nominal rate equation.

Table 1. Estimates of Forecast Model for Personal Saving Rate, First Quarter 1954 through Third Quarter 1972[a]

Independent variable and regression statistic[b]	*Regression coefficients*[c]				*Beta coefficients*			
	(1)	*(2)*	*(3)*	*(4)*	*(1)*	*(2)*	*(3)*	*(4)*
Constant	14.44	14.05	17.09	7.34	...	...	...	...
	(13.6)	(13.3)	(12.0)	(10.2)				
U	−0.6553	−0.7206	−0.9607	−0.6356	−0.78	−0.86	−1.14	−0.76
	(6.2)	(7.1)	(7.7)	(4.2)				
ΔU	0.2198	0.2162	0.2755	0.2473	0.31	0.30	0.39	0.35
	(2.9)	(2.8)	(3.7)	(2.6)				
R	0.3107	...	...	0.4318	0.54	...	...	0.75
	(1.8)			(2.1)				
$(SI + T)/Y$	−0.8710	−0.8380	−0.8655	−0.8622	−1.84	−1.77	−1.83	−1.82
	(9.5)	(9.1)	(9.9)	(7.3)				
TR/Y	0.8155	1.0273	1.2145	0.7053	1.44	1.81	2.15	1.25
	(5.0)	(9.2)	(9.9)	(3.7)				
CPI^*	−0.2199	−0.2330	−0.1051	−0.0985	−0.29	−0.31	−0.14	−0.13
	(2.3)	(2.4)	(1.0)	(0.7)				
CPI	0.2024	0.2647	0.1764	0.1119	0.41	0.54	0.36	0.23
	(2.7)	(3.9)	(2.5)	(1.4)				
A^*	...	...	−0.3470	...	...	...	−0.42	...
			(3.0)					
$\bar{R}^2$	0.7023	0.6926	0.7250	n.a.	...	...	...	...
Standard error of estimate	0.4717	0.4794	0.4534	0.4060	...	...	...	...
Durbin-Watson statistic	1.02	1.06	1.20	2.02	...	...	...	...

Source: Saving rate forecast model developed by authors. The basic data are from U.S. Bureau of Economic Analysis and U.S. Bureau of Labor Statistics. The numbers in parentheses are *t*-ratios.

a. The dependent variable in each equation is the ratio of personal saving to personal income.

b. Variables are defined as follows:

U = total unemployment rate

ΔU = four-quarter difference in U, that is, $U_t - U_{t-4}$

R = long-term bond yield (Aaa corporate bonds)

$(SI + T)/Y$ = ratio of personal social insurance contributions plus personal tax and nontax payments to personal income

TR/Y = ratio of transfer payments to personal income

CPI^* = expected rate of price change, as in *Brookings Papers on Economic Activity* (1:1972), pp. 112–14. The 1972:2 value of the basic index (Table B-3, p. 113) is 2.42.

CPI = actual rate of price change, calculated as the lagged two-quarter moving average of the percentage rate of change of the seasonally adjusted quarterly consumer price index, where the quarterly index is the mean of the monthly values

A^* = index of expected automobile purchases, as in *Brookings Papers on Economic Activity* (1:1972), pp. 109–11. The values for recent quarters (Table B-1, p. 111) are:

1971:3	8.86
1971:4	9.60
1972:1	9.20
1972:2	9.10
1972:3	9.00

c. Equation (4) is equation (1) corrected for serial correlation.

n.a. Not available.

standard error of estimate by 0.0077 and makes the inflation variables, CPI^* and CPI, somewhat stronger. In equation (3) the expected automobile purchase rate, A^*, is added to equation (2). The variable shows up strongly, but weakens the importance of the inflation variables. We also tried the index of consumer sentiment as an explanatory variable; it entered the equation with the appropriate negative sign, but its t-ratio was less than one.

The interpretation of the coefficients on actual and expected inflation is discussed in our earlier paper.[6] When both variables are in the equation, the effect of anticipated inflation is the sum of the two coefficients, and the effect of unanticipated inflation is the coefficient of CPI. The preferred equation (2) implies that anticipated inflation has only a small positive effect on saving and unanticipated inflation has a large positive effect. As noted, the data indicate that inflation is rarely fully anticipated.

In equation (4), the basic model is reestimated using a serial correlation correction based on the Cochrane-Orcutt transformation. The standard error declines by almost 15 percent, but the inflation coefficients are reduced. Their standard errors are unchanged, but their implied t-ratios fall below conventional acceptance levels.

Long-run Characteristics

The forecast model estimated here is static, yet many of the determinants of the saving rate are expected to have a lagged influence that varies over time. This is particularly true of the two income ratios, whose large estimated effects on saving shown in Table 1 are plausible as short-run phenomena only. There is no reason to think that a change in the proportion of income received as transfers should have a permanent influence on saving except through changes in the distribution of income, while a change in tax rates might be expected to change the ratio of saving to personal income, but not by as much as equation (1) suggests.

In order to test the effect of these variables on saving in the long run, the model was reestimated using eight-quarter, third-degree Almon lags on the two income ratios.[7] The initial lag coefficients are of the same order of magnitude and significance as the coefficients in Table 1. The sums of the lag

6. "Inflation and the Consumer."

7. Program limitations required that these estimates exclude R and ΔU from the basic equation.

coefficients are always smaller and not significantly different from zero at the 5 percent significance level. These results indicate that the Table 1 coefficients are impact effects and that the effect of taxes and transfers on the saving rate is negligible in the long run. Almon lags on the inflation variables indicate that their long-run effects are somewhat stronger than the impact effects shown in Table 1.

The Houthakker-Taylor Model

The second model used to test the effect of inflation on personal saving is that developed by Houthakker and Taylor from a simple behavioral hypothesis.[8]

The Houthakker-Taylor model is based on the following saving function:

$$S_t = \alpha + \beta K_t + \sum_{i=1}^{n} \alpha_i Y_{i_t}, \tag{1}$$

where

S = personal savings
K = stock of assets
Y_i = components of income and any other variables entering the saving function.

The reduced-form equation of the model, (3), is derived from (1), the stock identity (2), and a discrete time approximation:

$$\dot{K}_t = S_t \tag{2}$$

$$S_t = \frac{1 + \frac{1}{2}\beta}{1 - \frac{1}{2}\beta} S_{t-1} + \sum_{i=1}^{n} \frac{\alpha_i}{1 - \frac{1}{2}\beta} \Delta Y_{i_t}. \tag{3}$$

The reduced form includes lagged saving and the first differences of all the variables in the saving function (1). There is no constant term when assets are considered to be nondepreciating.

Estimates of the Houthakker-Taylor model for the period 1954:1–1972:3 are shown in Table 2. Equation (1) in that table follows Taylor's

8. Houthakker and Taylor, *Consumer Demand*, and Taylor, "Saving out of Different Types of Income."

specification and all variables are in constant prices and expressed per household. Income is divided into the following components:

L = labor income
P = property income
TR = transfer payments
SI = personal social security contributions
T = personal tax and nontax payments.

The disaggregation of income is highly significant and leads to large differences in the estimated marginal propensity to consume out of different types of income. These results are similar to Taylor's for the period ending with 1969 and have been analyzed extensively before. For all estimates of the Houthakker-Taylor model, the hypothesis of zero autocorrelation of the residuals is rejected at the 1 percent confidence level by the Durbin test.

When the rate of inflation is added to the behavioral equation (1), it too appears in the reduced form as a first difference. Experimentation with the inflation variables in the Houthakker-Taylor specification was not successful. Of the nonincome variables tested, only ΔR (and not ΔCPI or ΔCPI^*) entered the equation significantly. However, the implied long-run elasticity of interest rates is so large—0.42 when evaluated at the means—that we regarded the inclusion of either inflation or interest rate variables in the long-run behavioral specification of the Houthakker-Taylor model as an unsettled issue.

We therefore tested various specifications of actual and expected inflation rates in the reduced-form Houthakker-Taylor equation. When the level of expected or actual inflation was added to the equation, ΔR became insignificant. The actual inflation rate was more powerful than the expected rate, and the expected purchase variable did not enter significantly.

ALTERNATIVE SPECIFICATIONS

Equation (2) in Table 2 reestimates the model with the formal specification relaxed to allow a constant term, and with inflation, but not interest rates, included as an explanatory variable. This formulation yields a modest improvement in the explanatory power of the model. The structural income coefficients are unchanged and both the constant term and the actual rate of inflation enter significantly. The actual rate of inflation has a beta coefficient of 0.12 in equation (2), while ΔR has a beta coefficient of 0.06 in

Table 2. Estimates of Houthakker-Taylor Model for Real Personal Saving per Household, First Quarter 1954 through Third Quarter 1972

Regression coefficients			Structural coefficients		
	Equation			Equation	
Independent variable and regression statistic	*(1)*	*(2)*	*Parameter*	*(1)*	*(2)*
Constant	. . .	0.4081 (2.2)	. . .	. . .	. . .
S_{-1}, Lagged personal saving	0.9714 (18.9)	0.8473 (17.1)	β	−0.0290	−0.1653
ΔL, Change in labor income	0.4229 (4.5)	0.4503 (5.1)	α_L	0.4290	0.4875
ΔP, Change in property income	0.1134 (0.4)	0.0800 (0.3)	α_P	0.1150	0.0866
ΔTR, Change in transfer payments	0.9258 (4.4)	0.8022 (3.8)	α_{TR}	0.9392	0.8685
ΔSI, Change in personal social security contributions	−1.5525 (2.6)	−1.5725 (2.8)	α_{SI}	−1.5750	−1.6538
ΔT, Change in personal tax and nontax payments	−0.7645 (5.2)	−0.6784 (4.7)	α_T	−0.7756	−0.7345
ΔR, Change in long-term bond yield	0.3731 (1.6)	. . .	. . .	. . .	. . .
CPI, Rate of price change	. . .	0.0817 (2.4)	. . .	. . .	. . .
$\bar{R}^2$	0.9042	0.9109	. . .	. . .	. . .
Standard error of estimate	35.88	34.62	. . .	. . .	. . .
Durbin-Watson statistic	2.65	2.63	. . .	. . .	. . .

Source: Derived from equations (1) and (3) discussed in text, using basic data as in Table 1. The numbers in parentheses are *t*-ratios.

equation (1). According to equation (2), an increase in the rate of inflation of one percentage point will raise saving per household by $8.17, or by 1.8 percent.

Tracking Recent Saving

The standard error of estimate from the forecast model can be compared with the standard errors from the Houthakker-Taylor model by multiplying by the mean level of real income per household over the sample. The standard errors in real saving per household as implied by the saving rate forecast equations (Table 1) are $38.92, $39.56, $37.40, and $33.50, respectively. Only when the serial correlation correction is made is the standard error lower than that of the Houthakker-Taylor model. This is not surprising, for that model includes a lagged dependent variable while the forecast equation does not.

A better comparison is found in Table 3, where predicted and actual

Table 3. Estimates of Predicted and Actual Saving, Houthakker-Taylor and Forecast Models, First Quarter 1970 through Third Quarter 1972

Year and quarter	*Real saving per household, Houthakker-Taylor model*			*Personal saving as a percent of personal income, Forecast model*		
	Actual (1)	*Predicted* (2)	*Error* (3)	*Actual* (4)	*Predicted* (5)	*Error* (6)
1970:1	$576.9	$601.2	−4.2%	5.89%	5.76%	2.3%
2	686.7	684.4	0.3	6.93	6.87	0.9
3	703.1	713.9	−1.5	7.13	7.01	1.7
4	704.5	665.2	5.6	7.22	6.81	5.8
1971:1	695.5	724.9	−4.2	7.08	7.09	−0.1
2	741.6	750.4	−1.2	7.47	6.54	−0.8
3	698.3	709.6	−1.6	7.03	6.99	0.5
4	672.7	661.7	1.6	6.73	6.72	0.1
1972:1	623.4	591.6	5.1	6.14	5.51	10.2
2	554.1	618.5	−11.6	5.43	5.37	1.1
3	554.8	561.9	−1.3	5.40	5.61	−3.8

Sources: Column 1, *Survey of Current Business*, various issues; U.S. Bureau of the Census, *Current Population Reports*, Series P-20, Nos. 218 and 233, "Household and Family Characteristics, March 1970" (1971) and ". . . March 1971" (1972), respectively; column 4, *Economic Indicators* (December 1972) and preceding relevant issues. Column 2 is calculated from Table 2, equation (2), and column (5) is calculated from Table 1, equation (2). The errors are calculated from data before rounding.

values from the Houthakker-Taylor model and the forecast equation are presented for 1970:1–1972:3. The forecast model has a slightly better ex post performance in explaining the erratic saving behavior of recent years, although both equations track this period quite well. The root mean-square percentage error of the forecast model is 3.85 percent, while that for the Houthakker-Taylor model is 4.65 percent.

The large decline in the saving rate in recent quarters is well explained by the forecast model. From 1970:3 to 1972:3, the rate declined by 1.73 percentage points. Of this decline, 0.70 point is explained by the unemployment variables, 0.62 by the price variables, and 0.17 by the income ratios; the rest is unexplained.

Estimates of Future Saving Rates

Future saving rates, according to our model, will depend on three things: (a) the difference between changes in personal taxes and transfers, which have tended to have offsetting effects on income secularly but reinforcing effects cyclically; (b) the path of unemployment rates; and (c) the difference between actual and expected rates of price inflation.

We assume that changes in taxes and transfers will tend to offset each other over the next year, and that unemployment rates will go down somewhat. In the model, a 0.1 percentage point drop in the level of unemployment will be just offset by a 0.33 percentage point decline in the four-quarter change in unemployment. On balance, declining unemployment will generally lead to a higher saving rate. The probable effects of inflation rates are riskier to assess. At this writing, actual inflation exceeds the expected rate of inflation by 0.4 percentage point. If actual inflation speeds up, past history suggests that expectations will lag, leading to a 0.26 percentage point rise in the saving rate for every one percentage point of unanticipated inflation. But past history may be a poor guide in this case, since expectations appear to have quite long lags and are still based heavily on the inflation rates of 1970 and 1971.

Prospective declines in unemployment during 1973 will tend to increase saving rates, all other things held constant. If the unemployment rate declines to 4.8 percent by 1973:4 so that the average rate for 1973 is 5 percent, the saving rate will increase by 0.4 percentage point from 1972:4 to 1973:4. If the unemployment rate declines less rapidly, to 5.0 percent at year-end with an average rate of 5.15 percent in 1973, the saving rate will still increase, but by less than 0.3 percentage point.

While the likely course of prices in 1973 is unclear, some reasonable possibilities can be suggested. If inflation levels off at a fully anticipated rate of 3 percent, the saving rate will decrease by 0.1 percentage point. If, on the other hand, the inflation rate should rise by 2 percentage points more than expected, the saving rate will rise by 0.4 percentage point.

A final change that is expected to increase saving rates is the decline in the ratio of personal tax to personal income because of the unusually large refunds due in 1973 from overwithheld income taxes during 1972. The decline in the ratio may be about 1 percentage point in 1973:1 and 1.5 percentage points in 1973:2, with a return to normal levels thereafter. The effect would be an increase in the saving rate of 0.8 percentage point in 1973:1 and of 1.3 percentage points in 1973:2, followed by a decline to the 1972:4 level.

The analysis clearly suggests that the saving rate will tend to rise during 1973. The only influence in our model that might act to reduce the rate would be a decline in the actual rate of inflation, but it is difficult to visualize a reduction in price inflation of sufficient magnitude to prevent the saving rate from rising.