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PERSONAL SAVING BEHAVIOR IN FIVE MAJOR INDUSTRIALIZED COUNTRIES

by

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A major source of uncertainty in recent forecasts of economic activity in industrial countries has related to the expected course of the personal saving rate (i.e., personal saving as a per cent of personal disposable income). Changes in the personal saving rate can exert a significant influence on aggregate demand and it would appear that a greater degree of certainty as to the future course of saving rates in the major industrialized countries would improve forecasting and aid in the formulation of macroeconomic policy.

This paper examines the various factors put forward in the economics literature to explain the movement of either personal saving or the personal saving rate. Each factor's postulated relationship with saving behavior is briefly presented. A general model of aggregate household saving behavior is then formulated. Data on the United Kingdom, Germany, Japan, Canada, and the United States are used to estimate the personal saving function in each of the countries and the results are used to test various hypotheses about saving behavior, and to estimate the size of the effects of the various causal factors. The possibility of a structural change in the saving function during the last few years is investigated, and the predictive power of the estimated equations during the last few years is examined. Finally, the factors responsible for recent movements in the personal saving rate are ascertained.

I. Causal Factors: A Review[1/]

Personal saving rates in most industrialized countries have risen dramatically in recent years (see Table A). The rise in saving rates during a period of relatively high inflation rates does not conform with conventional wisdom that maintains that inflation discourages saving. A number of attempts to explain the phenomenon of rising saving rates coinciding with price inflation have drawn upon the work of Katona, who has stressed the feeling of uncertainty and pessimism about the future caused by inflation that, in turn, encourages saving.[2/] Of course, there are several factors other than the rate of inflation that can influence saving behavior. These include: the unemployment rate, the level of real income and its distribution, the level of real wealth or liquid assets, and the real interest rate.

Although recent discussions of personal saving behavior primarily have focused on the relationship between the rate of inflation and the personal saving rate, and, to a lesser extent, the relationship between the rate of unemployment and the saving rate, these discussions usually allow for the effects of other factors as well. Other theoretical models of saving behavior, that do not usually take inflation and unemployment directly into account, can be divided into three groups. The first includes those models that concentrate on the influence of income. The second consists of more elaborate models that incorporate certain variables in addition to income, such as liquid asset holdings. The third emphasizes the importance of the distribution of income

Table A

Personal Saving Rates in Major Industrial Countries
(Personal saving as a per cent of personal disposable income, seasonally adjusted)

	United Kingdom	Germany	Japan	Canada	United States
Average 1963-70	8.4	12.1	18.4	5.6	6.3
1971	8.8	13.9	20.7	6.4	7.7
1972	10.0	15.0	22.1	8.4	6.2
1973	10.9	14.2	25.0	9.3	7.8
1974	13.7	15.1	25.3	9.4	7.4
1973: Q1	9.1	14.0	19.8	7.3	6.8
Q2	12.3	13.6	26.0	7.8	7.8
Q3	11.0	14.5	26.3	8.9	7.9
Q4	11.3	14.7	24.4	9.8	8.7
1974: Q1	11.9	14.0	19.2	9.2	7.7
Q2	12.1	14.8	26.5	8.8	7.0
Q3	14.7	15.6	26.7	9.6	6.8
Q4	15.6	16.0	24.8	10.1	8.0
1975: Q1	14.4	16.7	21.6	9.8	6.6

Sources: See Appendix E.
Note: Definitions are not comparable across countries.
Due to revisions and rounding these data are not exactly the same as those used in the econometric work reported in this paper.

A. Inflation, Unemployment, and Saving

Inflation can be expected to exert two separate influences on saving. Inflation encourages the holding of real assets rather than assets fixed in nominal value. At the same time inflation creates a feeling of uncertainty and pessimism about the future which is hypothesized to encourage saving. The former effect is the familiar "flight from currency" that would be reflected in a decrease in the measured saving rate.[3/] The latter effect would, of course, increase the saving rate. In principle, each household would be subject to both influences although, at most, only one influence would prevail. On an aggregate level the net effect of inflation on the personal saving rate is, a priori, indeterminate since the effect on each household is indeterminate.

The tendency for inflation to increase personal saving can be explained in several ways. Perhaps the simplest is the hypothesis that inflation adversely affects consumer confidence and thus, in turn, leads to higher saving. A more elaborate explanation holds that inflation increases the variance of expected real income. Since, it is argued, households prefer unplanned additions to savings rather than unplanned withdrawals, the consumer will increase his saving rate in an inflationary period. (The variance in expected real income creates the possibility of unplanned additions to or withdrawals from savings; since the consumer is assumed to prefer the former, it is argued that he responds by increasing his saving rate to insure against unplanned withdrawls.)

In addition to what might be called the direct effects of inflation on saving mentioned above, there are several indirect effects. First, inflation erodes the real value of nominal assets and therefore reduces net real household wealth to the extent that household wealth consists of nominal assets; hence real consumption is reduced and the saving rate rises.[4/] Second, inflation may change the distribution of income among households and affect saving behavior through that means. For example, inflation that is not generally anticipated can redistribute income from creditor to debtor and from employee to employer. If propensities to save of these groups differ, the aggregate saving rate will be altered. Inflation of nominal income in an economy with a progressive income tax system increases average tax rates. This can affect the saving rate, particularly when some saving, such as pension contributions, is a fixed proportion of total income. (Saving in this case increases in proportion to total income, but disposable income does not, due to the progressive tax structure; the result is an increase in the saving rate.)

Search theory also predicts that inflation -- at least unexpected inflation -- will result in increased saving in that consumers encountering an increased price for a certain good will postpone purchase until a search of the market confirms that the prevailing nominal price for the good has indeed changed and that its price relative to all other relevant goods has not changed enough to affect his decision. Since search takes time, consumption expenditures fall, transactions balances accumulate, and the personal saving rate increases.

Macroeconomic disequilibrium theory also predicts that inflation will tend to increase saving. If prices are not perfectly flexible, rising prices indicate excess demand for goods. An excess demand for a good creates a spillover demand for substitutes for that good. One substitute for present consumption is future consumption, i.e., present saving. Thus inflation will tend to increase the personal saving rate.[5/]

Nearly all of the above arguments for why there would be a positive relationship between inflation and personal saving would seem to be valid only if the rate of inflation were unexpected (or at least not provided for in advance). Thus, a synthesis of most of the various theories as to the response of the household sector to inflation would be that unexpected inflation tends to increase saving while expected inflation tends to decrease saving.

The unemployment rate is given an important role in many discussions of the saving rate. The conventional view is that experienced unemployment lowers the saving rate as those individuals out of work reduce their saving in order to maintain consumption standards as much as feasible; whereas the expectation of unemployment increases the saving rate as workers increase their precautionary savings.

B. Income and Saving

Elementary macroeconomic analysis postulates that the level of saving is related to the level of income. The saving rate is defined as current personal saving (as measured by the national income accounts) divided by current personal disposable income. Thus with respect to

current measured income, saving rate behavior simply depends on what is assumed about the average propensity to save; the rate either will be constant or increase as income increases. In addition, the "normal" or "permanent" income hypothesis, although not relevant to the personal saving rate as usually measured, implies at least a tendency toward an increase in the measured saving rate if the rate of growth of measured income increases.[6/]

C. Liquid Assets, the Rate of Interest, and Saving

More elaborate models include the effects of wealth or liquid assets and the real interest rate, as well as the influence of income. Increases (for example) in wealth or liquid assets are postulated to increase consumption out of a given level of income and, hence, to decrease the saving rate. An increase in the real rate of interest will make present consumption more expansive in terms of foregone future consumption: this will tend to raise the saving rate. Furthermore, an interest rate increase will decrease the present value of existing claims to given future nominal income streams (e.g., bonds). Such a decrease in net household wealth will decrease consumption and increase the personal saving rate. However, many economists claim that an increase in interest rates decreases the amount of saving that must be done to acquire claims to a given future income stream and that this will tend to reduce the saving rate. Thus nothing certain can be said, a priori, about the direction of the relation between the real interest rate and the saving rate.[7/] (An increase in the rate of interest also will increase interest income and this will affect the saving rate if either the level of income or its distribution by source is a determinant of the rate.)

D. Income Distribution and Saving

Many theorists stress the importance of the distribution of income by source (i.e., by type of income) as an important determinant of the personal saving rate. It is postulated that the rate of saving out of different types of income varies systematically. This hypothesis is usually justified on two different grounds. The first is because the nature of the income streams differ, e.g., some types of income streams are more variable than others. An upward fluctuation in such an income stream, it is argued, will increase the saving rate since provision must be made for future lean years. Conversely, a decrease in such an income decreases the saving rate as consumption is maintained by drawing down the stock of savings built up for just such an occasion. Thus, for example, an increase in property income (e.g., profits), holding other types of income constant, is expected to raise the personal saving rate. The second reason used to justify the existence of a relationship between saving behavior and the distribution of income relates to alleged differences in the innate characteristics of the recipients of the various types of income. For example, it is assumed that recipients of property income have higher propensities to save than wage-earners, therefore an increase in property income is expected to increase the saving rate. Similarly, an increase in transfer income (e.g., welfare payments) is postulated to lower the saving rate since the recipients are assumed to consume nearly all of their income. (This is usually taken to be a long-run effect since, empirically, the immediate impact of transfers has been to raise the saving rate.) Various tax payments also are hypothesized as determinants of the saving

rate. In particular, taxes such as social security payments, that are a form of saving, are expected to lower the saving rate.[8]

II. The Model

Much of recent work on personal saving behavior has used the approach used earlier by Houthakker and Taylor and by Taylor.[9] The basic approach is to concentrate on the relation between personal saving and the stock of financial assets, various types of income and taxes, and the interest rate. Because of the difficulty of measuring financial assets, the basic behavioral relation is manipulated into a form which relates saving to saving done last period (i.e., lagged saving), the first differences in the various types of income and taxes, and the change in the interest rate. Estimates of the underlying behavioral parameters can be derived from the estimates of this first-difference equation. Juster and Taylor have added the unemployment rate and the inflation rate as explanatory variables in the first-difference equation. However, the elimination of the stock of financial assets requires some inconvenient assumptions. Recent papers by Taylor and by Juster and Wachtel assume that the real stock of financial assets is nondepreciating. Clearly this nondepreciation assumption is inappropriate when there is any significant price inflation. The Houthakker-Taylor and Juster-Taylor papers assume that the nominal stock of financial assets is nondepreciating. This assumption is tenable if one is willing to ignore capital losses on equities. However, they then specify the saving function in nominal terms.[10] This specification imposes either extreme money illusion (if a constant term is present) or a proportional short-run saving function (if there is no constant term). Neither of these properties is very

attractive theoretically. The high rates of inflation in recent years cast doubt on the usefulness of recent studies using an assumption of a nondepreciating real stock of financial assets; or at least they raise questions about the interpretation of the coefficients in first-difference equation models. Similarly, the particular behavioral implications of the functional form imposed by the elimination procedure (when it is assumed that the nominal stock of financial assets is nondepreciating) raise the same questions.

The Juster and Taylor model omits some potentially important variables. The task of this section of the paper is to formulate a more general model that retains the variables included in Juster and Taylor's behavioral equation while adding some additional variables. To do this, one can begin with the saving relation as postulated by Juster and Taylor, [11] but in real per capita terms:

$$S = \alpha + \beta A + \gamma_1 LAB + \gamma_2 PROP + \gamma_3 TR + \gamma_4 SS + \gamma_5 T + \delta_1 R,$$

where,

S = personal saving

A = stock of financial assets at beginning of the period

LAB = labor income

PROP = property income

TR = transfers

SS = social insurance contributions

T = personal tax and nontax payments

R = nominal rate of interest.

Rather than manipulate the equation in order to eliminate A, this paper uses the stock of net liquid assets as a proxy for A. There are many

reasons for doing this: liquid assets probably constitute a major share of household financial assets and in any case probably move in the same direction, i.e., liquid assets are probably a good proxy for financial assets; many economists stress the role of liquid assets in the determination of saving behavior and there is evidence from empirical work that, indeed, liquid assets are an important determinant of saving rate movements;[12/] finally, by using a stock-of-assets variable, the assumptions about nondepreciating assets or functional form (discussed above) are avoided. Thus throughout this paper, A is defined as the stock of net liquid assets.

Next, the actual and expected inflation rates (P and P*) and the actual and expected unemployment rates (U and U*) can be added to the behavioral relation itself. Other variables can also be included: these are the level of personal disposable income, and its most recent quarterly rate of growth (g). Thus the personal saving function can be written as:

$$(1) \qquad S = \alpha + \beta A + \gamma_1 LAB + \gamma_2 PROP + \gamma_3 TR + \gamma_4 SS + \gamma_5 T + \delta_1 R + \delta_2 P + \delta_2^* P^* + \delta_3 U + \delta_3^* U^* + \delta_4 g.$$

(The use of a constant term, α, allows the level of income to influence the level of saving and the saving rate. Inclusion of P* allows one to interpret δ_1 as the effect of changes in the real interest rate.)

This paper is concerned with the behavior of the personal saving rate. This relation can be obtained simply by dividing both sides of equation (1) by the level of real per capita personal disposable income (Y) to get:

$$(2) \quad SR = \alpha\frac{1}{Y} + \beta\frac{A}{Y} + \gamma_1\frac{LAB}{Y} + \gamma_2\frac{PROP}{Y} + \gamma_3\frac{TR}{Y} + \gamma_4\frac{SS}{Y} + \gamma_5\frac{T}{Y} + \delta_1\frac{R}{Y} + \delta_2\frac{P}{Y} + \delta_2^*\frac{P^*}{Y} + \delta_3\frac{U}{Y} + \delta_3^*\frac{U^*}{Y} + \frac{g}{Y},$$

where SR is the personal saving rate (i.e., SR = S/Y). There are two reasons why equation (2) should not be directly estimated; both have to do with the fact that :

$$(3) \quad LAB/Y = 1 + SS/Y + T/Y - PROP/Y - TR/Y.$$

First, from (3) it follows that only measurement errors would keep these ratio variables from being perfectly collinear. The second reason has to do with interpreting the coefficients for the income distribution terms in equation (2). The γ's are the partial derivatives of the saving rate function with respect to one of the income distribution terms, holding all other explanatory variables constant. But, as one can see from the constraint in equation (3), such an interpretation is impossible in this context. Nevertheless, equation (1) can be estimated and the estimates of the various coefficients will yield information about the effect on the saving rate of changes in the various explanatory variables.[13/]

III. Empirical Results

Before presenting the empirical results, it is necessary to explain how the variables called expected inflation and expected unemployment were constructed. Households can be expected to react both to the actual

rate and to some expectation of that rate which they have formed in some manner. Some studies, for example that by Juster and Wachtel,[14] have used consumer opinion surveys to calculate an expected inflation series. Such data are not generally available for the countries studied in this paper. Thus another method of calculating expected inflation (P^*) is needed. It is plausible to assume that the consumer takes into account both the recent inflation rate and its rate of change when forming his inflation expectations. Such a process can be expressed, following Carlson and Parkin, by a second-order adaptive expectations hypothesis. Let P_t^* be the expectations formed in period t for period t + 1, and P_t be the actual rate of inflation in period t. The hypothesis is that

$$P_t^* - P_{t-1}^* = \lambda_0 (P_t - P_{t-1}^*) + \lambda_1 (P_{t-1} - P_{t-2}^*)$$

There is some evidence that inflation expectations may very well be formed in this matter.[15] The above formulation can be rewritten as $P_t^* = DP$ where DP is some distributed lag function of actual inflation rates.

In period t household behavior is being influenced by expectations formed a period earlier (P_{t-1}^*) and actual inflation (P_t). (The latter does not affect expectations of inflation for period t because information about the current inflation only becomes generally known during the period.) The above argument implies that equation (1) should include data for current and some (perhaps all) past inflation rates.

These data would adequately summarize the effects of the two variables that must be included on theoretical grounds -- actual and expected inflation rates. A convenient method of estimating equation (1) is to use a Shiller lag technique.[16] Then the coefficients on the lagged variables are used to construct the coefficient for the variable called P*. This is the technique used in this paper. (A similar method was used for U*.)

In principle all past inflation and unemployment rates should be taken into account when formulating the effect of expectations. Clearly it is not practical to do so; some cut-off point must be imposed. In this study it is specified that information over a year and a half old is relatively unimportant in forming the household sector's expectations and, hence, in influencing its behavior. Thus the inflation variables included in the regression were P_t, P_{t-1}, P_{t-2}, P_{t-3}, P_{t-4}, P_{t-5}, and P_{t-6}. (Similarly for unemployment.)

When using a distributed lag technique it is necessary to specify a shape for the lag structure, i.e., specify the pattern of the coefficients of the lagged variables. Thus, choice of the shape of the lag structure is crucial. Evidence from Juster and Wachtel's study of the United States suggests that the shape is a second degree curve.[17] An advantage of the Shiller technique is that while the analyst must specify a certain degree for the curve, he need not force the data to conform. That is, the technique allows the data to specify its own lag structure shape, regardless of the analyst's a priori specification. In this study a second-degree curve specification was used but another

specification (the standard error of the unrestricted model over the standard error of the restrictions) was set so low as to allow the data to override the degree specification if it proved to be wrong. Finally, an end point restriction was made, i.e., the coefficient of the final lagged value was constrained (loosely) to be zero.

Table 1 (all numbered tables appear in Appendix A) presents the results of estimating equation (1) for the five countries covered by this paper. The sample size varies across countries but in all cases quarterly data ending with the first quarter of 1975 were used. (See Appendix E for data specification and sources.) There are two additional types of information that are of interest: the response of the saving rate to a change in an explanatory variable, and the elasticity of the saving rate with respect to an explanatory variable. Table 2 presents the estimated values of the changes in saving rates with respect to a change in an explanatory variable implicit in the estimates reported in Table 1. Table 3 presents the estimated values of the elasticities.[18/]

The estimated lag structures underlying the estimates reported in Table 1 are shown in Appendix C of this paper. The statistics for δ_2 and δ_3 were taken directly from the Shiller regression. The statistics for δ_2^* and δ_3^* can be computed as follows: the coefficient itself is the sum of the coefficients of the lagged values; the standard error is the square root of the sum of the variances and covariances of the coefficients of the lagged values (i.e., S.E. = $\sqrt{\sum_i \sum_j \text{cov}(x_i x_j)}$, where cov $(x_i x_i) \equiv$ var (x_i)). The latter calculation was not made for this study because various F-tests (presented below) indicate that the lagged variables, taken as a group,

are not significant. The diagrams in Appendix C indicate that the specified lag length is a fairly good approximation.

Table 4 reports the results of various F-tests made on the significance of various groups of inflation and unemployment variables. Of all of the F-statistics reported in the table, only one is significant -- the test for the inclusion of current P and U for Canada. A conclusion that one can draw from these data is that, after taking into account inflation and unemployment's indirect effects through the real value of assets, the distribution of income, etc., inflation and unemployment have little effect on personal saving behavior. In fact, lagged values have virtually no independent explanatory power; current values have some, particularly in the case of Canada. Nevertheless, the point estimates of δ_2, δ_2^*, δ_3, and δ_3^* are of some interest.

In a regression containing both an actual and an expected rate of inflation as well as the nominal rate of interest, the estimated coefficients can be interpreted in a manner that will convey information about the effects of expected and unexpected inflation and the effect of the real interest rate. Define the real rate of interest to be:

$$r = R - P^*.$$

Thus,

$$\delta_1 R + \delta_2 P + \delta_2^* P^* = \delta_1 r + \delta_2 P + (\delta_1 + \delta_2^*) P^*.$$

Therefore, as asserted earlier (p. 11), δ_1 is the effect of the real interest rate on personal saving. The total direct effect of inflation on personal saving is $\delta_2 P + (\delta_1 + \delta_2^*) P^*$. If the inflation is fully

expected then the effect on personal saving is $\delta_2 P^* + (\delta_1 + \delta_2^*)P^*$. The difference can be interpreted as the effect of unexpected inflation and is equal to $\delta_2(P-P^*)$. The sum $(P-P^*)$ is, of course, unexpected inflation. Thus, the coefficient of actual inflation also supplies information about the effect of unexpected inflation. (However, note that the elasticity will be $\delta_2 (P-P^*)/S.$) Similarly $\delta_2 + \delta_1 + \delta_2^*$ is the effect of an expected inflation on personal saving, and the elasticity is $(\delta_2 + \delta_1 + \delta_2^*)P^*/S.$[19/] A similar argument can be made about the interpretation of δ_3 and δ_3^* except that δ_1 is disregarded.

The figures in Table 4 indicate that an estimated saving relationship may very well be better off without expected inflation and expected unemployment. Such estimates were made and the results are reported in Table 5. For the purposes of this paper there seems to be no point in recalculating the various estimators presented in Tables 2 and 3. The interested reader can do so simply by multiplying the particular entries of interest in Tables 2 and 3 by the ratio of the relevant estimated coefficient in Table 5 to the corresponding coefficient in Table 1 for the first half of each table. The second half (i.e., those pertaining to the distribution of income) requires slightly more work; entries of interest must be multiplied by the ratio of the various sums indicated in Tables 2 and 3 (i.e., those involving σ). For this, values of σ are needed and are presented in a footnote.[20/]

IV. Discussion of the Empirical Results

The results in Table 1 can be used to test the various hypotheses presented in section I of this paper. A one-tailed test

at a level of confidence of 95 per cent will be used. Table 1 indicates that the German and Canadian household saving relations are not proportional but that the other three countries' may be. That is, α is significantly less than zero only for Germany and Canada. In all five countries, the postulated negative relation between the real value of liquid assets and real saving is significant. Labor income exerts a significantly positive effect on saving in all countries tested; property income does so in all but Japan and Canada; transfers are significant in only Germany, Canada, and the United States. Social security contributions have a significantly negative effect in only Germany; taxes have a similarly significant effect in Canada and the United States only.[21/] The interest rate does not have a significant effect on saving in any country except the United States (where it has a negative effect).[22/] Current actual inflation (P) has a positive effect on saving in all five countries, but it has a statistically significant effect in just the United Kingdom and Canada. (In Japan and the United States it is "almost" significant.) The effects of current actual unemployment vary in sign and are not significant in any country. (The effects of P* and U* are discussed in reference to Table 4.) Finally, the rate of growth of real income has a significant (and positive) effect on saving in the United Kingdom alone.

Although there are many coefficients that are not significantly different from zero, and some that have signs that are the opposite of the predictions in section I of this paper, there are no incorrect significant signs. The relative sizes of the various estimates of the

marginal propensities to save (the γ's) do not necessarily agree with theoretical preconceptions and one in particular, γ_1 for Japan, does not seem to make sense at all.[23] However it should be remembered that these are just point estimates, and that they estimate short-run propensitites only.

In terms of the overall fit, equation (1) with lags performs well for all five countries -- with R^2 (both adjusted and unadjusted) in excess of .9. The Durbin-Watson statistics indicate no evidence of autocorrelation.

The results presented in Tables 2 and 3 estimate the effects on the personal saving rate of changes in the various explanatory variables. Both tables present information that is useful for prediction and policy analysis. However, the data in Table 3 are more readily interpreted and compared because they are unit-free. The data show that in all of the countries the saving rate is more responsive (in terms of percentage changes) to a percentage change in the real value of liquid assets or labor income than to a percentage change in any of the other explanatory variables.

The F-tests presented in Table 4 indicate that, after taking into account the rest of the variables in equation (1), e.g., liquid assets and the distribution of income, the additional explanatory power of various combinations of price and unemployment variables is not significant except in the case of actual inflation and unemployment in Canada.[24]

The data in Table 5 (i.e., equation (1) without P* and U*) imply that only the U.K. equation is proportional. Aside from this change, there are a few minor changes from the estimates in Table 1. Property income's influence is significant for Canada, social security contributions are significant for Japan and taxes are significant for Germany. The interest rate effect is not significant for the United States in Table 5. The effect of inflation is no longer positive for the United States in Table 5, but the sign is not significant. In the Canadian equation, current unemployment exerts a significant and positive influence on saving. In subsequent analysis in this paper, both versions of equation (1) will be used, i.e., with and without lags.

The point estimates of the coefficients of actual and expected inflation and unemployment reported in Table 1 are not very precise. However they can be used to measure the effects of expected and unexpected inflation and unemployment, as explained in the previous section. Not much confidence can be put in these estimates, but they do indicate that unexpected inflation raises the saving rate in all of the countries analyzed in this paper.

The results presented in this paper so far indicate that the real value of liquid assets and the distribution of income by source are important determinants of the saving rate in the five industrialized countries studied. In addition, certain other variables are significant in some of the countries. However, in only some of the countries is the effect of inflation and/or unemployment significant <u>after</u> taking account of their effects by way of their influence on such variables as the real value of liquid assets and the distribution of income. Thus

there is no evidence of any general "uncertainty" or "pessimism" effect of inflation and/or unemployment on personal saving behavior. The effects of the two variables seem to work through more conventional channels, such as, in the case of inflation, the value of liquid assets. Studies that omit one or more of these channels are apt to find a significant influence on the part of inflation (or unemployment) that can be easily misinterpreted as evidence of a direct effect, e.g., an "uncertainty" effect.

V. Structural Change

Although the evidence reported above indicates that there has probably not been any general "uncertainty" effect of inflation and unemployment on household behavior, the tests cannot be considered conclusive. The regressions reported so far in this paper have tested for a linear relation between saving and rates of inflation and unemployment. An alternative way in which inflation and/or unemployment could affect saving behavior is to change basic saving behavior; e.g., by shifting a behavioral equation such as (1). The abnormally high inflation rates and unemployment rates of recent years could be hypothesized to have caused a structural change in the household sector's saving function. Such a shift perhaps could be attributed to an "uncertainty" effect. As an initial attempt at testing for a structural change, four versions of equation (1), both with and without lags, were estimated with binary variables for before and after 1971:I, 1972:I, 1973:I, and 1974:I, respectively. The results are presented in Table 6 along with the results of including a time trend in equation (1).

As can be seen from Table 6, only Japan has a significant time trend in its household saving relation. However, in all five of the countries there is evidence of a structural change in the relation during the past several years. The recent past has been characterized by the coincidence of relatively high inflation and unemployment rates in these countries. The question immediately arises as to whether the structural change indicated by the Table 6 results is caused by this coincidence. Table 7 presents the results of running equation (1), again both with and without P* and U* with a binary variable reflecting the interaction between inflation and unemployment. As Table 7 indicates, in the United Kingdom and Germany, the coincidence of inflation and unemployment, i.e., "stagflation," significantly raised personal saving (using the full model). The point estimate of the effect on the personal saving rate is the change in the intercept (the number reported in the table) divided by the mean value of Y. For the United Kingdom, the point estimate is .011 (11 per cent of the average personal saving rate for the sample period); for Germany, it is .013 (10 per cent of the average rate). However, in none of the other three countries is there any evidence of a significant effect of stagflation on the intercept of the household saving function.

VI. Predictive Power

There were insufficient data to do any kind of meaningful post-sample testing of equation (1)'s predictive power. However it is of some interest to examine the equation's predictive ability during the last 17 quarters of the sample. The results of such an examination

are interesting because they indicate how useful experience in the 1960's is for predicting behavior in the 1970's (where inflation and/or unemployment may have modified behavior in such a way that 1960's experience is irrelevant). The tests reported above have indicated that the earlier data may not be very useful for predicting recent behavior; an examination of the residuals for the last 17 quarters will indicate how useful (or useless) earlier data are. Examination of predictive performance in recent years will indicate which version of equation (1) -- with or without P* and U* -- is more relevant for the 1970's. Finally, the results provide a benchmark for judging the performance of models that contain the variables that the results reported in section V indicate should be included.

As can be seen from Table 8, except for the case of Japan (where the omitted time trend undoubtedly affects the equation's predictive power for recent years) the average absolute value of the difference between the actual and predicted personal saving rates is less than one half of a percentage point. This is not too bad a performance and would seem to indicate that the experience of the 1960's can be useful for predicting /explaining household behavior in the 1970's, particularly if provision is made for the various variables that were discovered to be of importance in the preceding section. Note, however, that the average absolute value of the residual after 1972 is a bit larger than that after 1970. Table 8 also shows that the full version of equation (1) performs somewhat better in the 1970's than does the version without P* and U*.

In section V, it was found that certain binary variables, as well as a time trend for Japan, entered into equation (1) as signficant explanatory variables when included one at a time. When these are combined in one regression some are no longer significant and can be omitted but some remain significant. Table 9 reports the results of such regressions (following the discussion in the above paragraph, only the full version of (1) is used here). The estimates for the United States are the same as in Table 1 because no additional significant variables were found for the United States in section V. The estimated lag structures are reported in Appendix C.

The results in Table 9 can be compared to those in Table 1. There are very few substantive differences between the two sets of regression results. However, there are a few changes in Table 9 that are worthy of mention. In all cases, and especially for Japan, the new variables increase the $\bar{R}^2$. For Japan, β is larger in absolute value and its t-statistic is practically doubled; γ_2 is larger and statistically significant; and δ_2 is now significant, whereas in Table 1 it was just barely insignificant. One should note also that the final version of the Japanese equation does not have a time trend since, apparently, the two binary variables pick up the effect previously detected by the use of a time trend. In the United Kingdom, γ_3 is now statistically significant but δ_2 is not. The change in the significance of δ_2 indicates that it is the interaction between inflation and unemployment (as measured by D5) that directly affects household saving behavior, rather than inflation <u>per se</u>. In

Canada, the only noteworthy change is that γ_2 is larger and significant. In both Canada and the United Kingdom, δ_2^* changes signs; in Germany δ_3^* changes sign. The estimates in Table 9 can be transformed into estimates of the ratio of the change in the personal saving rate over a change in an explanatory variable and the saving rate elasticity with respect to an explanatory variable (as in Tables 2 and 3) by the method presented above (p. 17).

The distinctive feature of Table 9 is the estimates of the effects of structural change since 1970 and the effects of the interaction between inflation and unemployment. It is interesting that in those countries (Canada and Japan) in which there was a shift in household saving behavior in 1971 or 1972, the effect was to increase the saving rate, ceteris paribus. However, in those countries (Germany, Canada, and Japan) in which a shift occurred in 1973 or 1974, the effect was to decrease the saving rate. Finally, in only two countries (the United Kingdom and Germany) does there seem to be evidence of a direct effect on personal saving of the interaction between inflation and unemployment. In these two countries such an interaction increases the saving rate -- by about 1 percentage point in both the United Kingdom and Germany,[25/] according to the point estimates in the table.

Table 10 presents summary statistics of the residuals for the Table 9 estimated equations. Except for the United States (where Table 1 and Table 9 estimates are identical), the average absolute value of the difference between the actual and predicted personal saving rates is less in Table 10 than in Table 8. Based on the Table 10 data, between 1971:I and 1975:I the average absolute difference between

actual and predicted personal saving rates as a percentage of the average personal saving rate in the entire sample period is: United Kingdom: 3.6; Germany: 1.9; Japan: 7.9; Canada: 3.8; and United States: 4.6. The figures on frequency of overprediction given in the tablesindicate that, if anything, the equations tend to overestimate household saving during the 1970's.

VII. Conclusions

This paper has analyzed household saving behavior during the past several years in five major industrialized countries. A general model of household saving behavior is used which builds upon the framework used by Houthakker and Taylor in their work on the United States. Although more research could be done in order to perfect each country's estimating equation, in particular more research could be directed toward finding the exact lag structure most appropriate for each country, many useful conclusions can be drawn on the basis of the research presented in this paper.

Several variants of the basic model were estimated. On the basis of these estimates it can be concluded that for the sample period in the five industrialized countries studied here, the real value of liquid assets is an important factor in determining the personal saving rate in all of the countries. The distribution of income seems to be important also but the estimates are difficult to interpret in this regard because they refer to immediate (i.e., same quarter) effects only. Various other factors were found to be significant explanatory variables in some of the countries studied. Some evidence was found for the hypothesis that inflation (and/or unemployment) has a significant direct effect on personal saving behavior. Specifically, in Table 1 inflation was found to increase saving in the United Kingdom and Canada, and inflation's effect on saving was "almost" significant in Japan and the United States as well. However, in Table 4 a stricter test found evidence for a direct effect of inflation and unemployment in Canada

only. In Table 5, evidence for a positive effect of inflation on saving was found in the United Kingdom and Canada and for a positive effect of unemployment on saving in Canada. Finally, in Table 9, where the basic model was augmented by various structural change variables, it was found that inflation had a significantly positive effect on saving in Japan and Canada and that the coincidence of abnormally high rates of inflation and unemployment increased saving in the United Kingdom and Germany. That is, after taking into account inflation's effect on such variables as the real value of liquid assets and the distribution of income and any unemployment effect on similar variables, various types of evidence were found for a direct effect of inflation and/or unemployment per se. However, based on the research reported here, the effects of inflation and/or unemployment also work through more conventional channels, such as a wealth effect, as well as through a direct "uncertainty" effect. Studies that omit or mistreat some of these conventional variables are likely to lead to results that can be misinterpreted as evidence of direct effects.

This paper also investigated the possibility of a recent structural change in the household sector's demand for saving function. It was found that there is some evidence for such a change in all of the countries studied. In the case of the United Kingdom and Germany the change was at least partly due to the coincidence of higher than normal rates of inflation and unemployment. Finally it was found that the model used in this paper performs fairly well as a predictor of personal saving behavior in the 1970's, especially if the model is augmented by the inclusion of various binary variables reflecting recent structural changes.

This paper has determined which variables significantly affected personal saving, and hence the personal saving rate, during recent years. As mentioned above (p. 2) there has been a dramatic increase in personal saving rates in the major industrial countries during recent years. The final objective of this paper is to determine what factors were responsible for the recent increase in saving rates. To do this the personal saving equation for each country, as estimated in Table 9, will be used.

A. United Kingdom

In the United Kingdom, the personal saving rate increased sharply in 1972 and continued to increase throughout the rest of the sample period. Of the explanatory variables found to be significant in Table 9, the real value of liquid assets -- after climbing steadily through most of the 1960's -- hit a plateau and then fell more-or-less continuously from 1972 to the end of the sample (the ratio of liquid assets to personal disposable income began to fall in 1970 and fell rather sharply throughout the rest of the period studied here). The behavior of the various components of real personal disposable income can best be summarized by expressing them as income shares; there was a mild upward trend in labor income's share until 1970, then a decline until 1974 when the shares of (pre-tax) labor income and taxes began a fairly sharp climb. Personal disposable income as a whole increased fairly steadily through 1971; in 1972 and early 1973 it jumped sharply and was more-or-less constant since then. There does not appear to be any trend in the quarterly rate of growth of income, however, it was negative for three quarters

in a row toward the end of the sample (1973:IV-1974:II). Finally, as might be expected, all but one of the "stagflation" observations are after 1970:I and the majority occur after 1972:III.

Based on the information in the above paragraph, it would appear that the explanations for the increase in the personal saving rate in the United Kingdom are the fear and uncertainty created by the coincidence of high rates of inflation and unemployment and the fall in both the ratio of liquid assets to income and the real value of liquid assets. This latter explanation can also be attributed to inflation since the 45 per cent inflation between 1972:I and 1975:I would have decreased the real value of the stock of liquid assets prevailing in 1972:I by 45 per cent. Based on the estimate of λ_5, stagflation increased the saving rate by about one percentage point, the remainder of the increase was due largely to the effects of inflation on the real value of liquid assets.

B. Germany

In Germany, the saving rate seems to have gone up in steps during the sample period: between the periods 1965:I-1968:IV and 1969:I-1971:III there was an increase in the average saving rate and another between 1969:I-1971:III and 1971:IV and 1974:I; since 1974:I, the rate increased sharply through the end of the sample period. The real value of liquid assets increased throughout the period but the ratio of liquid assets to personal disposable income did not; the ratio increased fairly continuously until 1969:IV, it then fell throughout 1970 and did not reach its 1969:IV level again until 1972:I after which

it increased until 1974:I. The ratio fell in 1974:II and had not reached its 1974:I peak by the end of the sample period. Although income shares in Germany were a bit more variable than they were in the United Kingdom the only noteworthy changes were an increasing share of pre-tax labor income since 1969:III, an increasing share of taxes from 1971 on, and an increasing share of transfer payments beginning in 1973. Personal disposable income was flat during 1965-67, increased steadily until 1973 when it fell for four quarters (1973:II-1974:I) before resuming its climb. Stagflation (as defined here) in Germany occurred during 1973:IV-1975:I. In addition, a structural change apparently took place in 1973:I.

Although the occasional declines in the liquid asset to income ratio suggests that the real value of liquid assets -- and hence indirectly the inflation rate -- had a role in the increase in the German personal saving rate, that role cannot be anything like that in the United Kingdom. Furthermore, since the saving rate increased throughout the period, the negative and statistically significant α coefficient in Table 9 and the fact that income did increase steadily for most of the period suggest that at least some of the upward trend in the saving rate can be explained by the rather pedestrian theory that the marginal propensity to save exceeded the average propensity to save. The estimate of λ_5 indicates that stagflation increased the saving rate by about one percentage point and the structural change beginning in 1973:I decreased the saving rate by roughly the same amount. Thus, the two effects roughly offset each other. Although inflation's effect on the

real value of liquid assets was, no doubt, important (since β was found to be statistically significant), the nonproportionality of the saving function is also an important explanatory factor in the increase in the saving rate in Germany.

C. Japan

During the sample period, the Japanese personal saving rate showed little or no trend until 1973; since 1973:I there have been several extraordinarily high quarterly saving rates. At the same time, the real value of liquid assets grew steadily until 1973:I; it has been roughly constant since then. The ratio of liquid assets to income, although fairly erratic, increased throughout the period until 1973:II when it started fluctuating around a more-or-less constant value. Personal disposable income grew steadily until 1973 when it too began to fluctuate. Starting in 1970, the labor share of income gained at the expense of property income's share. Starting in 1973:I, inflation rates began fluctuating around a larger average value with several extraordinarily high values. Finally,two structural changes were found in the Japanese saving equation.

In Japan, the real value of liquid assets -- although a significant explanatory variable -- was perhaps not as important a factor as it was in the United Kingdom. Given the large estimated values for γ_1 and γ_2, the change in income distribution since 1970 probably was not too important, although, since γ_1 is larger than γ_2, it might explain some of the increase in the saving rate after 1973:I. The structural changes acted first to increase the saving rate (after 1972:I) by about 4 percentage points but the second change (after 1974:I)

decreased the rate by some 11 points. Thus, the initial increase in the saving rate could be due to a structural change, but its continuation was due to some other factors that were strong enough to outweigh the second structural change. One factor seems to have been the rate of inflation. The average rate of inflation during 1973 and 1974 was nearly four times that during 1971 and 1972. Using the formula from Table 2 and the estimate of δ_2 in Table 9, the difference in the average rate of inflation between those two periods increased the saving rate by nearly 2 percentage points. The other major explanatory factor is the real value of liquid assets: in five of the six quarters that were characterized by exceptionally high saving rates, the ratio of the value of liquid assets at the beginning of the quarter to income during the quarter was lower than that of the previous quarter. (The 40 per cent inflation between 1973:I and 1975:I would have decreased the real value of the stock of liquid assets prevailing in 1973:I by 40 per cent.)

D. Canada

The Canadian personal saving rate deviated around a flat trend from 1963 through 1970 and then started deviating around another, higher, level from 1971 through the end of the sample period. The real value of liquid assets either grew or was flat during most of the period but from 1969:I through 1970:I it actually fell (by 1970:III, the 1969:I level had been exceeded). There was an upward trend in the ratio of liquid assets to income but the climb was not very steady; the ratio hit a peak in 1969:I that was not exceeded until 1971:I. This dip in the ratio of liquid assets to income does not appear to have been caused by

inflation since there seems to be nothing exceptional about the rates of inflation during that two-year period. Over the entire sample period there was a tendency toward an increase in the shares of income going to labor, transfers, and taxes, and a decrease in the share of property income. However, labor income's share reached a peak in 1970:II and its subsequent decline may have increased the saving rate. Income itself grew fairly steadily until 1974:III when it became essentially flat. Canadian inflation rates began to be generally higher than they had been earlier during the second half of 1972 and were especially high (by previous Canadian standards) after 1973. The first of two structural changes detected in the Canadian equation increased the saving rate and the second essentially shifted the saving function back to where it had been before the first structural change.

Some of the increase in the Canadian saving rate can be attributed to the nonproportionality of the saving function, that is, the marginal propensity to save exceeded the average (recall that in Table 9 α is significant and negative). The behavior of liquid assets around 1970 indicates that perhaps the household sector had delayed -- for some reason -- adjusting its stock of assets to its new income level and the structural change in 1971:I (that added about two percentage points to the saving rate) was aimed at restoring the desired relationship in a fairly short time. The higher rates of inflation after 1972 prevented the structural change in 1973:I from having as much of a depressing effect on the saving rate as it would have otherwise. (The inflation would have also played an indirect role by eroding the real value of liquid assets.)

E. United States

In the United States, the personal saving rate rose fairly steadily during the period 1963 through 1967; it then fell in 1968 and the first quarter of 1969. In the period from 1969:II to 1971:II it rose sharply only to fall rather precipitously during the next four quarters. The rate then rose continuously until it reached its peak for the sample period) in 1973:IV. It fluctuated around a fairly high level after that. The real value of liquid assets was on an upward trend during the period but there were two periods in which the real value fell: 1969:II-1970:II (the 1969:I level was not reached until 1971:II); and 1973:III-1974:IV (the increase in 1975:I was small). The ratio of liquid assets to income was on an upward trend but there were two major interuptions of its upward path: the 1969:I level was not exceeded until 1971:IV and there was a continuous decline between 1969:II and 1970:II; and between 1972:III and 1975:I the ratio was essentially flat. During the sample period, the share of income going to transfers increased, apparently at the expense of property income. There was also a mild upward trend -- with a bulge around 1969 -- in labor income's share. Personal disposable income as a whole grew until 1973. After a year of little growth, 1974:I through 1975:I was a period of negative growth in real personal disposable income.[26/]

In the above paragraph the correlation between the saving rate and the two measures of real liquid assets (the level and its ratio to real personal disposable income) is quite apparent. Hence the conclusion is that the real value of liquid assets (and therefore inflation, through its influence on that value) were largely responsible for recent movements in the U.S. personal saving rate.

F. General Conclusion

The real value of liquid assets (and thus, indirectly, inflation) was found to be an important factor in contributing to the recent increases in the personal saving rates in all of the major industrialized countries examined in this paper. This factor was found to be particularly important in the United Kingdom, Japan, and the United States. In the U.K. case, uncertainties created by stagflation were also an important factor. In Germany, the nonproportionality of the saving function was important and although the effects of stagflation were significant, they were mostly offset by a change in the structure of the saving function that roughly coincided with the period of stagflation. In Japan and Canada, the direct effect of inflation was found to be an important explanatory variable. The nonproportional nature of the Canadian saving function was also important, as was an apparent delayed adjustment by the Canadian household sector to higher real incomes around 1970.

APPENDIX A

TABLE 1

OLS Estimates of Equation (1) - With P* and U*

Parameter	United Kingdom	Germany	Japan	Canada	United States
α(const)	-12.188 (1.080)	-344.57 (6.023)	-5426.2 (0.089)	-119.56 (3.086)	-66.342 (1.674)
β (A)	-.062144 (2.052)	-.092922 (4.035)	-.15452 (1.730)	-.058749 (1.944)	-.050319 (2.985)
γ_1(LAB)	.32981 (3.649)	.40854 (3.467)	1.1799 (4.398)	.37451 (3.075)	.31879 (3.292)
γ_2(PROP)	.41631 (3.623)	.63678 (6.163)	.48373 (1.480)	.28461 (1.374)	.46310 (2.337)
γ_3(TR)	.57506 (1.448)	1.0906 (4.8488)	-.32387 (0.148)	.78561 (1.881)	.77996 (2.964)
γ_4(SS)	-1.0491 (1.672)	-.87298 (3.695)	-2.3369 (1.147)	-.031367 (.080)	.32568 (0.636)
γ_5(T)	-.17426 (0.872)	-.39677 (1.593)	-.64881 (0.570)	-.73333 (3.437)	-.89982 (7.549)
δ_1(R)	.049323 (0.163)	4.3791 (1.258)	-4145.0 (1.194)	-2.3698 (1.478)	-6.7113 (1.864)
δ_2(P)	60.018 (2.093)	235.98 (0.637)	66138. (1.689)	354.847 (1.912)	421.79 (1.496)
δ_2^* (P*)	-5.2579	-2886.1	345622.	-261.67	-627.83
δ_3(U)	-6.5157 (0.073)	488.11 (1.095)	292461. (0.730)	240.661 (1.402)	276.22 (1.078)
δ_3^* (U*)	-150.44	176.39	248383.	-34.851	-621.75
δ_4(g)	39.596 (3.058)	25.237 (0.175)	6442.4 (0.217)	109.339 (1.633)	-31.300 (0.347)
$\bar{R}^2$	.943	.975	.902	.947	.928
R^2	.958	.983	.927	.960	.946
DW	2.240	1.598	2.182	1.740	1.875
n	46	41	49	49	49
d.f.[a]	33	28	36	36	36

Note: Figures in parentheses are t-statistics.

a. Calculated by the formula:

$$\text{d.f.} = n + \sum_{i=1}^{m} (L_i - D_i - 1 + E_i) - k,$$

where m = number of lagged variables; L_i=lag length of i^{th} lagged variable; D_i = degree of curve; E_i = number of end-point restrictions, and, as usual, n = sample size and k = number of explanatory varibles (including lagged values).

TABLE 2
Estimates of the Ratio of the Change in Personal Saving Rate over a change in an Explanatory Variable

Estimator[a]	United Kingdom	Germany	Japan	Canada	United States
β/Y	-.0003955	-.00006704	-.000001552	-.00009281	-.00006158
δ_1/Y	.0003139	.003159	-.04164	-.003744	-.008213
δ_2/Y	.3820	.1702	.6644	.5606	.5162
δ_2^*/Y	-.03347	-2.082	3.472	-.4134	-.7683
δ_3/Y	-.04147	.3521	2.938	.3802	.3380
δ_3^*/Y	-.9575	.1273	2.495	-.05506	-.7609
δ_4/Y	.2520	.01821	.06472	.1727	-.03830
$(\gamma_1-\sigma)/Y$	.001504	.0001984	.000009876	.0004884	.0003084
$(\gamma_2-\sigma)/Y$	.002055	.0003630	.000002882	.0003464	.0004850
$(\gamma_3-\sigma)/Y$	.003065	.0006905	-.00000523	.001138	.0008728
$(\gamma_4+\sigma)/Y$	-.006082	-.0005335	-.0000215	.00005371	.0004803
$(\gamma_5+\sigma)/Y$	-.0005140	-.0001899	-.000004541	-.001055	-.001019

Note: a. Evaluated at the mean values.

TABLE 3
Estimates of the Elasticity of the Personal Saving Rate
with Respect to an Expanatory Variable

Estimator[a]	United Kingdom	Germany	Japan	Canada	United States
$\beta A/S$	-1.7518	-1.607	-2.081	-1.5675	-1.824
$\delta_1 R/S$	.029239	.1874	-1.180	-.3742	-.6573
$\delta_2 P/S$	.071742	.01282	.0634	.09570	.08574
$\delta_2^* P^*/S$[b]	-.006285	-.1568	.3313	-.07057	-.1276
$\delta_3 U/S$	-.010612	.03405	.1623	.2928	.2415
$\delta_3^* U^*/S$[b]	-.245030	.01230	.1378	-.04240	-.5437
$\delta_4 g/S$	.01594	.001760	.005686	.02238	-.003457
$(\gamma_1-\sigma)LAB/S$	2.142	1.457	3.3041	3.877	3.098
$(\gamma_2-\sigma)PROP/S$	.8467	.9010	.5471	.7423	1.556
$(\gamma_3-\sigma)TR/S$	.6069	1.420	-.1826	1.3797	1.111
$(\gamma_4+\sigma)SS/S$	-.7364	-.1742	-.5881	.02092	.2273
$(\gamma_5+\sigma)T/S$	-.1318	-.001405	-.1908	-1.5570	-1.981

Note: a. Evaluated at the mean values.
b. For simplicity it is assumed that average P* equals average P and likewise for U* and U.

TABLE 4
F-Tests on Inflation and Unemployment Variables

Variables	United Kingdom	Germany	Japan	Canada	United States
excluding[a]:					
P, P*	.772	.877	1.050	.638	1.109
P, P*, U, U*	.725	.565	.627	.661	.958
U, U*	.788	.149	.096	.591	.958
including[b]:					
P, P*	.696	1.288	1.431	.801	.966
P	1.628	1.029	1.064	2.471	0.0
U	.922	.378	.080	2.471	.337
P, U	2.159	.628	.518	3.277[c]	.188
U, U*	.716	.262	.201	.742	.788

Additional F-statistics can be calculated from the information in Appendix D.

Note: a. The F-statistic refers to that calculated in a test between equation (1) and an equation containing all the variables in (1) except for those indicated in the table.

b. The F-statistic refers to that calculated in a test between an equation containing all the variables in (1) except P, P*, U, U* and an equation with the same variables and, in addition, containing those variables indicated in the table.

c. Significant at a 5 per cent level.

TABLE 5
OLS Estimates of Equation 1 - Without P* and U*

Parameter	United Kingdom	Germany	Japan	Canada	United States
δ (const.)	-9.1498 (0.854)	-230.248 (5.802)	-28350. (2.782)	-153. (4.063)	-90.303 (2.138)
β (A)	-.055695 (2.032)	-.05769 (3.344)	-.17581 (2.291)	-.052078 (2.093)	-.060736 (3.632)
γ_1 (LAB)	.28153 (3.231)	.22118 (2.965)	1.3234 (4.718)	.45027 (3.936)	.29531 (3.032)
γ_2 (PROP)	.31928 (3.009)	.54612 (5.266)	.47392 (1.638)	.36530 (2.784)	.58130 (3.397)
γ_3 (TR)	.28002 (0.775)	1.0406 (4.880)	.80808 (0.398)	.56876 (1.740)	.76306 (2.780)
γ_4 (SS)	-.65436 (1.039)	-.38692 (2.008)	-3.6016 (1.849)	-.30902 (0.966)	.50421 (0.863)
γ_5 (T)	.010237 (0.064)	-.46462 (2.110)	-.50122 (0.452)	-.84041 (4.044)	-.93736 (8.237)
δ_1 (R)	-.034126 (0.128)	1.0481 (0.301)	1131.2 (0.626)	-2.0982 (1.526)	-1.8176 (0.499)
δ_2 (P)	57.948 (1.834)	366.77 (0.906)	40204. (0.983)	343.42 (1.976)	-67.685 (0.215)
δ_3 (U)	-84.747 (1.620)	-182.59 (0.488)	-67735. (0.158)	315.68 (1.994)	-142.77 (0.620)
δ_4 (g)	44.959 (3.309)	189.37 (1.505)	15130. (0.488)	100.85 (1.573)	-84.052 (0.864)
$\bar{R}^2$	.931	.968	.880	.942	.899
R^2	.946	.976	.904	.954	.919
DW	2.178	1.605	2.048	1.664	1.624
n	46	41	49	49	49
d.f.	35	30	38	38	38

TABLE 6
Tests for a Structural Change

Test	United Kingdom	Germany	Japan	Canada	United States
Trend	No	No	Yes	No	No
Intercept Change:					
1971:I	No	No, Yes[a]	No	Yes	No
1972:I	No	No	Yes	No	No, Yes[a]
1973:I	Yes	Yes	Yes	Yes	No
1974:I	No	No	Yes	No	No

Note: a. The first entry refers to the test performed on the full model; the second to that performed on the model without P* and U*.

TABLE 7
Intercept Test for the Effect of an Interaction
Between Inflation and Unemployment

Test	United Kingdom	Germany	Japan	Canada	United States
Observations[a]	14	6	11	13	8
Effect:					
with P* and U*	1.665 (3.268)	18.536 (2.207)	1162.9 (0.642)	-1.6807 (0.614)	-2.915 (1.162)
without P* and U*	0.841 (1.594)	6.432 (0.790)	2517.1 (1.440)	-1.9317 (0.694)	-2.608 (0.914)

Notes: a. Number of times that stagflation, defined to be when both inflation and unemployment are above their average values, occurs in the sample.

TABLE 8

Summary Statistics of Residuals for Equation (1): With and Without P* and U*

Statistic	United Kingdom		Germany		Japan		Canada		United States	
	With	Without	With	Without	With	Without	With	Without	With	Without
1971:I-1975:I										
$\sqrt{SSR/17}$	.9001	1.1235	6.8194	7.5019	3348.8	4000.1	3.7632	3.9568	3.4250	3.8762
$\Sigma \lvert R \rvert /17$	.676	.807	5.53	6.33	2649.	3119.	2.87	3.10	2.75	2.98
$\Sigma \lvert R \rvert /(17 \cdot \bar{Y})$	.0039	.0047	.0035	.0040	.0204	.0240	.0039	.0042	.0031	.0033
Frequency of overprediction	6/17	6/17	10/17	9/17	10/17	10/17	9/17	8/17	10/17	11/17
1973:I-1975:I										
$\sqrt{SSR/9}$	1.0723	1.3628	7.3299	7.9960	4200.5	4976.9	3.9025	4.0929	4.1867	5.0314
$\Sigma \lvert R \rvert /9$	.747	.918	5.67	6.96	3556.	4039.	3.27	3.39	3.50	4.30
$\Sigma \lvert R \rvert /(9 \cdot \bar{Y})$	.0042	.0051	.0035	.0043	.0257	.0292	.0043	.0044	.0038	.0047
Frequency of overprediction	3/9	3/9	6/9	5/9	5/9	5/9	6/9	6/9	6/9	6/9

Notes: SSR = Sum of the squared residuals.
$\lvert R \rvert$ = The absolute value of the residual.
$\bar{Y}$ = The mean value of Y during the indicated sub-sample.

TABLE 9
OLS Estimate of Equation (1) - With Additional Variables

Parameter	United Kingdom	Germany	Japan	Canada	United States
α(const.)	-8.7086 (0.867)	-330.546 (6.763)	-43478. (1.274)	-135.60 (4.563)	-66.342 (1.674)
β(A)	-.056729 (2.109)	- .085352 (4.307)	-.25288 (3.145)	-.096365 (3.952)	-.050319 (2.985)
γ_1(LAB)	.27760 (3.399)	.32650 (3.141)	1.0357 (3.636)	.38294 (4.069)	.31879 (3.292)
γ_2(PROP)	.43868 (4.298)	.69038 (6.462)	.73677 (2.474)	.63268 (3.580)	.46310 (2.337)
γ_3(TR)	.62297 (1.768)	1.0923 (5.757)	3.1987 (1.430)	.66952 (2.063)	.77996 (2.964)
γ_4(SS)	-.85553 (1.530)	-.97246 (4.595)	-2.7438 (1.595)	-.26216 (0.853)	.32568 (0.636)
γ_5(T)	-.32237 (1.763)	-.19011 (0.858)	-.39981 (0.392)	-.70205 (4.043)	-.89982 (7.549)
δ_1(R)	.12324 (0.458)	4.8522 (1.602)	2443. (0.686)	-1.6161 (0.958)	-6.7113 (1.864)
δ_2(P)	26.245 (0.957)	194.775 (0.619)	70304. (1.981)	320.17 (2.012)	421.79 (1.496)
δ_2^*(P*)	58.666	-3296.8	263625.	1165.5	-627.83
δ_3(U)	-34.201 (0.428)	309.56 (0.815)	281169. (0.829)	-80.004 (0.500)	276.22 (1.078)
δ_3^*(U*)	-145.09	-140.49	612630.	218.76	-621.75
δ_4(g)	36.515 (3.171)	-85.486 (0.643)	-2160.1 (0.081)	56.947 (1.088)	-31.300 (0.347)

OLS Estimate of Equation (1) - With Additional Variables

Parameter	United Kingdom	Germany	Japan	Canada	United States
$\lambda_1(D_1^a)$				14.054 (3.774)	
$\lambda_2(D_2^b)$			5103.0 (2.568)		
$\lambda_3(D_3^c)$		-15.483 (2.487)		-16.533 (3.572)	
$\lambda_4(D_4^d)$			-15452. (2.631)		
$\lambda_5(D_5^e)$	1.6650 (3.268)	18.080 (2.367)			
$\bar{R}^2$	.955	.982	.931	.969	.928
R^2	.968	.989	.951	.978	.946
DW	2.101	1.768	2.369	1.728	1.875
n	46	41	49	49	49
d.f.	32	26	34	34	36

Note: a. D1 equals 0 before 1971:I and 1 afterwards.
b. D2 equals 0 before 1972:I and 1 afterwards.
c. D3 equals 0 before 1973:I and 1 afterwards.
d. D4 equals 0 before 1974:I and 1 afterwards.
e. D5 equals 1 if both inflation and unemployment exceed their sample means and 0 otherwise.

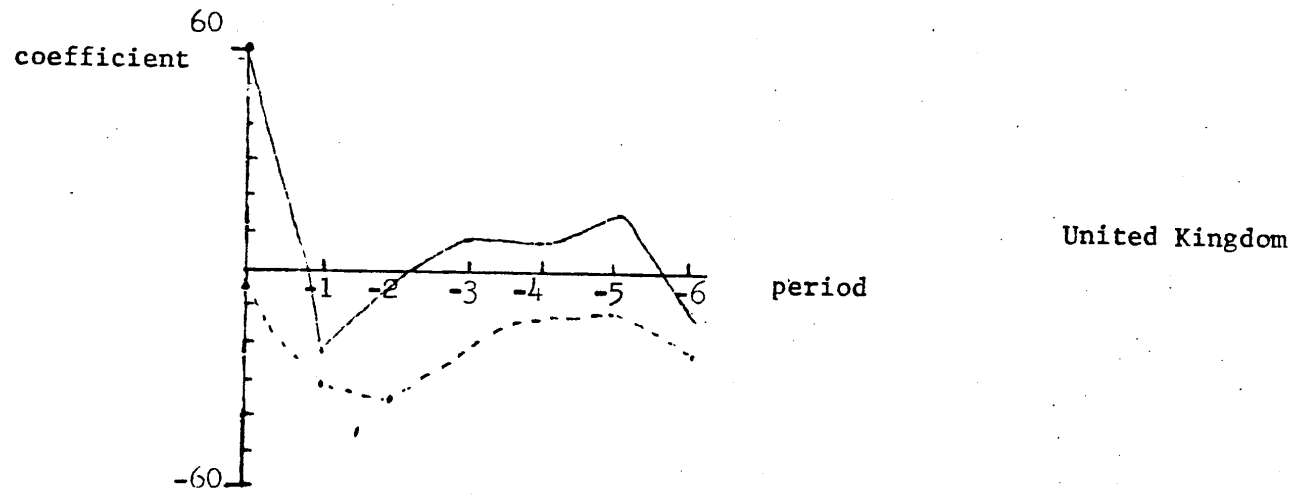
TABLE 10
Summary Statistics of Residuals for Table 9 Equations

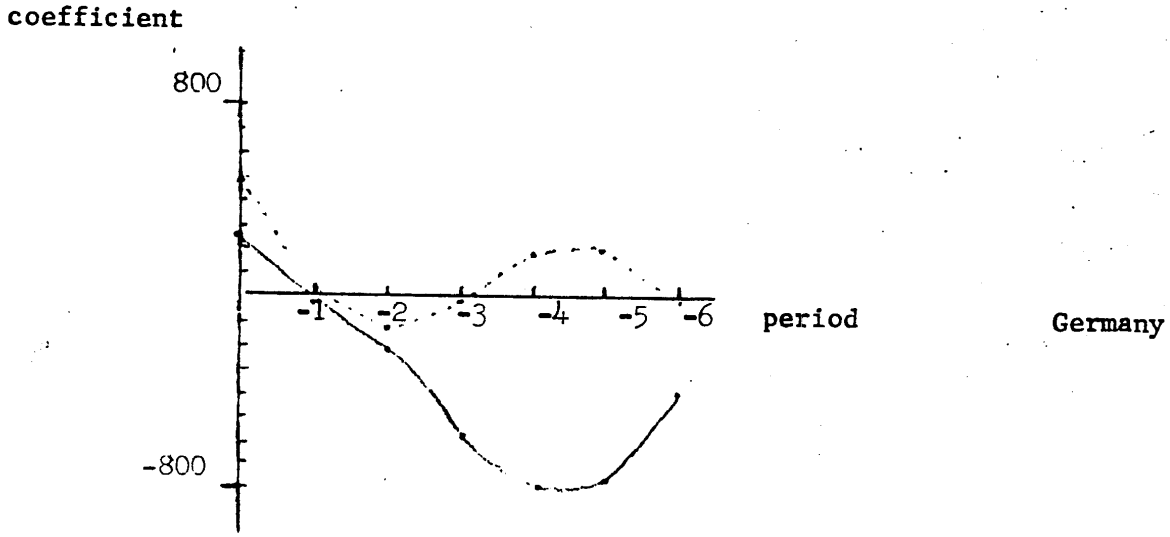
Statistic	United Kingdom	Germany	Japan	Canada	United States
1971:I-1975:I					
$\sqrt{SSR/17}$	.7920	4.6369	2553.7	2.2798	3.4250
$\Sigma\|R\|/17$	0.584	4.12	2027.	1.87	2.75
$\Sigma\|R\|/(17\cdot\bar{Y})$	.0034	.0026	.0156	.0026	.0031
Frequency of overprediction	9/17	10/17	11/17	11/17	10/17
1973:I-1975:I					
$\sqrt{SSR/9}$	.8837	5.0096	3012.5	2.3922	4.1867
$\Sigma\|R\|/9$	0.636	4.67	2445.	1.81	3.50
$\Sigma\|R\|/(9\cdot\bar{Y})$	.0035	.0029	.0177	.0024	.0038
Frequency of overprediction	5/9	6/9	5/9	6/9	6/9

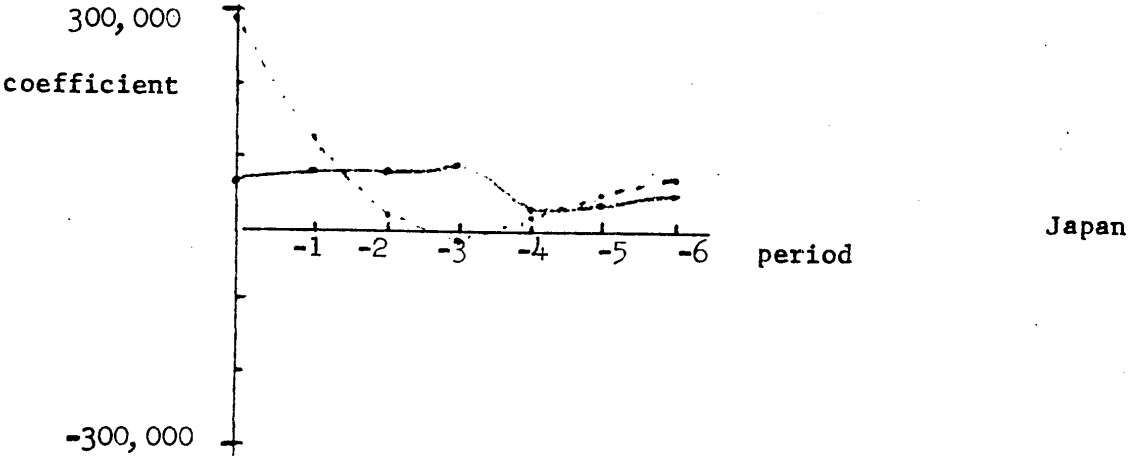
APPENDIX B
OLS Estimates of Equation 2'

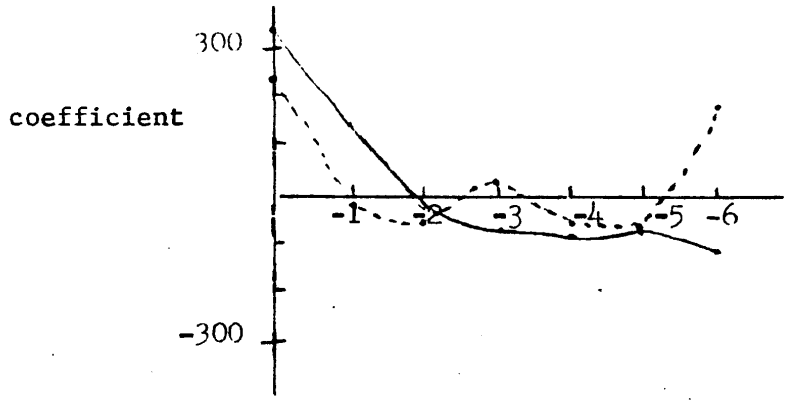
Parameter	United Kingdom	Germany	Japan	Canada	United States
$\alpha(1/Y)$	-10.358 (0.957)	-317.02 (5.336)	-15317. (1.201)	-148.67 (3.559)	-71.838 (1.759)
$\beta(A/Y)$	-.077224 (2.781)	-.095077 (3.795)	-.21005 (2.858)	-.071995 (2.510)	-.042701 (2.697)
γ_1(const.)	.34182 (3.609)	.38604 (3.375)	1.0934 (4.506)	.41900 (3.280)	.32404 (3.593)
$\gamma_2-\gamma_1(PROP/Y)$	.11711 (0.727)	.24574 (1.750)	-.76304 (2.167)	.081611 (0.304)	.096349 (0.436)
$\gamma_3-\gamma_1(TR/Y)$	.21428 (0.521)	.74435 (2.641)	.04095 (0.023)	.39911 (0.942)	.46184 (1.496)
$\gamma_1+\gamma_4(SS/Y)$	-.72175 (1.154)	-.24448 (1.317)	-.44808 (0.259)	.18944 (0.585)	.48894 (0.963)
$\gamma_1+\gamma_5(T/Y)$	.24663 (1.330)	-.058181 (0.233)	1.2845 (1.418)	-.40058 (2.751)	-.63249 (5.736)
$\delta_1(R/Y)$	-.0049945 (0.016)	2.3890 (0.681)	-1805.1 (0.725)	-2.2215 (1.299)	-4.5272 (1.325)
$\delta_2(P/Y)$	18.285 (0.722)	219.03 (0.606)	70712. (2.678)	343.568 (1.841)	399.39 (1.707)
$\delta_2^*(P^*/Y)$	-4.88995	-1794.8	155818.	-209.71	-938.32
$\delta_3(U/Y)$	9.9701 (0.223)	-35.521 (0.160)	129794. (0.516)	206.98 (1.494)	285.93 (1.547)
$\delta_3^*(U^*/Y)$	-121.79	480.65	761800.	-2.4603	628.74
$\delta_4(g/Y)$	29.182 (2.337)	32.317 (0.270)	26621. (1.169)	66.645 1.008)	18.186 (0.203)
$\bar{R}^2$	.858	.853	.592	.862	.847
R^2	.896	.897	.694	.896	.885
DW	2.308	1.448	2.141	1.573	1.872
n	46	41	49		49
d.f.	33	28	36		36

APPENDIX C
Estimates of the Lag Structure in Table 1



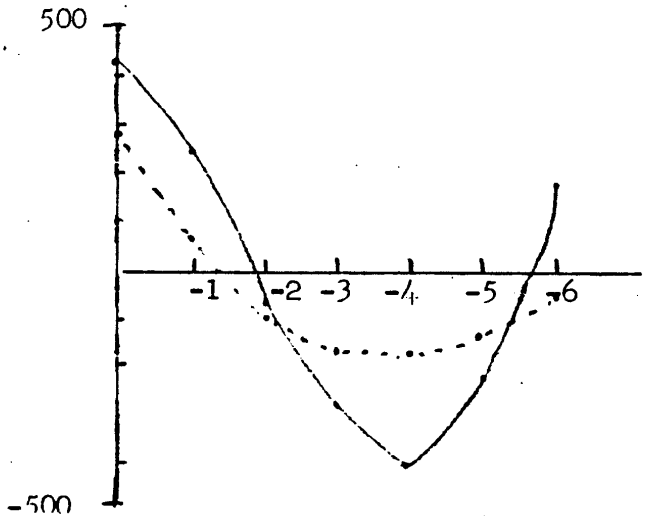






Canada

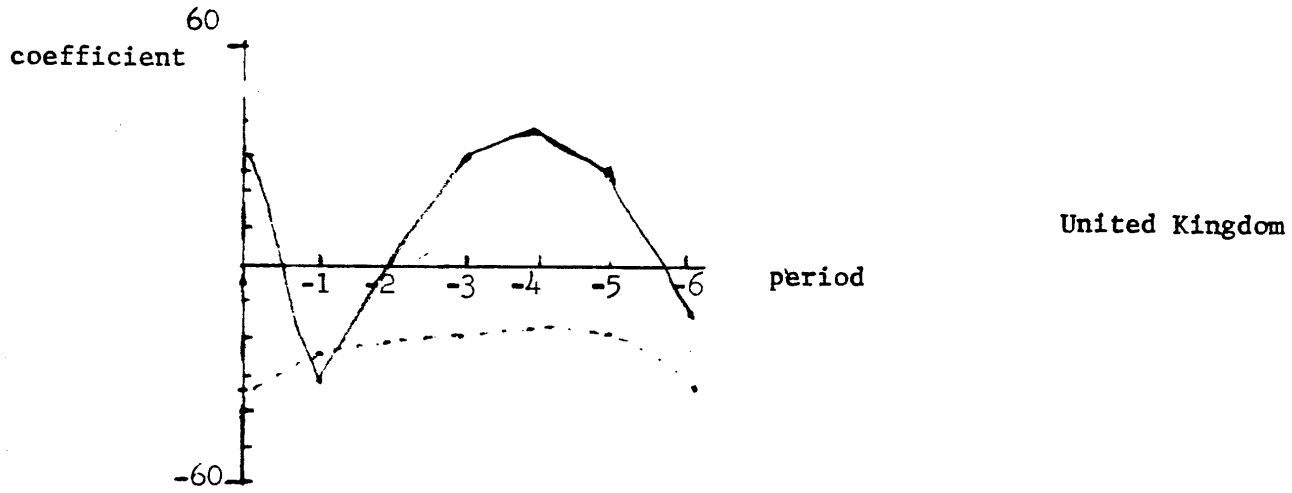
coefficient

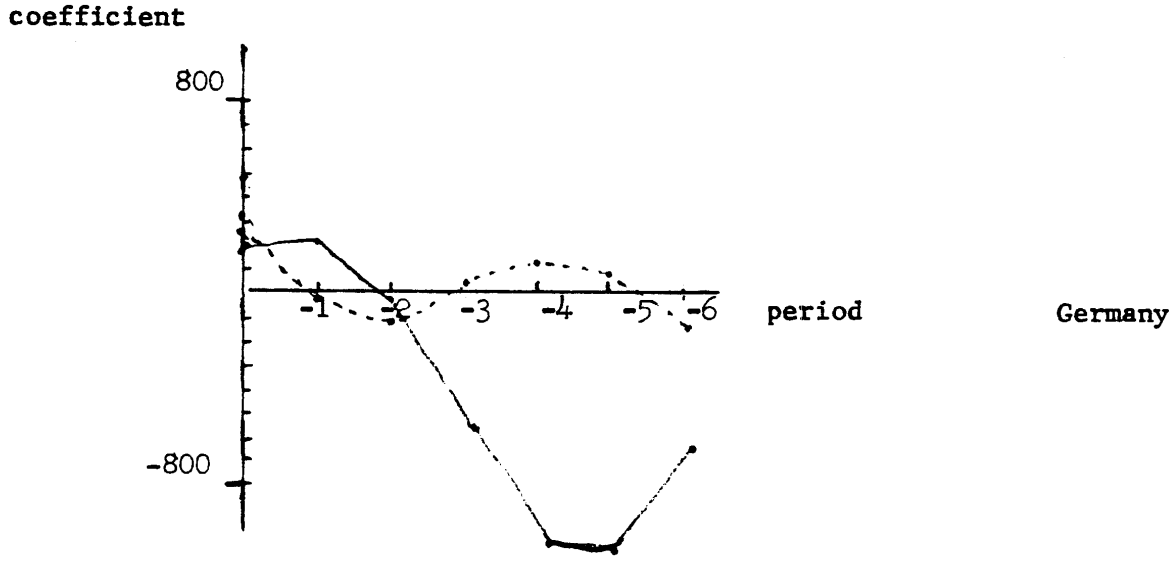


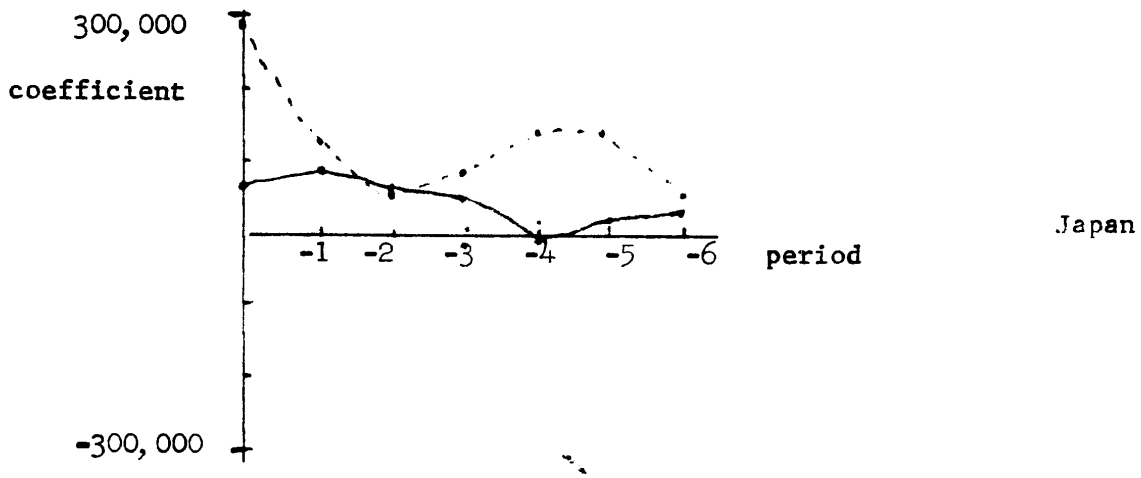
United States

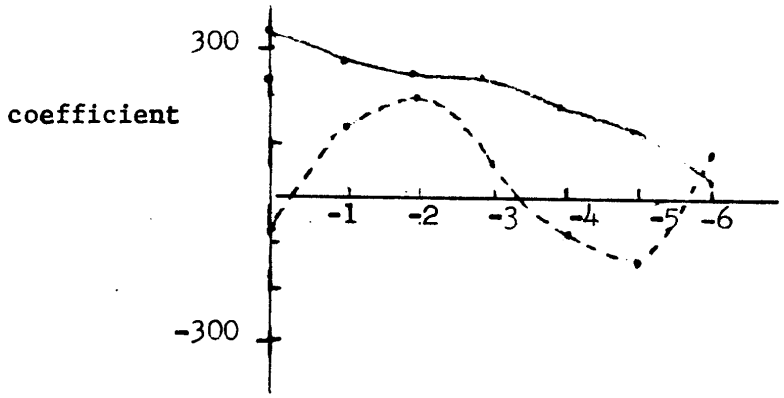
Legend: Solid line refers to inflation; dashed line refers to unemployment.

Estimates of the Lag Structure in Table 9



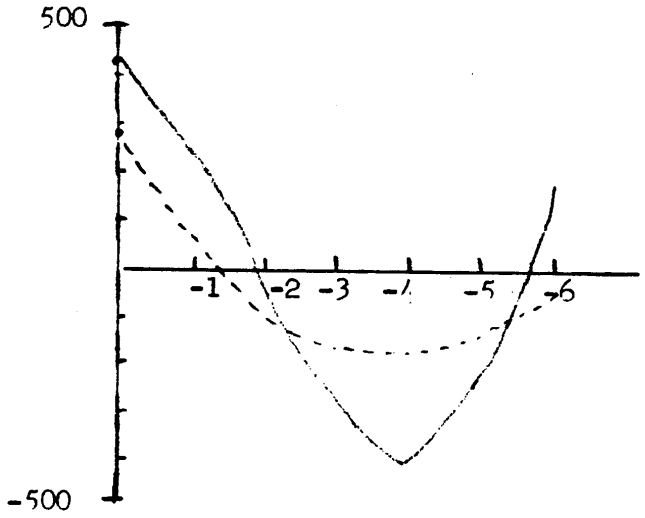






Canada

coefficient



United States

Legend: Solid line refers to inflation; dashed line refers to unemployment.

APPENDIX D

R^2 of Various Estimates of Variants of (1)

Variables Excluded	United Kingdom	Germany	Japan	Canada	United States
None	.9583	.9827	.9268	.9604	.9461
P*	.9546	.9773	.9085	.9573	.9302
P, P*	.9485	.9768	.9061	.9536	.9300
P, P*, U*	.9414	.9754	.9023	.9495	.9190
P, P*, U, U*	.9399	.9751	.9021	.9463	.9183
P*, U*	.9465	.9761	.9047	.9542	.9191
P*, U, U*	.9425	.9759	.9047	.9495	.9183
U*	.9520	.9823	.9259	.9571	.9333
U, U*	.9483	.9817	.9249	.9541	.9322

APPENDIX E

Data Sources

I. United Kingdom

The data on consumer prices, unemployment, income (and its distribution), and saving are from Economic Trends (various issues); liquid assets data are from Financial Statistics and Monthly Digest of Statistics, the rate of interest used is that on the undated 3-1/2 per cent war loan (from Bank of England Statistical Abstract and Quarterly Bulletin). Population data are from Monthly Digest of Statistics (linearly interpolated for quarterly observations).

The definition of liquid assets requires elaboration. The total identified liquid assets of the personal sector were used as gross assets. From this figure bank advances and hire purchase credit were subtracted to get net liquid assets, which were used as A in the estimates reported in this paper.

II. Germany

The data on consumer prices, unemployment, income and its distribution, and saving are from Statistische Beihefte zu den Monatsberichten der Deutschen Bundesbank, Reihe 4. Liquid assets are from DIW, Vierteljahrsheft. The rate of interest is the yield on "fixed interest securities" as reported in the Monthly Report of the Deutsche Bundesbank. Population data are from IMF, International Financial Statistics (interpolated).

The form of presentation of the data necessitated using property income net of tax. Gross liquid assets were used due to the lack of data on short-term consumer debt. The neglect of such debt

should not present a problem because German households make relatively little use of installment credit.[27]

III. Japan

Data on income (and its distribution) and saving are from Annual Report on National Income Statistics as are the data for the interest rate used -- the rate on 1 year time deposits. Unemployment rates are from the I.L.O.'s Bulletin of Labour Statistics. Prices and population (interpolated) are from International Financial Statistics. Liquid assets are from Flow of Funds Accounts in Japan and Economic Statistics Monthly. Net liquid assets were defined as currency plus current deposits plus short term and time deposits minus trade credit received. (Most of the Japanese data had to be seasonally adjusted using the X-11 program).

IV. Canada

Income, its distribution, and saving are from Statistics Canada, National Income and Expenditure Accounts. Unemployment, prices, and the rate of interest (government of Canada average bond yield 10 years and over) are from Canadian Statistical Review. Population is interpolated from International Financial Statistics. Data on liquid assets are taken from Financial Flow Accounts, where net liquid assets are currency and bank deposits plus deposits in other institutions minus consumer credit received.

V. United States

Data for income and its distribution, and saving are from the U.S. national income accounts (as reported on the FRB macro data library). The rate of interest (long term government bond yields), consumer prices, and population (interpolated) are from International Financial Statistics. The unemployment rate is from Business Statistics and Survey of Current Business. Net liquid assets are from the Federal Reserve Board's Flow of Funds Accounts and are defined as demand deposits and currency plus time and savings deposits minus installment consumer credit minus other consumer credit.

Footnotes

* International Finance Division, Federal Reserve Board. This paper represents the views of the author and should not be interpreted as reflecting the views of the Board of Governors of the Federal Reserve System or other members of its staff. I would like to thank Irene Cavanagh for her assistance and Dale Henderson and Larry Promisel for their helpful comments on an earlier draft of this paper.

1/ The literature on saving and consumption behavior is enormous and cannot be documented here. A useful summary of the literature can be found in Robert Ferber, "Consumer Economics, A Survey", Journal of Economic Literature, 11 (December 1973). Ferber's bibliography is especially valuable. In the discussion in this section of the paper, no attempt is made at tracing the origins of each of the various causal factors presented.

2/ The latest statement of his views are in George Katona, Psychological Economics, New York: Elsevier, 1975.

3/ In national income accounting, saving is usually defined as personal disposable income not spent on consumption expenditures. Consumption expenditures include such items as consumer durables purchases, even though such purchases are a form of saving.

4/ The wealth effect has a long history in economics. In the United Kingdom, the effect of inflation on wealth and, hence, the saving rate was forcefully pointed out by John Forsyth in the September 9, 1975 Morgan Grenfell Economic Review (London). Subsequently, J.C. Townsend in the March 1976

Bank of England Quarterly Bulletin reported evidence supporting the hypothesis that the real value of liquid assets is negatively related to the personal saving rate.

5/In cases of severe excess demand a decrease in labor supply and hence income would also be likely to occur and thus the resulting effect on the personal saving rate is, a priori, indeterminate. However, for less severe cases the entire spillover would probably be in the form of saving. See David H. Howard, "Rationing, Quantity Constraints, and Consumption Theory," Econometrica, forthcoming, for a discussion of these spillover effects and David H. Howard, "The Disequilibrium Model in a Controlled Economy: An Empirical Test of the Barro-Grossman Model," American Economic Review, forthcoming, for a test of the existence and size of such effects.

6/ In the permanent income hypothesis, the saving rate concept used is not the usual national income account definition that includes consumer durable purchases as consumption.

7/But cf. Martin J. Bailey, "Saving and the Rate of Interest", Journal of Political Economy, 65 (August 1957).

8/In addition to the above-mentioned factors, demographic factors, such as the proportion of the population over retirement age, can affect the saving rate. Although demographic factors are potentially important in explaining cross-country differences or secular trends, they are probably not important in explaining movements in the quarterly data, particularly the recent upsurge in saving rates.

(Normally, demographic factors do not change rapidly.) A recent study has failed to find any evidence of a direct connection between variations in average household size or in age distribution of the population and aggregate consumption. See Frank T. Denton and Byron C. Spencer, "Household and Population Effects on Aggregate Consumption." Review of Economics and Statistics, 58 (February 1976).

9/H.S. Houthakker and Lester D. Taylor, Consumer Demand in the United States: Analyses and Projections, 2nd ed., Cambridge: Harvard University Press, 1970. Lester D. Taylor, "Saving Out of Different Types of Income", Brookings Papers on Economic Activity, 2: 1971. The more recent studies are: F. Thomas Juster and Paul Wachtel, "A Note on Inflation and the Saving Rate," Brookings Papers on Economic Activity, 3: 1972, and F. Thomas Juster and Lester D. Taylor, Towards a Theory of Saving Behavior," American Economic Review, 65 (May 1975).

10/See Taylor, "Saving Out of Different Types of Income," p. 390; Juster and Wachtel, "Inflation and the Saving Rate," p. 774; Houthakker and Taylor, Consumer Demand, p. 290; and Juster and Taylor, "Saving Behavior," p. 206.

11/Juster and Taylor, "Saving Behavior," p. 204, with interest rate added to be consistentwith p. 206.

12/E.g., A. Zellner, D.S. Huang, and L.C. Chau, "Further Analysis of the Short-Run Consumption Function with Emphasis on the Role of Liquid Assets," Econometrica, 33 (July 1965).

In Susan W. Burch and Diane Werneke, "The Stock of Consumer Durables, Inflation, and Personal Saving Decisions," Review of Economics and Statistics, 57 (May 1975) the stock of net financial assets -- including equities -- is used and a negative relation is found between it and saving. The stock of liquid assets rather than net financial assets is used here because some of the countries here do not publish such data and because it is not clear whether or not unrealized short-run capital gains on equities should be included in household wealth. Some regressions run on those countries where such data are readily available revealed either that the choice seems to make little difference or that liquid assets have more explanatory power. The level of liquid assets is more likely than the level of other assets to have a close relation with short-run saving decisions because the level of such assets is more easily adjusted in the short-run than is the level of other assets. In addition, the wealth effect of inflation is highlighted by looking at its effect on the real value of liquid assets.

13/Alternatively, one could substitute (3) into (2) and estimate the resulting

$$(2') \quad SR = \gamma_1 + \alpha\frac{1}{Y} + \beta\frac{A}{Y} + (\gamma_2-\gamma_1)\frac{PROP}{Y} + (\gamma_3-\gamma_1)\frac{TR}{Y} + (\gamma_1+\gamma_4)\frac{SS}{Y}$$
$$+ (\gamma_1+\gamma_5)\frac{T}{Y} + \delta_1\frac{R}{Y} + \delta_2\frac{P}{Y} + \delta_2^*\frac{P^*}{Y} + \delta_3\frac{U}{Y} + \delta_3^*\frac{U^*}{Y} + \delta_4\frac{g}{Y}.$$

The individual γ's can then be easily calculated. Such an operation would remove the collinearity problem but not the problem of interpreting the coefficients, unless one is willing to assume all changes are at the expense of labor income (or any one type of income). If the latter

is actually the case, the coefficients of (2)' are used without translating them into the individual γ's of (2). See Appendix B to this paper for estimates of (2'). As is readily seen, the point estimates are broadly similar to those in Table 1, but the R^2 are substantially lower.

14/Juster and Wachtel, "Inflation and the Saving Rate".

15/John A. Carlson and Michael Parkin, "Inflation Expectations," Economica, 42 (May 1975).

16/Robert J. Shiller, "A Distributed Lag Estimator Derived from Smoothness Priors," Econometrica, 41 (July 1973).

17/Juster and Wachtel, "Inflation and the Saving Rate."

18/The formulae used in the tables are derived as follows: As an example, consider the change in the saving rate brought forth by a change in the rate of inflation. From equation (1) it is known that,

$$\frac{\delta S}{\delta P} = \delta_2.$$

This means that for a small change in the rate of inflation, call it η, there is a change of $\delta_2\eta$ in saving. Since income is unchanged, the new saving rate is $(S + \delta_2\eta)/Y$ and

$$\frac{\Delta \sigma}{\Delta P} = \frac{\delta 2}{Y},$$

where σ denotes the saving rate. It is readily seen that the change in the saving rate with respect to A, R, P*, U, U*, or g are analogous to that with respect to P. The effect of a change in a component of personal disposable income is a slightly different case, because both saving and income are affected. For example, consider a small change in labor income. It can be shown that

$$\frac{\Delta \sigma}{\Delta LAB} \approx \frac{(\gamma_1 - \sigma)}{Y}$$

The changes in the saving rate in response to a change in property income or transfers are analogous. Changes in saving rate with respect to changes in social security contributions or taxes are slightly different because an increase in either of these variables decreases income. Thus, for example,

$$\frac{\Delta\sigma}{\Delta T} \approx \frac{(\gamma_5 + \sigma)}{Y}.$$

The effects of changes in income distribution are easily calculated. For example, if $\Delta LAB = -\Delta PROP$ then,

$$\frac{\Delta\sigma}{\Delta LAB} = \frac{(\gamma_1 - \gamma_2)}{Y}.$$

The formulae for elasticities are derived by multiplying the above formulae by the ratio of the relevant independent variable to the saving rate. Again taking the inflation rate as an example,

$$\epsilon_{\sigma,P} = \frac{\delta_2 P}{S},$$

where $\epsilon_{\sigma,P}$ denotes the elasticity of the saving rate with respect to the rate of inflation.

19/The above argument is an extension of that made in F. Thomas Juster and Paul Wachtel, "Inflation and the Consumer," Brookings Papers on Economic Activity, 1: 1972, p. 88.

20/The average personal saving rates over the sample periods are: United Kingdom: .0935; Germany: .1336; Japan: .1968; Canada: .0654; and United States: .0668.

21/It turns out that all of these significant marginal propensities to save are also significantly greater than the average propensity to save. The test statistic used is $(\sigma/\hat{\gamma} + t_{.05}/t)$; if this statistic is less than one, $\hat{\gamma}$ and σ are significantly different. The interested reader can apply this test to the results presented in other tables of the paper.

22/ See also Warren E. Weber, "Interest Rates, Inflation, and Consumer Expenditures," American Economic Review, 65 (December 1975), for the same result for the United States. Various other U.S. interest rate series were tried -- with similar results. In some of these cases the current rate of inflation had a positive coeffficient with a t-statistic exceeding 2.

23/ A γ_1 higher in Japan than in the other countries makes sense given conventional wisdom as to Japanese labor's saving habits, particularly with regard to the semiannual bonuses. What does not make sense is a γ_1 in excess of one.

24/ In these tests, degrees of freedom were calculated in the usual manner, not as in Table 1 and Appendix B where account was taken of the "pseudo observations" involved in the Shiller estimating procedure.

25/ Evaluated at mean values.

26/ Nominal interest rates tended upward over the sample period, but, since it is difficult to say what happened to inflation expectations, it is not possible to calculate the effects of any changes in real rates of interest. But even a decrease of one percentage point in the real rate would raise the saving rate by less than one percentage point. Thus, real interest rate effects are ignored here.

27/ Burkhard Strumpel, "Saving Behavior in Western Germany and the United States," American Economic Review, 65 (May 1975).

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