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INFLATION AND THE ACCUMULATION OF ASSETS IN PRIVATE PENSION FUNDS

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Private pensions are a major source of U.S. capital formation. The annual growth of private pension reserves, one definition of pension saving, averaged about 25 percent of personal saving during the decade ending in 1975. Annual employer contributions to private pensions have increased (in 1972 dollars) from $3 billion in 1940 to $21 billion in 1975. [1/]

This paper examines the effect of inflation on private pension saving. The role that private pensions can or should play in providing income in old age in the current inflationary environment is an important policy issue. A number of studies have discussed the effect of inflation on pensions. [2/] This study extends the existing analysis and presents the first empirical estimates. Inflation is seen to have a large negative effect on this aspect of retirement saving by workers.

In the first section, a simple model of private pension saving is presented. In the second section, inflation is incorporated into this model. In the third section, the model is extended to include what are called nonbehavioral effects of inflation. In the fourth section, the regression model is specified, and in the fifth section the regression results are analyzed.

I. Private Pension Saving

Pension assets $PA_{t,k}$ in period t for individual k can be defined in real terms as the expected present value of accumulated future real retirement benefits

$$PA_{t,k} = \sum_{j=t}^{\infty} \frac{B_{j,k}B_{j,k}}{(1+r)^{j-t}} \tag{1}$$

where $P_{j,k}$ is the probability that on the basis of accumulated earned pension benefit rights, real pension benefits $B_{j,k}$ will be received in period j. The variable r is the real interest rate. Pension saving $PS_{t,k}$ for a worker can be defined as the first difference of his pension assets (measured at year's end)

$$PS_{t,k} = PA_{t,k} - PA_{t-1,k} \quad . \tag{2}$$

Most pension plans are defined benefit plans where benefits at the point of retirement are determined by a benefit formula usually based on some combination of years of employment and earnings. Since earnings are generally not indexed for inflation in pension benefit formulas, benefits at retirement decline in real value with inflation unless an inflation adjustment is made. During retirement, indexation of benefits is generally far from complete.

Whatever the benefit formula, the inflation adjustment of future pension benefits for currently employed workers can be viewed as an aspect of equalizing differentials in the labor market.[3/] Private pension contributions are made primarily by employers rather than employees. With equalizing differentials, the employee "pays" for at least part of the employer's contribution by accepting a lower wage. If future pension benefits are not adjusted for inflation, the real compensation of workers decreases unless nonpension compensation is increased. If inflation makes it more costly to provide pension benefits, the employer will decrease the marginal rate of substitution between pension benefits and wages in compensation determination when there is expected inflation. Workers (or unions) then react to this relative price change. While the firm bears some risk to real pension benefits with unexpected inflation, workers doubtlessly share that risk. For these reasons pension saving can be analyzed as an aspect of worker saving decisions.

The effect of inflation on pension saving is analyzed within the framework of a stock adjustment model. Individuals are assumed to save in pensions in order to adjust their actual pension assets PA to their desired pension assets PA'. Retirement income is provided by social security wealth SSW and other retirement wealth OW as well as by pension assets. Desired retirement assets RA' are defined as the sum of social security wealth desired pension assets and desired other retirement wealth

$$RA' = SSW + PA' + OW'. \tag{3}$$

Desired retirement assets are determined in this simple model by permanent income YP and by features SS of social security such as the earnings test that induce retirement

$$RA' = \alpha_o + \alpha_1 YP + \alpha_2 SS \tag{4}$$

The ratio of desired pension wealth to desired other retirement wealth is a function of their real rates of return r_{PA} and r_{ow} so that desired other retirement wealth can be written as

$$OW' = \Gamma (r_{ow} - r_{PA})PA'. \tag{5}$$

Combining equations (5) and (3) and equating with (4) yields

$$SSW + [1 + \Gamma (r_{ow} - r_{PA})] PA' = \alpha_o + \alpha_1 YP + \alpha_2 SS . \tag{6}$$

Solving for desired pension wealth PA' gives the following nonlinear relationship

$$PA' = \frac{1}{1 + \Gamma (r_{ow} - r_{PA})} [\alpha_o + \alpha_1 YP + \alpha_2 SS - SSW]. \tag{7}$$

To facilitate the derivation of a simple estimable relationship desired pension assets are expressed as a linear approximation to equation (7) (the first term of a Taylor series expansion)

$$PA' = \phi_o + \phi_1 YP + \phi_2 SS + \phi_3 SSW + \phi_4 (r_{ow} - r_{PA}). \tag{8}$$

Pension saving is determined by a partial adjustment of actual to desired pension assets

$$PS = \lambda[PA' - PA_{-1}]. \tag{9}$$

The parameter λ is the partial adjustment coefficient which is assumed to be constant. One source of adjustment costs is the institutional setup whereby, probably for tax reasons, most pension contributions are made by employers rather than employees.

Using equations (8) and (9), a pension saving equation can be determined

$$PS = \lambda[\phi_o + \phi_1 YP + \phi_2 SS + \phi_3 SSW + \phi_4 (r_{ow} - r_{PA}) - PA_{-1}]. \tag{10}$$

Equation (10) provides a lagged adjustment model of pension saving.

II. Pension Saving and Inflation

Since private pension funds are financial intermediaries, inflation affects them indirectly through its effect on the assets in which they invest. Inflation also affects pensions directly through its effect on the tax treatment of pensions. Thus inflation may affect the real rate of return on pension assets and it may also affect the comparison of real after-tax rates of return on various assets.

(i) The Real Rate of Return

The real rate of return on pension assets r_{PA} is a function of the real after-tax rates of return r_i on the assets in pension fund portfolios

$$r_{PA} = R(r_1, r_2, \ldots, r_n). \tag{11}$$

Inflation may lower r_{PA} by lowering the rates of return on assets held by pension funds.

Corporate equities and corporate bonds are the two major assets held by pension funds. Aspects of the income tax system may cause inflation to lower the after-tax rates of return on these assets. Valuing inventories at historical prices creates spurious "inventory profits" for corporations because the cost of these inventories is understated. Valuing depreciation at historical cost understates the current value of that cost. The overstatement of profits by these accounting procedures raises real business income tax liabilities and causes inflation to lower after-tax real rates of return on corporate equities for most nonfinancial businesses (Tideman and Tucker, 1976). Thus, the tax treatment of corporate equities tends to lower the real rate of return on pension assets.

The tax treatment of corporate bonds may raise the real rate of return on corporate equities and thus on pensions. Tax laws treat the inflation premium on nominal interest rates as an increase in real interest rates. Since most nonfinancial firms are debtors, this raises their real interest deductions and lowers their real income tax liability. However, holders of corporate bonds who are taxed find their real after-tax rate of return declining and thus may require an additional premium on corporate bonds to compensate for their tax losses due to inflation.

Private pensions also may be directly affected by their holdings of corporate bonds. Private pensions as holders of corporate bonds are net creditors. The real rate of return on pension fund holdings of corporate bonds declines (rises) when the nominal rate of return on corporate bonds does not fully adjust for inflation as when inflation is higher (lower) than expected. Thus the real rate of return on pension assets may also be affected by inflation due to pension funds being net creditors. [4/]

(ii) After-tax Rates of Return

The special tax treatment of private pensions causes inflation to affect their after-tax rates of return relative to assets not receiving similar tax treatment. The earnings on pension assets are not taxed as they accrue but are only taxable when they are distributed which may be many years later. Many pensioners pay low marginal tax rates or pay no income taxes at all because of their low taxable income in retirement. Since personal income taxes treat the inflation premium on rates of return as an increase in real rates, real after-tax rates of return on taxed assets may be lowered during inflationary periods.

The postponement, and for some individuals the elimination, of personal income taxes on pension benefits increases the real after-tax rate of return on pension assets relative to assets with earnings which are taxed as they accrue. With inflation, the effect of these tax preferences for pensions is increased since many assets not enjoying these preferences are taxed more heavily. Thus, the tax treatment of pensions may cause inflation to have a positive effect on pension saving.

Recognizing the various effects of inflation and marginal income tax rates on rates of return, the following substitution in equation (10) is made

$$r_{ow} - r_{PA} = f(\pi, \text{MTR}) = \beta_o + \beta_1 \pi + \beta_2 \text{MTR}. \tag{12}$$

The variable π is the rate of inflation and MTR is a measure of personal marginal income tax rates. Pension saving (equation 10) can thus be written

$$PS = \lambda[\phi_o' + \phi_1 \text{YP} + \phi_2 \text{SS} + \phi_3 \text{SSW} + \phi_5 \pi + \phi_6 \text{MTR} - PA_{-1}] \tag{13}$$

Equation (13) constitutes Model I, and it is the simplest of three models presented concerning inflation and pension saving.

III. Inflation and Capital Gains

The effect of inflation on pension saving through a behavioral adjustment was discussed in the previous section. This behavioral adjustment occurs if anticipated inflation causes desired pension assets at the end of the period to differ from initial pension assets. Inflation may also cause nonbehavioral pension saving. Nonbehavioral saving is defined as the residual saving when benefits and contributions in a year are set at zero or equal to each other. Thus this saving is due solely to capital value changes and pensions asset income. This saving occurs with zero or low adjustment cost.

The term "nonbehavioral" is qualified in its use here. When inflation is anticipated, pension asset income and capital value changes may be affected by substitution within pension fund portfolios. Such substitution would be towards assets that provide a better hedge against inflation. In any period, however, there presumably would only be a partial adjustment of the actual to the desired pension fund portfolios. With unanticipated inflation, and with incomplete pension fund portfolio adjustment to anticipated inflation, describing some aspects of saving as nonbehavioral may be analytically useful. The key distinguishing feature of nonbehavioral saving is that it is a change (perhaps undesired) in pension assets that occurs with substantially lower adjustment costs than changes that occur through altering contributions or benefits.

Non-behavioral saving is discussed first without and second with the effect of inflation. Then the model is extended to incorporate effects of pension fund portfolio composition which may be important for empirical estimation. This section concludes with a presentation of the full lagged adjustment model with nonbehavioral effects.

(i) Nonbehavioral Effects Without Inflation

To demonstrate nonbehavioral effects on pension saving, assume for simplicity that there are no behavioral effects (contributions and benefits are zero). Let r^*_{PA} be the zero inflation real rate of return on pension assets ($r^*_{PA} = r_{PA} - \frac{\pi \partial r_{PA}}{\partial \pi}$). With no inflation, nonbehavioral pension saving PS^{NB} would equal

$$PS_t^{NB} = PA_t - PA_{t-1} = (1+r^*_{PA})\ PA_{t-1} - PA_{t-1} \tag{14}$$

$$= r^*_{PA} PA_{t-1} \tag{15}$$

It is assumed that reinvestment of pension asset income is costless. Pension asset income is automatically reinvested until retirement. Pension saving brought about by changes in contributions or benefits is assumed to be costly.

(ii) Nonbehavioral Effects with Inflation

Now consider nonbehavioral effects when there is inflation. Assume the nominal rate of return excluding capital gains on pension assets $i_{PA} = (1+r_{PA})(1+\pi) - 1$ adjusts by $\Pi \frac{\partial i_{PA}}{\partial \pi} = \pi \bar{i}_{PA}$

($=\frac{\pi \partial r_{PA}}{\partial \pi} + \pi.$ cross-product term ignored). An overline indicates the partial derivative with respect to inflation ($\bar{X} = \frac{\partial X}{\partial \pi}$). This adjustment is the sum of a) a change in r_{PA} the real rate of return on pension assets ($\pi \frac{\partial r_{PA}}{\partial \pi}$ is probably negative as discussed in the previous section); and b) an inflation premium on the real rate of return.

To allow for nominal capital value changes, let the change in the nominal price P_{PA} of pension assets by represented by $\pi \frac{\partial P_{PA}}{\partial \pi} = \pi \bar{P}_{PA}$. Then, ignoring cross-product terms and using the approximation $1-\pi = \frac{1}{1+\pi}$, real nonbehavioral pension saving PS_t^{NB} can be written as

$$PS_t^{NB} = \frac{(1+r^*_{PA})(1+\pi_t \bar{i}_{PA})\, PA_{t-1}\, (1+\pi_t \bar{P}_{PA})}{1+\pi_t} - PA_{t-1} \tag{16}$$

Again, ignoring cross-product terms, this equals

$$PS_t^{NB} = (1 + r^*_{PA})\, PA_{t-1} + (\bar{i}_{PA} + \bar{P}_{PA} - 1)\, \pi_t\, PA_{t-1} - PA_{t-1} \tag{17}$$

which can be be rewritten as

$$PS_t^{NB} = r^*_{PA}\, PA_{t-1} + (\bar{i}_{PA} + \bar{P}_{PA} - 1)\pi_t \; PA_{t-1} \tag{18}$$

Nonbehavioral pension saving under inflation can be divided into four components: (1) saving that would occur in the absence of inflation ($r^*_{PA}\ PA_{t-1}$), (2) saving due to the increase in the nominal rate of return on pension assets ($\bar{i}_{PA}\ \pi_t PA_{t-1}$), (3) saving due to the change in the nominal price of pension assets ($\bar{P}_{PA}\ \pi_t\ PA_{t-1}$), and (4) dissaving due to real capital losses on pension assets ($-\pi_t PA_{t-1}$). If pension assets are fully indexed ($\bar{i}_{PA} + \bar{P}_{PA} = 1$), nonbehavioral saving is $r^*_{PA}\ PA_{t-1}$ as in the case of no inflation. If there is no indexing ($\bar{i}_{PA} + \bar{P}_{PA} = 0$), nonbehavioral pension saving is $(r^*_{PA} - \pi_t)\ PA_{t-1}$.

(iii) Pension Fund Portfolio Composition

The preceding discussion assumed that the portfolio composition of assets held by pension funds was unimportant. It is plausible, however, that some assets are more adversely affected by inflation than others. For instance, if corporate equities were more adversely affected by inflation than other assets, then the negative nonbehavioral effect of inflation on pension saving would increase with the share of corporate equities in the portfolios of pension funds. If that were the case, when inflation is anticipated, portfolio readjustments would also occur which would tend to mitigate that effect.

To allow for an effect of pension fund portfolio composition, pension assets are separated into corporate equities CE and noncorporate equities NCE(- PA-CE) with nominal rates of return of i_{CE} and i_{NCE} and real rates of return in the absence of inflation of r^*_{CE} and r^*_{NCE} .

Following from equation (18), pension saving can be written as

$$PS_t^{NB} = r^*_{CE} CE_{t-1} + (\bar{i}_{CE} + \bar{P}_{CE} - 1)\pi_t \, CE_{t-1}$$
$$+ r^*_{NCE} (PA_{t-1} - CE_{t-1}) + (\bar{i}_{NCE} + \bar{P}_{NCE} - 1)\, \pi_t \, (PA_{t-1} - CE_{t-1}) \tag{19}$$

In this model, there are the 4 nonbehavioral effects for each type of asset. An alternative and perhaps more enlightening analysis is provided by rearranging terms

$$PS_t^{NB} = a_1 \, PA_{t-1} + a_2 \, CE_{t-1} + a_3 \, \pi_t \, PA_{t-1} + a_4 \, \pi_t \, CE_{t-1} \tag{20}$$

$$a_1 = r^*_{NCE} \qquad a_3 = \bar{i}_{NCE} + \bar{P}_{NCE} - 1$$

$$a_2 = r^*_{CE} - r^*_{NCE} \qquad a_4 = \bar{i}_{CE} - \bar{i}_{NCE} + \bar{P}_{CE} - \bar{P}_{NCE}$$

This form, which is convenient for estimation, collapses the 8 nonbehavioral effects of equation (19) into 4 terms. The coefficient a_1 is the real rate of return on pension assets other than corporate equities when there is no inflation and is presumably positive. The coefficient a_2 is the differential real rate of return between corporate equities and other assets when there is no inflation, and it is positive if the real rate of return on corporate equities is higher than that on other assets. The coefficient a_3 is a measure of the degree of inflation indexing of pension assets other than corporate equities and it is negative if those assets are not completely indexed. The coefficient a_4 is the differential inflation adjustment of corporate equities and other assets and it is negative if corporate equities provide a relatively poor hedge against inflation.

(iv) Lagged Adjustment with Nonbehavioral Effects

The lagged adjustment model can be extended in the following manner to incorporate nonbehavioral effects PS_t^{NB}

$$PS_t = PS_t^{NB} + \lambda(PA_t' - \tilde{PA}_t) \tag{21}$$

where

$$\tilde{PA}_t = PA_{t-1} + \delta PS_t^{NB} \tag{22}$$

With no behavioral effects, the adjustment parameter λ would be zero and pension saving would equal nonbehavioral saving. The parameter δ in equation (22) is the fraction of nonbehavioral saving that is anticipated at the beginning of the period. The variable $\tilde{PA}$ thus is the amount of pension assets the individual anticipates having at the end of the period if he makes no behavioral adjustment. The individual then bases his behavioral adjustment on the difference between his desired pension assets PA' and his anticipated pension assets if he were to do nothing $\tilde{PA}$.

It should be noted that pension saving is not simply the sum of behavioral and nonbehavioral saving but that nonbehavioral saving enters in a more complicated way because of its effect on behavioral saving. If nonbehavioral saving were perfectly anticipated ($\delta=1$) and if full adjustment occurred each period ($\lambda=1$), nonbehavioral saving would have no effect on pension saving, being exactly offset by changes in behavioral saving.

There are 3 basic effects of inflation on pension saving in this lagged adjustment model. First, anticipated inflation may affect desired pension assets as described in Section II. Second, inflation (anticipated or unanticipated) may have a direct nonbehavorial effect on pension saving [the first term in equation (21)].

Third, anticipated inflation may affect anticipated pension assets $\widetilde{PA}$ by anticipated nonbehavioral saving (δPS_t^{NB}). This change in $\widetilde{PA}$ would affect pension saving by influencing the behavioral adjustment of anticipated to desired pension assets. The nonbehavioral effects can be further decomposed as discussed previously.

Using the partial adjustment model of equations (21) and (22), pension saving can now be written

$$PS_t = (1-\delta\lambda)\ PS_t^{NB} + \lambda(PA_t' - PA_{t-1}) \quad . \tag{23}$$

Substitution from equations (13) and (18) yields pension saving model (Model II) with nonbehavioral effects

$$\begin{aligned} PS_t = {} & (1-\delta\lambda)[(r^*_{PA}-\lambda)\ PA_{t-1} + (\bar{i}_{PA}+\bar{P}_{PA}-1)\ \pi_t\ PA_t] \\ & + \lambda(\phi_0+\phi_1\ YP_t + \phi_2\ SS_t + \phi_3\ SSW_t + \phi_5\ \pi_t + \phi_6\ MTR_t) \end{aligned} \tag{24}$$

An implcation of this model is that an insignificant coefficient on lagged pension assets [as found in Munnell (1979)] does not imply that all other coefficients should be zero as is the case in the simple lagged adjustment model (model I).

Substituting from equations (13) and (20, yields the full model (Model III) incorporating both nonbehavioral and portfolio composition effects

$$\begin{aligned} PS_t = {} & (1-\delta\lambda)[(a_1 - \frac{\lambda}{(1-\delta\lambda)})\ PA_{t-1} + a_2\ CE_{t-1} + a_3\pi_t PA_{t-1} + a_4\pi_t CE_{t-1}] \\ & + \lambda[\phi_0,+\phi_1\ YP_t+\phi_2\ SS_t + \phi_3\ SSW_t + \phi_5\ \pi_t + \phi_6\ MTR_t] \quad . \end{aligned} \tag{25}$$

Equation (25) provides a pension saving model where general nonbehavioral effects are included.

IV. Regression Specification

A least squares regression analysis of time series data on private pension saving is presented. Data on two different definitions of pension saving are used. Hypotheses concerning the effects on pension saving of inflation, personal income taxes, social security, and other variables are tested. All monetary variables are measured in (thousands of) per capita dollars, and the data sources are provided in the Appendix.

Net pension saving PS is defined empirically as the first difference in pension assets measured at book value in constant dollars. Definition PS includes realized capital gains or losses Z and changes in real book value V .[5/] This definition is equivalent to

$$PS = C + i_{PA} PA_{-1} + Z - B - E + V \tag{26}$$

where C is the pension contributions of employers and employees, B is benefit payments, and E is administrative expenses. This series is based on a standard empirical definition of pension assets, and it has been used in earlier studies.[6/] The change in the aggregate unfunded pension liability is unknown but may affect the estimated coefficients and standard errors in the pension saving regressions.

Pension saving is also defined both net and gross of dissaving through benefit payments. Gross pension saving is the saving that occurs for covered workers and it exceeds net pension saving by the total of benefit payments.

$$PS\ gross = PS\ net + Benefits. \tag{27}$$

Gross pension saving is the definition used in the theoretical section where dissaving by beneficiaries is not considered. Net pension saving is the definition of relevance for capital formation since it measures the contribution of pensions to capital formation.

The partial adjustment model of equation (25) is used for the specification of the regressions. Permanent income variables used are disposable income YD and lagged disposable income YD_{-1}.[7/] Disposable income is expected to have a positive coefficient, while lagged disposable income is expected to have a negative coefficient.[8/]

Both the social security wealth SSW and retirement effects SS of social security can be represented empirically by social security wealth[9/] and the estimated coefficient of this variable is thus ambiguous. The wealth effect of social security on pension saving would be negative or zero depending on whether social security transfers raise permanent income above what it would be in a system with only non-social security intergenerational transfers (see Barro 1974). The early retirement effect of social security on pension saving is positive, the earnings test and possibly other aspects of social security induce retirement and thus a need for greater retirement income.[10/] Social security wealth may affect the portfolio composition of saving, having a larger effect on assets which are close substitutes such as pension assets. In 1974, 25 to 30 percent of pension plan participants were in plans that were integrated with social security (Schmitt 1974, p. 174) so that increases in social security benefits automatically caused a reduction in employer contributions and hence pension saving.

The marginal income tax rate MTR may have a positive effect on pension saving because of tax preferences to private pensions.[11/] The marginal income tax rate does not affect the after-tax rate of return on pension assets but by lowering the after-tax rate of return on assets not enjoying these preferences it may affect the composition of saving. Lagged pension wealth is expected to have a negative coefficient based on the lagged adjustment model of equation (13) but the exact interpretation of the coefficient depends on nonbehavioral effects and its sign could be positive.

The maturity of the pension system MAT is expected to have a negative effect on net pension saving because of increased total benefit payments to the rising number of beneficiaries. It can be measured by the ratio of beneficiaries to covered workers.

In the previous sections, both positive and negative effects of inflation on pension saving have been discussed. While previous analyses have stressed negative effects (see footnote 2), the theory presented here does not yield an unambiguous prediction.

The specification for the net pension saving regression (ignoring nonbehavioral effects) is

$$\begin{aligned} PS = b_o + b_1\, YD + b_2\, YD_{-1} + b_3\, SSW \\ + b_4\, \pi + b_5\, MAT + b_6\, MTR + b_7\, PA_{-1} + u . \end{aligned} \qquad (28)$$

The specification for the gross pension saving regressions without nonbehavioral effects is the same except the maturity variable is not included. Specifications with nonbehavioral effects are discussed later.

V. Regression Results

The regression results are analyzed in this section. The sample period begins in 1951 because annual data for PS are not available for earlier years. The sample period ends in 1974 so as to exclude the effect of the Employee Retirement Income Security Act (ERISA).

The main result from the regressions displayed in Table 1 is that inflation has a large negative effect on private pension saving. This result is found using different specifications. The results are similar using either the net or gross definition of pension saving. For this reason, and because the pension system maturity variable in the net specification is insignificant, generally only the regressions for the gross definition of pension saving are shown.

Three different models of the effect of inflation on pension saving are estimated. Model I is the simple lagged adjustment model of equation (13) which does not consider nonbehavioral effects. Model II is based on equation (19) and includes nonbehavioral effects but does not consider the possible effect of portfolio composition. Model III is the full model found in equation (25) which incorporates both nonbehavioral and portfolio composition effects.

Model I

In Model I [regressions (1.1) and (1.2)], inflation has a significantly negative effect. This effect is robust with respect to small changes in sample period. The inflation rate was relatively high during the two years 1973-74 which were years of large pension dissaving. When those two years are dropped from the sample, the estimated coefficients (not shown) for the inflation rate retain their significance but decline in magnitude by about 17 percent.

While these results must be regarded as preliminary and are subject to the usual caveats applicable to time series regressions,

Table 1.--Pension Saving Regressions, 1951-74

Model I: $\pi_1 = \pi$

Model IIA: $\pi_1 = \pi$, $\pi_2 = \pi\ PA_{-1}$

Model IIB: $\pi_1 = \pi$, $\pi_3 = PS^{NB}$

Model III: $\pi_1 = \pi$, $\pi_2 = \pi\ PA_{-1}$, $\pi_4 = \pi\ CE_{-1}$, $\pi_5 = CE_{-1}$

Eq.	Pension Saving Definition	YD	YD_{-1}	SSW	π_1	π_2	π_3	π_4	π_5	MAT	MTR	PA_{-1}	C	$\bar{R}^2$	DW
1.1	PS gross	.194 (2.52)	-.008 (.16)	-.034 (1.70)	-.005 (2.88)						-.002 (.81)	.091 (.99)	-.231 (1.35)	.73	1.77
1.2	PS net	.202 (2.56)	-.018 (.31)	-.041 (1.82)	-.005 (2.51)					.000 (.01)	-.002 (.59)	.107 (.86)	-.209 (1.07)	.69	1.76
2.1A	PS gross	.032 (.65)	-.114 (3.42)	-.011 (1.93)	.001 (.40)	-.028 (6.52)					-.002 (.98)	-.003 (.05)	-.238 (2.58)	.92	2.53
2.1B	PS gross	.223 (3.78)	-.051 (1.26)	-.032 (2.06)	-.003 (1.58)		.678 (3.67)				-.001 (.27)	.070 (.99)	-.285 (2.18)	.84	1.18
3.1	PS gross	.025 (.64)	.075 (2.26)	.006 (.57)	.001 (.17)	-.026 (1.08)		-.007 (.26)	-.120 (.76)		-.001 (.33)	-.021 (.20)	-.217 (2.10)	.94	2.30
3.2	PS gross	.051 (1.44)	.081 (2.62)	-.008 (1.12)		-.017 (2.96)		-.016 (2.29)			-.001 (.43)		-.239 (3.36)	.94	2.26

Note: $|t|$ statistics in parentheses, $\bar{R}^2$ adjusted for degress of freedom, DW is Durbin-Watson statistic.

it is interesting to examine the implication of the estimated parameter values for aggregate pension saving. Multiplying the estimated inflation coefficient [eq. (1.2)] by the inflation rate and population, these results imply that in 1974 inflation reduced pension saving by \$10 billion. This figure compares with net pension saving of -\$7 billion in that year (Appendix, Table 2). The extent that inflation caused an increase in the unfunded liability is unclear because the real liability presumably also decreased.

Model II

The effect of inflation on pension saving is further investigated in Model II regressions which incorporate nonbehavioral effects. In Model IIA, regression (2.1A), nonbehavioral effects are represented by the interaction of inflation with lagged pension assets [see equation (24)]. The plausible assumption is made that the multiplicative term $(1-\delta\lambda)$ is positive. In this specification, the linear term for inflation is not significant but the interaction of inflation with lagged pension assets is negative and highly significant. This result indicates that the magnitude of the negative effect of inflation on pension saving depends on the amount of assets held in pension funds.

The adjusted R^2 is considerably higher in regression (2.1A) than in the Model I regressions. The disposable income coefficient is, however, reduced to insignificance. This model can be interpreted as indicating that there are significantly negative nonbehavioral effects measured by the interaction term, but that behavioral effects, measured by the linear term for inflation, are unimportant.

In Model IIB, regression (2.1B), nonbehavioral pensions saving PS^{NB} is entered directly. The variable PS^{NB} is calculated as

$$PS^{NB} = PS\ net - C + B = i_{PA}\ PA_{-1} + Z + V \quad E \qquad (29)$$

In this regression, inflation is again insignificant in linear form and nonbehavioral pension saving is significantly positive. The adjusted R^2 is intermediate between Model I and Model IIA regressions and the Durbin-Watson statistic is low. The results for

the disposable income variables are closer to a priori expectations. Current disposable income is significantly positive, and lagged disposable income is insignificant. Social security wealth is significantly negative in this regression while it was negative but insignificant in the previous regressions. This regression has the weakness that it does not explicitly show the effect of inflation. However, when nonbehavioral pension saving was regressed on pension assets and inflation interacted with pension assets, the interaction with inflation was significantly negative. This result supports the interpretation of nonbehavioral pension saving as indirectly capturing an effect of inflation on pension saving.

Model III

In Model III, portfolio composition effects are incorporated. The main result from these regressions is that the negative effect of inflation is greater the higher the proportion of pension fund assets held in corporate equities.

The full model is estimated in regression (3.1). Probably because of multicollinearity, most of the coefficients are insignificant. The remaining regression for Model III displayed in Table 1 [eq. (3.2)] estimates the nonbehavioral effect by including only the interaction terms for inflation. The results of other specifications are presented in the discussion.

This regression (3.2) provides some support for the full model which includes both nonbehavioral and portfolio composition effects. The interaction of inflation with lagged corporate equities is significantly negative. The interaction of inflation with lagged pension assets is also significantly negative. Lagged pension assets and lagged corporate equities were not significant when different combinations of the variables were tried.

A weakness of these regressions is that the coefficients for the permanent income variables do not conform to expectations. Current disposable income is insignificant while lagged disposable income is significantly positive. Nevertheless, this model may provide some useful information.

These results for Model III can be interpreted using equations (20) and (25).

The significantly negative coefficient for the interaction of inflation and lagged corporate equities supports the hypothesis that corporate equities are less indexed for inflation than are other assets held by pensions. This finding may be due to the adverse tax implications of inflation or to the negative effect on corporate equities of the greater uncertainty that may be associated with inflation. The significantly negative coefficient for the interaction of inflation and lagged pension assets supports the hypothesis that assets other than corporate equities held by pension funds are also not fully inflation indexed.

The coefficient for lagged pension assets can be interpreted as an estimate of $r^*_{NCE} - \delta\lambda r^*_{NCE} - \lambda$. Ignoring the cross-product term, the insignificant coefficient for lagged pension assets may suggest that the difference bewteen the zero inflation real rate of return on assets other than corporate equities and the lagged adjustment coefficient is small. This indicates the plausible result that the lagged adjustment coefficient may be fairly small. Pension assets are not needed by most workers for many years, and thus there is little cost to them for a deviation of actual and desired pension assets but there are institutional costs in rapidly adjusting actual to desired pension assets. The insignificant coefficient for lagged corporate equities may indicate that the (zero inflation) real rate of return on corporate equities over this period was roughly equal with that for other assets held by pensions.

Expected inflation was entered in regressions not shown. It can be argued that the behavioral response in equations (12) and (13) is a reaction to expected rather than actual inflation. The expected inflation rate was estimated from an adaptive expectations model of price expectations truncated after 5 years, with varying speeds of adjustment. Expectations were projected forward to form long-run average rates for five and ten years. This measure of expected inflation was entered instead of actual inflation to measure the behavorial effect in the regression specifications shown in Table 1. It was never significantly negative but was occasionally significantly positive. A possible explanation for these results is that the expected inflation was measured as a weighted average of past inflation, and the higher is past inflation the higher would be current pension saving to recoup in part capital losses.

Other Variables

The results for the remaining variables are now discussed. The estimated coefficients for disposable income are positive but not always significant. Lagged disposable income is insignificant in some specifications but is significantly positive (counter to expectations) in some specifications where inflation is interacted with lagged pension assets.

Social security wealth is usually negative but generally not significant. Earlier studies by Munnell (1974, 1979) found a significantly negative effect for social security wealth on retirement and pension saving. A recent survey by Esposito (1978) of time series studies concluded that the net effect of social security on consumption or personal saving is insignificant, but this conclusion has been challenged by Feldstein (1979). A possibly insignificant effect of social security on aggregate personal saving does not preclude it from having a significantly negative effect for some forms of saving.

The maturity of the pension system measured as the ratio of beneficiaries to covered workers which is entered in the net pension saving regression is insignificant. A possible explanation for the insignificance of this variable is that the degree of funding may increase with pension maturity which would have an offsetting positive effect on pension saving as empirically measured here. 12/ Omitting this variable has little effect on the estimates for the remaining variables.

A proxy for the sum of the marginal Federal, State and local income tax rates paid by the median taxpayer is entered to test the effect of changes in marginal income tax rates. This variable is the marginal income tax rate paid by the median taxpayer filing a joint return plus a measure of the comparable marginal State and local income tax rates (see the Appendix). It is widely presumed that the personal income tax has had a positive effect on pension saving (e.g., Ture 1976). This variable is insignificant in all regressions. The effect of changes in marginal income tax rates depends on the cross-price elasticity between pension assets and other assets and on the magnitude of the change in marginal income tax rates. Over the sample period, this variable ranges from 22.0 to 24.9 percent with a standard deviation of 1.0. The limited amount of variation in median marginal income tax rates over this period may account for the insignificance of the variable. Omitting this variable has little effect on the estimates for the remaining variables. Lagged pension assets are always insignificant. This may be interpreted as evidence of a low adjustment coefficient. That hypothesis is supported by Saito (1977) who estimates an adjustment coefficient for life insurance and pension reserves of .094.

VI. Conclusion

This paper presents the first regression estimates of the effect of inflation on funded pension saving. This empirical evidence suggests that inflation has a large negative effect on aggregate funded private pension saving. The extent that inflation causes an increase in the unfunded pension liability is unclear because the real liability presumably also decreases.

The regressions suggest that this negative effect is not due to a behavioral adjustment to changed relative rates of return. Perhaps the absence of a behavioral response is because the lagged adjustment coefficient may be low. Rather, it appears that the negative effect of inflation on pension saving is primarily due to capital losses suffered with inflation. To the extent that pension funds bear these losses through an increase in the real unfunded liability, these regressions overstate the effect on pension saving as viewed by workers.

The effect of inflation is affected by the portfolio composition of assets held by pension funds. The effect is larger, at least for this time period, the higher the proportion of pension fund holdings in corporate equities. This finding suggests that the effect of inflation on pensions will diminish as pension portfolios adjust to inflation. In addition, the long run effect on pension saving may be less than the short run effect if contributions are increased to compensate for capital losses caused by past inflation.

The regressions presented also weakly suggest that social security has a negative effect on private pension saving. Inferences concerning aggregate saving cannot be drawn since these effects on pension saving may only indicate a change in the composition of saving rather than a change in aggregate saving. Some evidence is presented against the widely presumed positive effect of income tax laws on the time series of private pension saving at least over the sample period 1951-74.

It should be emphasized that the parameter estimates presented here are a first analysis of an important question. This research can be extended in a number of ways. The effect of inflation on the various components of pension saving--pension asset earnings, employee and employer contributions, and benefit payments--should be examined to provide deeper insight into the process by which inflation affects pension saving. The variability and rate of change of inflation and the deviation of actual from expected inflation may also affect pension saving. The effect of inflation on the unfunded pension liability should be investigated. The effect of inflation on saving in other assets and on aggregate saving are important areas for additional empirical research.

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FOOTNOTES

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1/ See Yohalem (1977). All monetary figures are in 1972 constant dollars.

2/ See Melone and Allen (1972, pp. 225-40), Deutsch (1975), Greenough and King (1976, p. 235), Ture (1976, p. 9), International Labour Office (1977), Lenarcic (1977), Pesando and Rea (1977), Pesando (1978), Cymrot (1978), Myers (1978), and Munnell (1980). Wachtel (1979) provides a general survey of theoretical and empirical research on the effects of inflation on saving.

3/ Schiller and Weiss (1977) and Ehrenberg (1980) present evidence indicating that employer pension contributions are associated with lower wages *ceteris paribus*.

4/ For tax reasons, private pensions are at a disadvantage in investing in real estate which may be a good investment in an inflationary environment. The tax benefits associated with real estate investment, for example, accelerated depreciation, do not benefit qualified pension funds which are tax exempt, but would tend to lower before-tax rates of return on real estate. It is the before-tax rate of return on real estate that is relevant to pension funds.

5/ The component of pension saving occurring in life insurance companies is the first different in pension reserves. Pension saving through life insurance companies must be measured from the liability side of the balance sheet because assets held by life insurance companies are not separated according to source of liability. The source for the pension saving series is provided in the Appendix.

6/ PS net was used by Munnell (1979) and Feldstein (1978). Pension saving defined as the net acquisition of financial assets by pension funds was used by Munnell (1974). This definition excludes all realized and unrealized capital gains. In regressions using that variable and the specifications of my Table 1, none of the independent variables were significant with the expected sign. It was thought that the fluctuations since 1967 in PS might be due largely to inflation eroding the real book value of pension assets. The same fluctuations, however, though not as large, are also evident in the series of nominal pension saving.

7/ Per capita net worth of the household sector may also be included in consumption or saving regressions as a measure of financial wealth. It had an insignificant coefficient when entered in preliminary regressions. The yield on high grade tax free municipal bonds (corrected for a measure of the expected five-year average rate of inflation) was entered as a measure of the expected real interest rate but was insignificant in various specifications tried.

8/ The expected sign for the coefficient on lagged disposable income can be obtained by deriving the saving function from a permanent income model of the consumption function

$$C_t = Y_t - S_t = abY_t + a(1-b)Y_{t-1}$$

$$S_t = (1-ab)Y_t - a(1-b)Y_{t-1}$$

where a is the marginal propensity to consume and b is a weight $(0<b<1)$. The unemployment rate was also entered in some regressions but was always insignificant.

9/ Social security may also affect private pensions through the exemption of pension contributions from the payroll tax. If the payroll tax is viewed as a tax rather than as compulsory saving, this exemption would have a positive effect on the pension saving of covered workers earning less than the taxable maximum. For workers earning more than the taxable maximum, the exemption would have no effect since the payroll tax is not applicable on their marginal wage.

10/ Increases in social security wealth increase the probability that the individual is on the earnings test taxed segment of his budget constraint, and thus social security wealth can be used as a proxy variable for the early retirement effect of social security. The effect of social security on aggregate saving has been examined by Feldstein (1974), Munnell (1974), Barro (1978), Darby (1979) and others. A nonpositive effect has been found but as a whole the results appear to be inconclusive (see Esposito 1978). Munnell (1974) has attempted to separate the wealth and early retirement effects of social security but that procedure is not pursued here.

11/ In 1974, the Employee Retirement Income Security Act extended these tax preferences to Individual Retirement Accounts which were first available in 1975.

12/ An alternative explanation is that pension coverage is a somewhat ambiguous concept and different data sources provide considerably different estimates (see Greenough and King 1976, p. 113).

APPENDIX

Table 2

Net Pension Saving
1972 dollars (billions)

Year	(1) First Difference of Total Financial Assets, PS net (Skolnik, 1976)
1951	2.307
1952	3.906
1953	4.799
1954	5.001
1955	5.898
1956	5.366
1957	5.362
1958	5.507
1959	7.717
1960	6.594
1961	7.335
1962	6.960
1963	7.681
1964	9.278
1965	9.953
1966	8.351
1967	9.896
1968	8.693
1969	4.205
1970	1.869
1971	8.683
1972	11.407
1973	1.840
1974	-7.013

Data Appendix

1. Pension saving: PS --Skolnik (1976, p. 4). PS is the first different of the per capita deflated book value of pension reserves.

2. Nonbehavioral pension saving: Skolnik (1976, p. 4).

3. Maturity of pension system, pension benefits: Skolnik (1976).

4. Personal disposable income, social security wealth: Munnell (1979b).

5. Inflation rate: calculated from implicit GNP deflator, Statistical Abstract of the United States.

6. Marginal tax rate: the Federal marginal income tax rate paid by the median taxpayer with taxable income filing a joint return is from annual volumes of Statistics of Income: Individual Income Tax Returns. Marginal State and local income tax rates were computed from the Statistical Abstract of the United States for the years 1962, 1971 and 1974 and missing values were interpolated.

7. Corporate equities and total financial assets of noninsured pension funds: Federal Reserve System (1976, pp. 37-39).