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CORPORATE SUPPLY OF INDEX BONDS

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SUMMARY

This paper develops a simple theory of the supply of index bonds by a firm, and uses that model to examine in some detail possible reasons for the non-existence of privately issued index bonds in the United States.

The major elements of the theory involve the trade-off between the tax advantages of using debt finance and the increasing risk of bankruptcy debt finance involves. The theory is first used to examine the supply of nominal bonds--it is thus a theory of the debt-equity ratio. Then the firm's optimal supply of index bonds is examined, and the values of the firm using the alternative debt instruments is compared. In general, there is no reason to think that nominal bonds dominate index bonds--i.e. the theory cannot explain why firms have not issued index bonds.

The paper then turns to a number of other reasons that have been advanced for the non-issue of indexed bonds in the United States, such as the tax treatment of such instruments and the argument that their issue would saddle the firm with open-ended obligations.

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CORPORATE SUPPLY OF INDEX BONDS

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M.I.T.

This paper develops a simple theory of the supply of index bonds by a firm, and uses that model to examine in some detail possible reasons for the non-existence of privately issued index bonds in the United States.[1]

In an earlier paper, I used portfolio theory and the capital asset pricing model to study the demand for index bonds and some properties of equilibrium in a capital market with equity assets as well as indexed and nominal bonds,[2] and in which individuals may also own (but not sell) human capital. The major conclusions of that paper are that the equilibrium relationship between the real yields on indexed and nominal bonds depends on the extent to which equity and human capital are hedges against inflation[3] -- the real yield on index bonds tends to be below that on nominal bonds to the extent that real returns on equity and human capital are negatively correlated with inflation; that, in the absence of human capital and with

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no relative price uncertainty, all private lending and borrowing would take place through indexed bonds; and that, with human capital, both types of bonds would in general be expected to exist. I noted that the analysis did not throw much light on the non-existence of indexed bonds in most major capital markets.

The non-existence of privately issued indexed bonds is a phenomenon requiring explanation for two main reasons. First, the tying of contracts to the price level is not unknown nor even especially unusual in the United States: labor contracts, rent contracts, certain aspects of insurance contracts and even the prices to be paid for future delivery of manufactured products have all been tied to the price level.[4] Second, there has been no dearth of innovation in the financial area over the years, although those innovations taking the form of the issue of new types of securities by existing firms -- such as the certificate of deposit and the floating rate note -- have been undertaken mainly by banks.

The previous paper concentrated on the demand for index bonds and equilibrium in a market composed of lifetime - utility-maximizing households. However, the most likely private issuers of index bonds are corporations. Accordingly the emphasis in this paper is on the supply of index bonds by firms whose assumed notivation is the maximization of their stock market value.

It is well known that in the absence of bankruptcy and the differential tax treatment of equity returns and interest, the Modigliani-Miller theorem[5] establishes that the value of the firm is independent of its debt structure. A simple theory of the supply of bonds, based on the existence of bankruptcy and the tax treatment of interest as a business expense is developed in this paper[6] and used to evaluate some of the arguments typically advanced to explain the non-existence of indexed bonds.[7]

The elements of the theory of the supply of index bonds are outlined in Section I. The theory is used in Section II to examine the view that firms should be more willing to issue index bonds the more their profits are (positively) correlated with the price level; Section II also presents evidence on the correlation of the profits of some American corporations with the price level. Because the theory makes clear the crucial role of the tax treatment of indexed payments, Section III reviews the ambiguous tax status of such payments in the United States. Section IV considers the argument that systematic underestimation of inflation is responsible for the non-appearance of indexed bonds. Section V briefly reviews the argument that index bonds have not been issued because such bonds would saddle firms with open-ended obligations which nominal bonds with call-clause protection do not. Two further explanations for non-issuance of index bonds are considered: Section VI examines the variability of the rate of inflation over the past twenty years; Section VII discusses the costs of innovation and the possibility that a large-scale change in the form of debt issues would be easier to accomplish than piecemeal changes. Conclusions are contained in Section VIII. An appendix compares the variability of hypothetical profit streams for sixteen U.S. firms, constructed on the assumption that all their long term debt issues over the period were indexed, with the variability of their actual profit streams.

I. The Supply of Index Bonds

This section develops a theory of the supply of bonds in the context of the capital asset pricing model,[8] using a number of other simplifying assumptions. The major result of the section is that neither nominal nor indexed bonds dominates the other; depending on the stochastic characteristics of profit streams, certain firms will have a higher stock market value if they issue indexed bonds than if they issue nominal bonds, and vice versa.

Assume there are only two periods, and consider a firm that has made its investment decision in period one which will produce (uncertain) real profits, π, in period two. Real profits are assumed to be distributed as:

$$(1) \quad \pi = x + \alpha(q - 1) \qquad c \leq x \leq d$$

where x is a random variable uniformly distributed on (c,d) and q is the purchasing power of money (the inverse of the general price level) in period two.[9] The purchasing power of money has the simple symmetric distribution:

$$(2) \quad q = 1 + \varepsilon \quad \text{with probability } 1/2 \qquad 0 \leq \varepsilon < 1$$
$$= 1 - \varepsilon \quad \text{with probability } 1/2$$

The variance of q is ε^2 and the purchasing power of money in period two is expected to be the same as in period one.[10] Note that $\alpha < 0$ implies that profits are positively correlated with the price level, since q is the inverse of the price level.

The firm is assumed to sell claims on its second period profits. Initially we examine a situation in which it can sell indexed bonds and equity. It promises to pay an amount W in real terms to holders of index bonds, provided its profits are at least W. Such payments are treated as business expenses. Any amount of profits not paid out to index bond holders is distributed to equity holders, after payment of taxes at rate τ.[11] If the firm's profits are less than W, it is bankrupt. In such a case, equity holders receive no payments. Certain fixed real bankruptcy costs, b, are assumed to be incurred and bondholders received either zero or π - b, whichever is greater, in the event of bankruptcy.

To summarize this discussion, let W be the real amount promised to index bond holders. Let S be the set of x and q on which the firm is solvent:

(3) $S = \{\pi;\ x + \alpha(q - 1) \geq W\}$

The set of x and q on which the firm is bankrupt but profits exceed the fixed cost of bankruptcy is:[12]

(4) $M = \{\pi;\ b \leq x + \alpha(q - 1) < W\}$

Payments to index bond holders are:

(5) W for $\pi \in S$

$\pi - b$ for $\pi \in M$

0 otherwise.

Payments to equity holders are:

(6) $(1 - \tau)(\pi - W)$ for $\pi \in S$

0 otherwise.

The elements of the theory of the supply of index bonds can now be seen. The issue of bonds produces a tax advantage, but the more bonds are issued, the greater the probability of bankruptcy. Thus bonds will be issued to the point at which the tax benefit balances the expected bankruptcy costs.[13] It should be noted that in the absence of differential tax treatment of interest and profit distributions, no bonds would be issued by this firm.

In the capital asset pricing model assets issued by the firm are valued by the market on the basis of their expected return and the covariance of their returns with the market return. Let R_M be the rate of return on the market:

$$(7)\quad R_M = \beta(q - 1) + \eta$$

where η is a random variable with expectation $\bar{R}_M$, finite variance, σ^2, and zero covariance with x. Thus it is assumed that the only covariance between the firm's profits, π, and the return on the market portfolio, R_M, occurs through the relationship of each variable to the price level.[14] Empirical evidence suggests that β is positive, i.e. that the real return of the market is negatively correlated with the price level, and we shall henceforth generally treat β as positive or zero.[15]

The expected payment on the firm's issue of securities is

$$(8)\quad E[R] = (1 - \tau)\iint_S(\pi - W)\ df(x)\ dg(q) + W\iint_S df(x)\ dg(q) - + \iint_M(\pi - b)\ df(x)\ dg(q)$$

where the first term in the right hand side of (8) is the expected payment on equity, and the remaining terms represent the expected payment on index bonds. Some calculation results in:

$$(9)\quad E[R] = \frac{1}{d - c}\left\{\frac{-\tau W^2}{2} + W(\tau d - b) + \frac{(1 - \tau)}{2}(d^2 + \alpha^2\varepsilon^2) + \frac{b^2}{2}\right\}$$

The market is also assumed to value (negatively) the covariance of asset returns with the market's return. This covariance is

$$(10)\quad E[(R - \bar{R})(R_M - \bar{R}_M)] = (1 - \tau)\iint_S (\pi - W)(R_M - \bar{R}_M)\,df(x)dg(q)$$

$$+ W\iint_S (R_M - \bar{R}_M)\,dg(x)dg(q) + \iint_M (\pi - b)(R_M - \bar{R}_M)\,df(x)dg(q)$$

$$= \frac{\alpha\beta\varepsilon^2}{(d - c)}\{\tau W + d(1 - \tau)\}$$

Let μ be the market price of expected return (the price currently paid either for one real dollar paid with certainty in period two or for the expected return of one real dollar in a portfolio that has zero covariance with the market) and λ the market price of risk (with risk defined as covariance with the market). The value of the firm when it promises to pay W to index bond holders[16] is

$$(11)\quad V_I = \frac{1}{d - c}\left\{\frac{-\mu\tau W^2}{2} + W[\mu(\tau d - b) - \alpha\beta\varepsilon^2\lambda\tau]\right.$$

$$\left. + \frac{\mu}{2}[(1 - \tau)(d^2 + \alpha^2\varepsilon^2) + b^2] - \alpha\beta\varepsilon^2\lambda d(1 - \tau)\right\}$$

where $\lambda = (\mu\bar{R}_m - 1)(\sigma^2 + \beta^2\varepsilon^2)^{-1}$

Optimization of V_I with respect to W yields the interior maximum:

$$(12)\quad W = d - \frac{b}{\tau} - \frac{\alpha\beta\varepsilon^2\lambda}{\mu}$$

The solution (12) holds only if $c - \alpha\varepsilon \leq W < d + \alpha\varepsilon$; if (12) implies $W < c - \alpha\varepsilon > 0$, then W is set at $c - \alpha\varepsilon$

If $c - \alpha\varepsilon$, which is the minimum profits the firm can earn, exceeds zero, then the tax benefit of issuing index bonds will clearly be used. The constraint $W < d + \alpha\varepsilon$ follows from the requirement there be some equity financing.

Concerning ourselves now with the interior maximum, the supply of index bonds is positively related to the maximum profits the firm expects to earn (d) and to the tax rate on corporate profits (τ), and negatively related to the cost of bankruptcy (b). The effects of price level uncertainty on the issue of index bonds depend on the product $\alpha\beta$; if the firm's profits are related to the price level in the opposite direction to which the market's return is related to the price level ($\alpha\beta<0$), price uncertainty increases the firm's issue of index bonds. If $\alpha\beta$ is positive, then the firm's issue of index bonds is reduced by price level uncertainty. Thus, it is not the sign of the correlation of the firm's profits with inflation which affects the amount of index bonds supplied, but rather the relationship between the behavior of the firm's profits with inflation and the market's return with inflation.

The supply function for index bonds (12), does not establish whether the firm will have a higher value by issuing index bonds than by issuing no bonds at all or by issuing (an optimal amount of) nominal bonds. Clearly, if the firm's minimum profits are positive, it will always profit by issuing bonds up to that minimum. Assume therefore that the firm's minimum profits, $c - \alpha\varepsilon$ are zero, and calculate the value of the firm when it is purely equity financed:

$$(13) \quad V_E = (1 - \tau)\left[\frac{\mu(d + c)}{2} - \alpha\beta\lambda\varepsilon^2\right]$$

Assuming the optimum W is interior, and substituting from (12) into (11) we obtain the optimized value of the firm when it issues indexed bonds:

$$(14) \quad V_I{}^* = \frac{1}{d - c} \left\{ \frac{(\mu(\tau d - b) - \alpha\beta\varepsilon^2\lambda\tau)^2}{2\mu\tau} + \frac{\mu}{2}[(1 - \tau)(d^2 + \alpha^2\varepsilon^2) + b^2] - \alpha\beta\varepsilon^2\lambda d(1 - \tau) \right\}$$

Then

$$(15) \quad V_I{}^* - V_E = \frac{1}{d - c} \left\{ \frac{(\mu(\tau d - b) - \alpha\beta\varepsilon^2\lambda\tau)^2}{2\mu\tau} + \frac{\mu}{2}[(1 - \tau)(c^2 + \alpha^2\varepsilon^2) + b^2] - \alpha\beta\varepsilon^2\lambda c(1 - \tau) \right\}$$

Thus it is clear that if $\alpha\beta < 0$, then the value of the firm is greater when it issues index bonds than when it is purely equity financed. Similarly, for $\alpha\beta$ small, or for high tax rates, or for small c (an eventuality which is more than plausible), it is clear that the issue of index bonds will increase the value of the firm. There is accordingly a presumption that the firm will issue some index bonds rather than be purely equity financed in any case, and, under the assumptions of the theory, there is certainty that it will do so if $\alpha\beta < 0$, i.e. if the relationship between its profits and the price level is in the opposite direction to that of the market return with inflation.

There remains the question of indexed versus nominal bonds. Suppose that the firm offered to pay nominal bond holders a fixed nominal amount B in the event that its nominal profits exceed B, and that in that event, equity holders receive $(1 - \tau)(\pi - Bq)$ in real terms. In the event of bankruptcy, bond holders receive the real amount $(\pi - b)$ or zero, whichever is greater, and equity holders receive nothing.

Define now the solvency set S' by

$$(16) \quad S' = \{\pi;\ x + \alpha(q - 1) \geq Bq\}$$

and the set M' of x and q on which the firm is bankrupt but profits exceed the fixed cost of bankruptcy:

(17) $M' = \{\pi;\ b < x + \alpha(q - 1) < Bq\}$

Then real payments to nominal bond holders are

(18) Bq for $\pi \varepsilon S'$

$\pi - b$ for $\pi \varepsilon M'$

0 otherwise.

Real payments to equity holders are

(19) $(1 - \tau)(\pi - Bq)$ for $\pi \varepsilon S'$

0 otherwise.

Calculations similar to those carried out in equations (8)-(10) yield a market value for the firm of:

$$(20)\quad V_N = \frac{1}{d - c}\Big\{\frac{-\tau B^2}{2}[\mu(1 + \varepsilon^2) - 2\lambda\beta\varepsilon^2] + B\big[\mu[\tau(d + \alpha\varepsilon^2) - b] - \lambda\beta\varepsilon^2[\tau(d + \alpha) - b]\big] + \frac{\mu}{2}[(1 - \tau)(d^2 + \alpha^2\varepsilon^2) + b^2] - \lambda\beta\varepsilon^2(1 - \tau)\alpha d\Big\}$$

Assuming an interior maximum, the supply of nominal bonds[17] is

$$(21)\quad B = \frac{\mu[\tau(d + \alpha\varepsilon^2) - b] - \lambda\beta\varepsilon^2[\tau(d + \alpha) - b]}{\tau[\mu(1 + \varepsilon^2) - 2\lambda\beta\varepsilon^2]}$$

The second order condition for an optimum requires the denominator of (21) to be positive, which we shall henceforth assume to be the case. At the interior optimum, the value of the firm is

$$(22)\quad V_N^* = \frac{1}{d - c}\Big\{\frac{B^2\tau[\mu(1 + \varepsilon^2) - 2\lambda\beta\varepsilon^2]}{2} + \frac{\mu}{2}[(1 - \tau)(d^2 + \alpha^2\varepsilon^2) + b^2] - \lambda\beta\varepsilon^2(1 - \tau)\alpha d\Big\}$$

From (14) and (22) we obtain

$$(23)\quad V_I^* - V_N^* = \frac{\tau}{2(d-c)}\left\{\mu W^2 - B^2[\mu(1+\varepsilon^2) - 2\lambda\beta\varepsilon^2]\right\}$$

$$(23')\quad V_I^* - V_N^* = \frac{\varepsilon^2(\mu^2-\lambda^2\beta^2\varepsilon^2)}{2(d-c)\tau[\mu(1+\varepsilon^2) - 2\lambda\beta\varepsilon^2]}\,[(\tau d-b)^2 - 2\alpha(\tau d-b) - \frac{\alpha^2\tau^2\varepsilon^2}{\mu}(\mu-2\lambda\beta)]$$

Note first from (23') the obvious: the value of the firm is the same whichever asset is issued when $\varepsilon^2 = 0$. Second consider the term

$$(24)\quad \mu^2 - \lambda^2\beta^2\varepsilon^2 = \frac{\mu^2}{(\sigma^2+\beta^2\varepsilon^2)^2}\,[(\sigma^2+\beta^2\varepsilon^2)^2 - (\bar{R}_M - \frac{1}{\mu})^2\,\beta^2\varepsilon^2\,]$$

Since the term $(\bar{R}_M - \frac{1}{\mu})$, which is the excess return on the market, is, for a period of a year, considerably below unity,[18] and since σ^2 is large relative to ε^2 (see Section VI below), it is reasonable to treat $(\mu^2-\lambda^2\beta^2\varepsilon^2)$ as positive. Accordingly, we shall henceforth assume that $(V_I^* - V_N^*)$ is of the same sign as the contents of the last set of brackets.

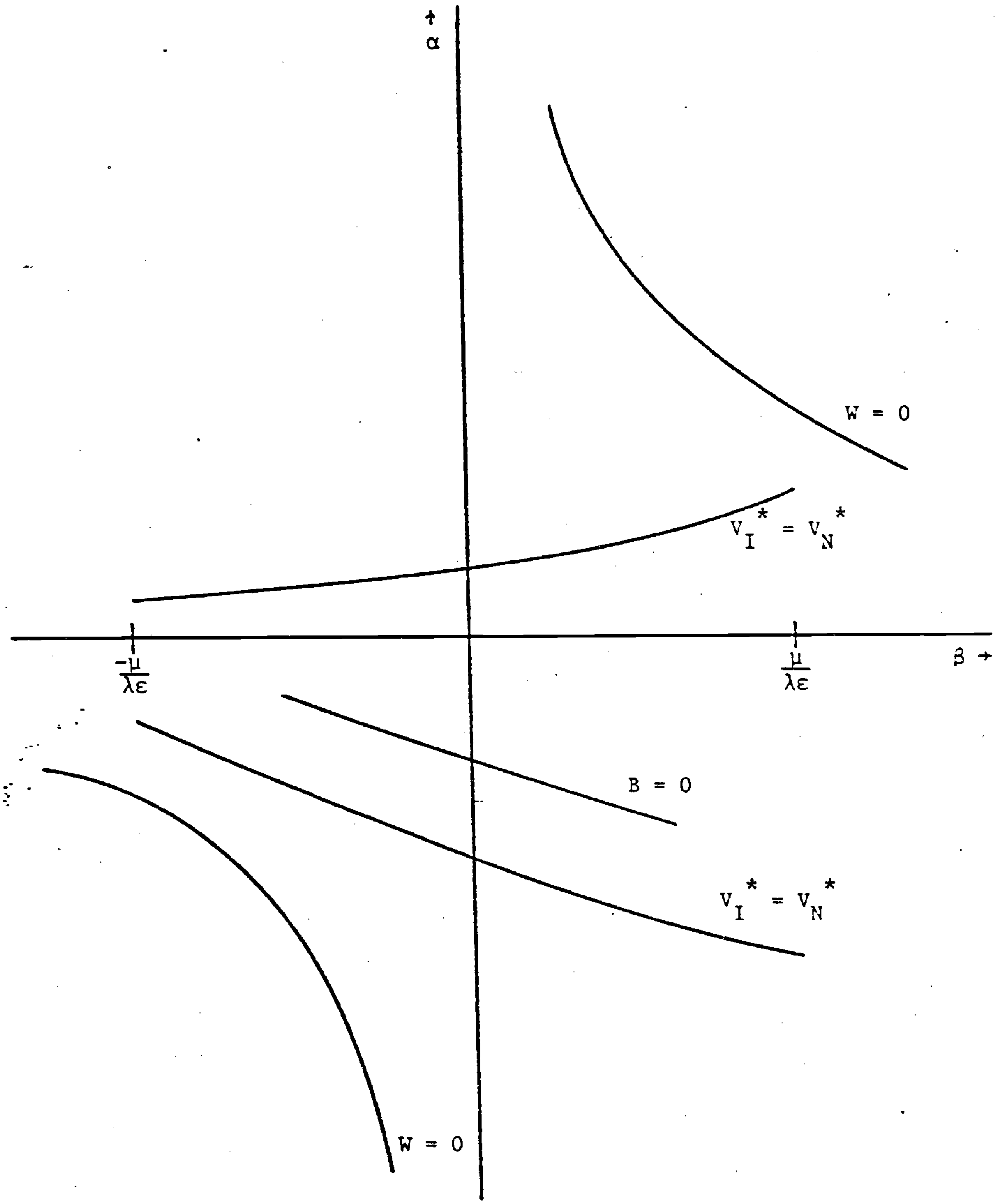
For given $\tau d-b > 0$, and given τ, ε^2, μ and λ, Figure 1 plots the pairs of α and β for which $V_I^* = V_N^*$, i.e. the loci on which

$$(25)\quad 0 = (\tau d-b)^2 - 2\alpha(\tau d-b) - \frac{\alpha^2\tau^2\varepsilon^2}{\mu}(\mu-2\lambda\beta)$$

In Figure 1, the shaded area represents those parameter values for which the firm has a higher value by issuing indexed than nominal bonds.[19] Also included in Figure 1 are the loci on which W = 0 and B = 0 respectively; interior solutions for W and B lie in each case towards the origin.[20]

Figure 1 makes it clear that there are situations in which the value of the firm is higher if it issues indexed bonds than if it issues nominal bonds, and also that the reverse may occur -- i.e. that neither type of bond

FIGURE 1


α
β
W = 0
$V_I^* = V_N^*$
$\frac{-\mu}{\lambda\varepsilon}$
$\frac{\mu}{\lambda\varepsilon}$
B = 0
$V_I^* = V_N^*$
W = 0

should be expected to dominate the other in the market. If the nominal bond is to be issued, then the firm will have to be located above the upper $V_I^* = V_N^*$ locus. Taking $\beta > 0$, the firm which finds it profitable to issue nominal bonds will have profits negatively correlated, with the price level. Similarly, for $\beta > 0$, a firm is more likely to increase its stock market value by issuing index bond the smaller is α -- the more highly its profits are correlated with the price level.

We want next to consider the effects of a change in the variance of the price level on the difference $V_I^* - V_N^*$. We take derivations on two loci: first, on the upper $V_I^* - V_N^*$ locus, at which both W and B are interior, and the firm is indifferent between the two issues, and second on the locus $B = 0$, where the firm prefers to issue indexed bonds but where the direction of change of $V_I^* - V_N^*$ is still of interest.

$$(26) \quad \left.\frac{\partial(V_I^* - V_N^*)}{\partial\varepsilon^2}\right|_{V_I^* = V_N^*} \sim -\frac{\alpha^2\tau^2}{\mu}(\mu - 2\lambda\beta) < 0 \quad \text{for } \mu > 2\lambda\beta$$

where $\sim$ means "of the same sign as"

$$(27) \quad \left.\frac{\partial(V_I^* - V_N^*)}{\partial\varepsilon 2}\right|_{B = 0} = \frac{-\alpha\beta\lambda\tau W}{d-c}$$

Equation (26) tells us that when $\alpha > 0$, and also the firm is indifferent between issuing the two types of bonds, then an increase in the variance of the price level leads it to issue nominal bonds, so long as β is not too large. In turn, (27) suggests that if $\beta > 0$, and $\alpha < 0$, then an increase in the variance of the price level does not lead the firm towards the issue of nominal bonds. The conclusion is that the effects of an increase in uncertainty about the price level on the desire to issue index bonds depends on the covariance of profits with the price level; if profits are positively correlated with the price level, then an increase in the variance of the price level tends to make a firm more likely to issue index bonds.

In this section we derived supply functions for indexed and nominal bonds and showed that neither type of bond dominates the other from the viewpoint of the maximization of the firm's stock market value. There are situations in which a firm issuing nominal bonds will command a greater stock market value than one issuing indexed bonds - such situations require, given the inverse correlation between the market and the price level, an inverse correlation between the firm's profits and the price level -- and there are also situations in which stock market value is higher if the firm issues indexed rather than nominal bonds. In addition, we established, given the empirically negative relationship between the market rate of return and the price level, that the greater the correlation of a firm's profits with the price level, the more likely its stock market value will be higher if it issues indexed rather than nominal bonds. Further, the effect of increases in the variance of the price level on the relative attractiveness of issuing index bonds depends on the correlation between the firm's profits and the price level.

II. The Correlation of Profits with the Price Level

The analysis above established that firms are more likely to have a higher stock market value by issuing indexed rather than nominal bonds if their profits are positively correlated with the price level.

In Table I, we present correlation coefficients between after tax profits with an adjustment (described below) for interest payments and the consumer price index for sixteen firms. These firms were chosen from the industrial, public utilities, transportation and merchandising categories of the Fortune 500 firms for 1964. The criterion of selection was originally to be the largest five firms on the basis of long term debt outstanding in 1964 in each category, subject to the firms existing in both 1954 and 1973. There are only three transportation firms because debt issues of many of the largest transportation firms were so numerous that the analysis of Section IV below became too costly, and there are only three merchandising firms because these firms tended to have very little debt outstanding.

Profits for each firm were adjusted by adding back to reported net profits the computed amount of interest paid on long term debt multiplied by one minus the corporate tax rate (state plus federal) in each year. Thus we obtained a series for each firm

$$(1)\quad \pi_{it} = \pi^R_{it} + (1 - \tau_t)R_{it} \quad , \quad i = 1,\ldots, 16; \quad t = 1954,\ldots, 1973$$

where π_{it} will henceforth be called after tax profits, π^R_{it} is reported net income, and R_t is reported interest payments on long term debt. We chose to work with after tax profits because it was simpler to make the tax adjustment to interest than to compute comparable pre-tax profits for each firm.

Nominal after tax profits, π_{it}, were then deflated by the consumer price index for each year, a linear time trend[21] was fitted to the real profit series, and the deviations of real profits from the trend values were calculated. Similarly, an exponential time trend was fitted to the annual average of the CPI for each of the twenty years, with a dummy being included for the low inflation years, 1959-65, and the residuals from that regression were calculated. The price level regression was

$$(29)\quad \log\,(CPI_t) = \alpha_o + \beta_1 t + \beta_2 Dt$$

where D = 1 for t = 1959,..., 1965

= 0 otherwise.

Equation (28) represents a crude estimate of the predicted path of the price level. The regression, with standard errors in parentheses, was:

$$(29) \quad \log(CPI_t) = \underset{(.0185)}{4.3330} + \underset{(.0014)}{.0242t} - \underset{(.0018)}{.0051Dt}$$

In addition, the regression was run without the dummy variable, yielding

$$(30) \quad \log(CPI_t) = \underset{(.0197)}{4.3116} + \underset{(.0016)}{.0247t}$$

Table I presents the correlations of the deviations of real after-tax profits from their trend values with the deviations of the price level from its trend value, for equations (29) and (30) respectively. In each case most of the correlations are negative. The correlations for the largest debt issuing category - the utilities - are all either negative or close to zero, with the correlation for AT&T, the largest individual borrower, being strongly negative. Table I suggests that the most likely issuers of index bonds would be Mobil Oil, IBM and Sears.

While the most obvious feature of Table I may be that the correlation of deviations of real profits with deviations of the price level from their respective trends is negative for so many firms,[22] the major lesson of the table is that there is a wide diversity of behavior of profits with respect to the price level and that there are indeed firms that have a positive correlation of detrended profits with the detrended price level and that, according to the theory, might have been expected to issue index bonds. We conclude that the failure of indexed bonds to appear is not due to the fact that there are no firms whose profits are positively correlated with the price level.[23]

Table I: Correlations of After-Tax Interest-Adjusted Real Profits with the Price Level, 1954-73

Firm	Correlation Coefficient: Price Level Residuals from (29)	Correlation Coefficient: Price Level Residuals from (30). (Simple time trend.)	Total Long Term Debt Outstanding (1973) (millions)
1. U.S. Steel	-.06	.08	1,464
2. Mobil Oil	.27	.50	1,052
3. Union Carbide	-.29	-.49	940
4. Bethlehem Steel	-.11	.15	670
5. I.B.M.	.32	.65	652
6. A.T.&T	-.64	-.83	7,594
7. Consolidated Edison	.08	-.01	2,843
8. Pacific G. & E.	-.36	-.30	2,677
9. Public Service E. & G.	.18	-.04	1,658
10. Tennessee Gas Transmission	-.45	-.12	882
11. Eastern Airlines	-.31	-.06	785
12. American Airlines	-.88	-.80	692
13. Baltimore and Ohio R.R.	-.12	.03	361
14. Sears	.30	.46	956
15. May Co.	-.24	-.51	317
16. Woolworth	-.44	-.62	295

Data Sources:

1. Profits:
2. Debt Position:

{ Moody's industrial manual; " transportation manual; " public utility manual }

3. CPI: BLS, unpublished data series, monthly seasonally adjusted CPI.

III. The Tax Treatment of Index Bonds

The analysis of Section I points to the tax treatment of interest as a major determinant of the type of security issued.[24] Consider two types of long term bond that can be called "indexed interest" and "indexed principal" bonds respectively. The indexed interest bond is redeemed at a nominal par value known at the time of issue, say $1000. It promises to pay a fixed real rate, say 2%, plus the realized rate of inflation over the previous period at each payment date. The indexed principal bond is issued with a nominal par value of, say $1000, which nominal value is increased at each payment date by the realized rate of inflation over the preceding period and interest is paid equal to, say again, 2% of the outstanding principal. Redemption occurs at the nominal value of the outstanding principal which has been cumulated as the price level changes, and is for the same real value as the initial par value.

Take first the indexed interest bond. There seems little doubt that the annual interest payment would be treated as interest income for the recipient. There is some doubt, however, as to whether the payment by the firm in excess of the stated real rate (2% in the example above) would be treated as a business expense. The following quotation from the Standard Federal Tax Reporter[25] makes the source of the ambiguity clear:

> In reaching its determination as to the existence of a bona fide debtor-creditor relationship upon which the payment and deductibility of interest could be predicated, the courts have considered such factors as: whether there was a written instrument of the debt; whether the instrument was negotiable, had a fixed maturity date, and bore a fixed rate of interest; ....; and whether there was any valid business reason for the debt.

The only source of ambiguity is the mention of a fixed rate of interest; on all other grounds, the indexed interest qualifies as interest. Since interest paid on floating rate notes is deductible, it would now appear that in fact a very strong case could be made that indexed interest should be treated as deductible, and that there is probably no tax obstacle to the issue of indexed interest bonds.[26] However, it should be noted that there does not appear to be any precedent precisely covering the indexed interest case, and that the issue could only be finally resolved by rulings applied to a proposed and not a hypothetical bond issue, so that some uncertainty remains.[27]

In the case of an indexed principal bond, the tax questions concern the treatment of the increases in principal to the lender, and also to the borrower. It is not clear whether only the actual interest payment each year would be treated as interest income and the excess of the repayment of nominal principal at redemption over the purchase price would be treated as a capital gain, or whether interest plus nominal increase in principal would be treated as interest income in each year. The general use of the realization principle would tend to favor the former approach. If that were the case, such bonds would generally be more attractive to lenders than the typical nominal bond. However, if the borrower could deduct only the interest paid in each year as a business expense, it would find indexed principal bonds relatively unattractive.

It is also appropriate here to consider a suggestion which has been made that firms would be more willing to issue bonds indexed to their own output price than bonds linked to the general price level. If their own output price were perfectly correlated with their profits (which is the reasoning behind the suggestion) it is easy to see that the model of Section I would support this argument. However, it would seem that the indexed payment on such bonds would be treated as a profit distribution. It should also be noted that in the case of the issues of such bonds by French firms in the 1950's, indexing to the own price was a device used by firms to circumvent the monetary law against indexation to the general price level[28] and should accordingly not be treated as evidence confirming the view that firms would prefer to issue bonds tied to their own output price.

In brief, then, it is not obvious that the tax treatment of indexed bonds should deter their issue. It appears likely that indexed interest bonds would be treated similarly to existing nominal bonds, and it is even possible that indexed principal bonds would provide some tax advantages to lenders. The general uncertainty concerning the tax treatment of indexed bonds suggests that there has been little effort made to clarify their tax status, which in turn suggests that it is unlikely that the tax treatment of index bonds has held back potential issues.

IV. Expectations and Index Bonds

The experience of the last decade has been of increasing inflation. The experience of the last two decades has also been of low real yields on bonds. It is becoming well known that the average real rate of return, ignoring taxes to the holding of U.S. treasury bills for the 1954-73 period was 1%.[29]

The average real yield on long-term corporate debt for 1954-73 was less than 2%. Table II presents the results of a calculation in which hypothetical indexed bonds were issued by the sixteen firms of the sample described in Section II. The long-term debt outstanding at the end of each half-year for each firm was calculated, and it was then assumed that each firm paid interest on outstanding debt equal to, in one case, 1%, at an annual rate and in the other 2% annual, plus the realized rate of inflation over the preceding six months. Profits were calculated for each firm for each year on the basis of the hypothetical interest payments, and then deflated by the CPI to yield a hypothetical real profit series. Table II shows the ratio of the mean of the calculated real profit series to the mean of actual real profits over the period 1954-73. The ratios are not identical for all firms both because the share of interest payments in profits varies among firms and because dates of debt issues vary among firms. Table II demonstrates that every firm effectively obtained bond financing at less than a 2% real rate over the period, and that some, including A.T.&T., paid less than 1% real.

It is tempting to conclude that the low real rate is a result of rising and therefore unexpected inflation, and that if inflation had been accurately foreseen, the real rate of interest on bonds would have exceeded 2%. Thus, it is argued, firms have had little incentive to issue index bonds because real rates on nominal bonds have been low.[30] This argument obviously requires borrowers to have had systematically higher expectations of inflation than lenders and is difficult to confirm or refute. It should, however, be recognized that expectations of inflation among lenders are not homogeneous: it is possible that there are enough lenders in the American economy who are sufficiently pessimistic about inflation to make it

Table II: Ratio of Mean Real Profits with Indexed Interest Payments to Actual Mean Real Profits, 1954-73.

Firm	Real Rate 1%	Real Rate 2%
1. U.S. Steel	1.003	.988
2. Mobil Oil	1.001	.995
3. Union Carbide	.997	.980
4. Bethlehem Steel	1.000	.991
5. I.B.M.	1.003	.999
6. A.T.&T.	.998	.987
7. Consolidated Edison	.983	.919
8. Pacific G. & E.	.993	.943
9. Public Service G. & E.	1.010	.954
10. Tennessee Gas Transmission	1.027	.982
11. Eastern Airlines	1.392	.717
12. American Airlines	1.047	.951
13. Baltimore and Ohio R.R.	1.101	.982
14. Sears	1.005	1.000
15. May Co.	1.013	.991
16. Woolworth	1.010	.998

Note: Actual mean real profits for Eastern Airlines is close to zero.

worthwhile for some corporation to issue an indexed bond at a low real rate.[31] Thus the expectations explanation, too, should be treated with suspicion.

V. The Call Provision

Corporate bonds issued in the United States typically carry a call provision by which the corporation can repay the debt on specified terms before maturity but after five years (in general) or ten years (for utilities) of its existence. Thus corporations appear to be covered against the possibility that the nominal interest rate will fall after their debt is issued, and they are, of course, covered against increases in the nominal rate. Accordingly, the call clause protects the corporation from the risk that the interest rate and rate of inflation will fall.

There are three points to be made in connection with the argument that the call provisions has precluded the issuance of index bonds because the corporation is covered against increases in nominal interest rates by the fact that it has a fixed nominal rate on its debt and decreases in nominal rates by the call clause. First, the call clause is not free.[32] It could be, though, that the issue of call protected nominal bonds dominates index bonds from the viewpoint of the firm; the model of Section I is not equipped to analyze that issue. Second, the call clause provides protection only after five or ten years, and interest rates can change a great deal in that period. Third, there is no reason why index bonds should not have similar clauses creating minimum and maximum nominal payments.

The last two points suggest strongly that the call provision is not the explanation for the non-existence of indexed bonds.

VI. The Variance of the Rate of Inflation

The analysis of Section I, in particular equation (23'), showed that the benefit to the firm of issuing indexed rather than nominal bonds would be small if the variance of the price level were small. Figure I shows the time path of the CPI in the U.S. 1954-74 (for quarterly observations) and also the inflation rate, defined as

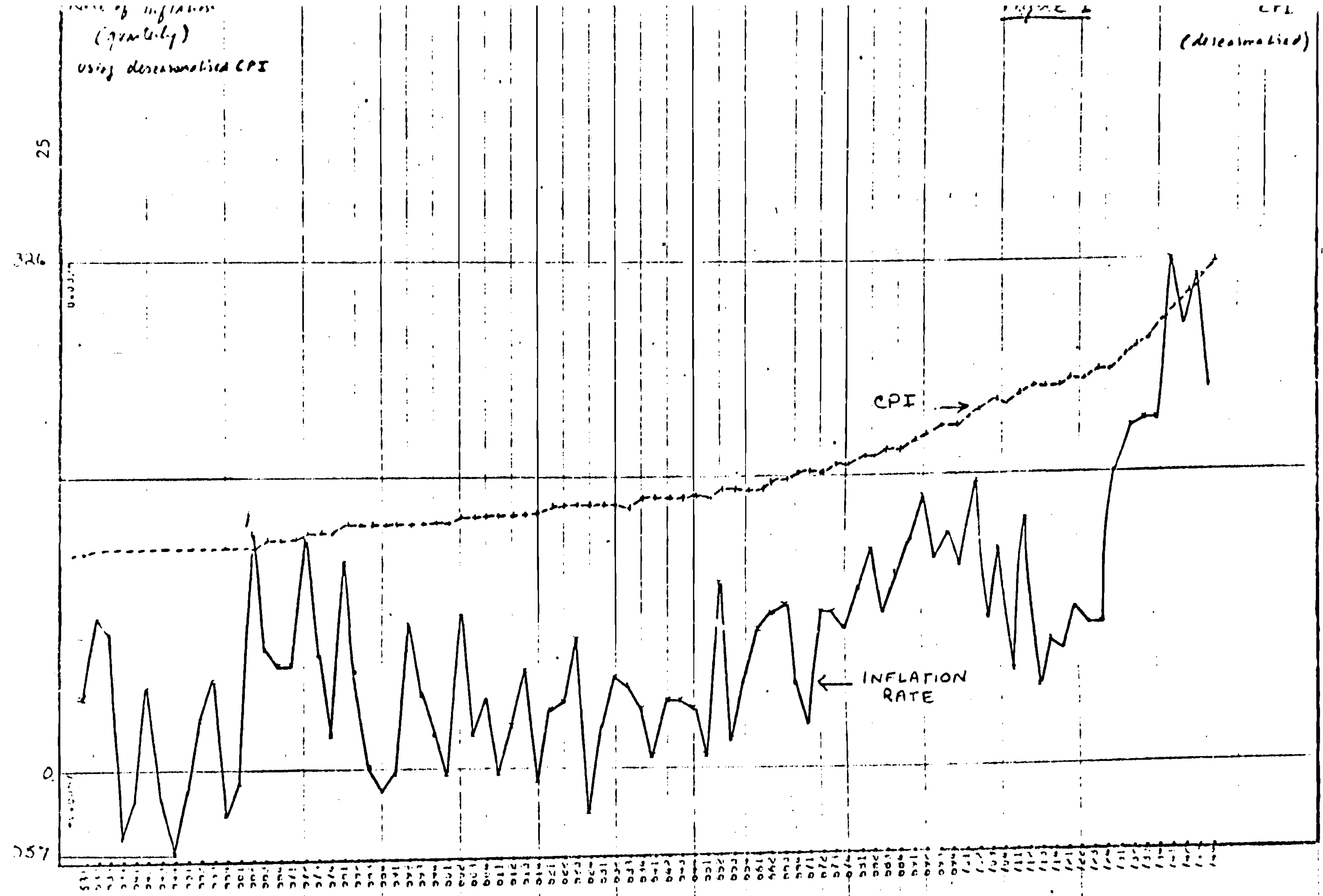
$$\frac{P_t}{P_{t-1}} - 1 \quad \text{where } t = 1953 \text{ II to } 1974 \text{ IV}$$

Table III presents data for the variance of the quarterly inflation rate for the four five-year subperiods of 1954-73. Although

Table III: Variance of Rate of Inflation

Period	Inflation Rate Variance	Variance of Inflation Calculated at Annual % Rate
1954 - 73	.3771	6.0336
1954 - 58	.3346	5.3536
1959 - 63	.0979	1.5664
1964 - 68	.1563	2.5008
1969 - 73	.2892	4.6272

it is difficult to establish an absolute measure of variability, the second column of Table III provides some notion of absolute variation: it presents the variance of the rate of inflation calculated at an annual percentage rate, and is generally of the same order of magnitude as the mean rates of inflation for the subperiods, except for 1954-58. This



1: March
2: June
3: September
4: December

variance itself falls as the time interval over which the inflation rate is calculated is increased. However it is lower by an order of magnitude than the variance of, say, the stock market rate of return,[33] and it should probably be regarded as small. In a system in which nominal bonds are, for whatever reason, the predominant form of bond financing, and in which innovation is not costless (see Section VII below), the inducement to issue index bonds is small so long as the variance of the price level is small.

Whatever the absolute magnitude of the variance of inflation, it is clear that the periods most favorable to the issue of index bonds were 1954-58 and 1969-73. These are also of course the periods in which economists were most actively discussing indexing. Further, the variance for 1970-74 (11.792) considerably exceeds that for 1969-73 (4.2672). Thus the recent instability of the inflation rate has created conditions substantially more favorable to the issue of index bonds than existed in the previous ten years.

VII. The Costs of Innovation

The introduction of the floating rate note[34] involved the issuer of the first such note in discussion and negotiation with the Federal Reserve System that resulted in modification of the terms of the note.[35] Such negotiation is an obvious cost of financial innovation, as are the costs involved in listing applications. There are other costs of innovation such as the education of the public to the advantages and disadvantages of the new instrument.[36] Most of these costs are borne by the innovator and not by subsequent issuers.

The fact is, however, that the innovation was carried out in the case of the floating rate note. The note was aimed at the small borrower and thus the educational costs could be expected to be relatively high. Further, the difficulties Citicorp encountered with the Federal Reserve System stemmed largely from the fact that the issue was regarded by financial intermediaries such as savings banks as aimed directly at their depositors,[37] and it is not certain that similar interests would be affected if an indexed bond were to be issued.

In discussing innovation, it is worthwhile distinguishing financial institutions from other corporations. Financial institutions tend to carry hedged portfolios and it is probable that they would want to innovate on both sides of their balance sheet if they innovated by issuing an indexed bond.[38] Citicorp presumably found the floating rate note more attractive than an indexed bond because its liabilities are nominal. The desire of financial intermediaries for hedging even makes it possible that a large scale transitin to indexation is as feasible as the piecemeal introduction of indexation by financial intermediaries.

Non-financial corporations have not been particularly innovative in the types of securities they issue and it may be that the costs of innovation for them are high. However, it is difficult to believe that the costs of educating a public, by now well aware of inflation, to understand the features of an indexed bond can be very high. Accordingly continuance of the current levels and variability of inflation could well make the costs of innovation for some non-financial corporation low enough to result in the issue of an indexed bond. Similarly, if proposals for reform of the mortgage system[39] lead to the introduction of indexed mortgages, the spread of indexation could thereafter be rapid.

VIII. Conclusions

Most of the explanations usually advanced for the non-issuance of private indexed bonds do not appear to explain the phenomenon. There are firms whose profits are positively correlated with the price level; the tax treatment of indexed interest would probably not be adverse; the call clause provides protection to the borrower only after a lengthy period and a similar provision could in any case be applied in the case of index bonds; the costs of innovations have not prevented sophisticated innovation aimed at small lenders. There are two arguments that may have some merit. The first is that expectations of inflation by borrowers have been systematically higher than those of lenders. However, it is difficult to believe that borrowers will always expect more inflation than lenders, or for that matter, that there are not now lenders who would accept a low real rate of interest in exchange for protection against inflation. Thus, although evidence on this issue is difficult come by, it is hard to believe that this factor would prevent the future emergence of index bonds. The second is that the variance of inflation has been low, partivularly relative to the other risks incurred in the capital markets. Given this low variance. and the existence of some costs of innovation, the incentive for firms to issue indexed bonds has been small. However, the variance of inflation has recently been higher than it was in the sixties, and increased instability of the inflation rate, if maintained, could lead to the emergence of privately issued index bonds.

Appendix: The Variability of Hypothetical Profit Series for Sixteen Firms Issuing Indexed Bonds

Closely related to the question examined in Section II of the correlation of a firm's detrended profits with the detrended price level, is an issue of independent interest -- the stability of after-interest profits if firms were to issue indexed rather than nominal bonds. Table AI presents the results of comparisons of the variability of hypothetical real profit streams where firms issued index bonds with the variability of their actual real profit streams. The construction of the hypothetical profit series is described in Section IV (the real interest rate was 1%). Each nominal profit series was deflated by the CPI to give a real profit series.

A linear trend was then fitted to each hypothetical real profit series and the sum of squared residuals from that series was calculated and divided by the square of the mean of the series to give a "coefficient of variation" of hypothetical real profits around its trend line. An identical procedure was applied to the time series for actual real profits and the corresponding "coefficient of variation" calculated.

Table II presents the ratio of the "coefficient of variation" for the hypothetical real profit series to that for the actual real profit series. It is seen from Table AI that, given the actual debt issues of firms, the profits of the industrial firms would on the whole have been more stable had they issued indexed debt rather than nominal debt, while profits for the utilities would on the whole have been less stable. The reasons the ratios in Table AI are not uniformly greater (less) than unity if the corresponding correlation of Table I is negative (positive)

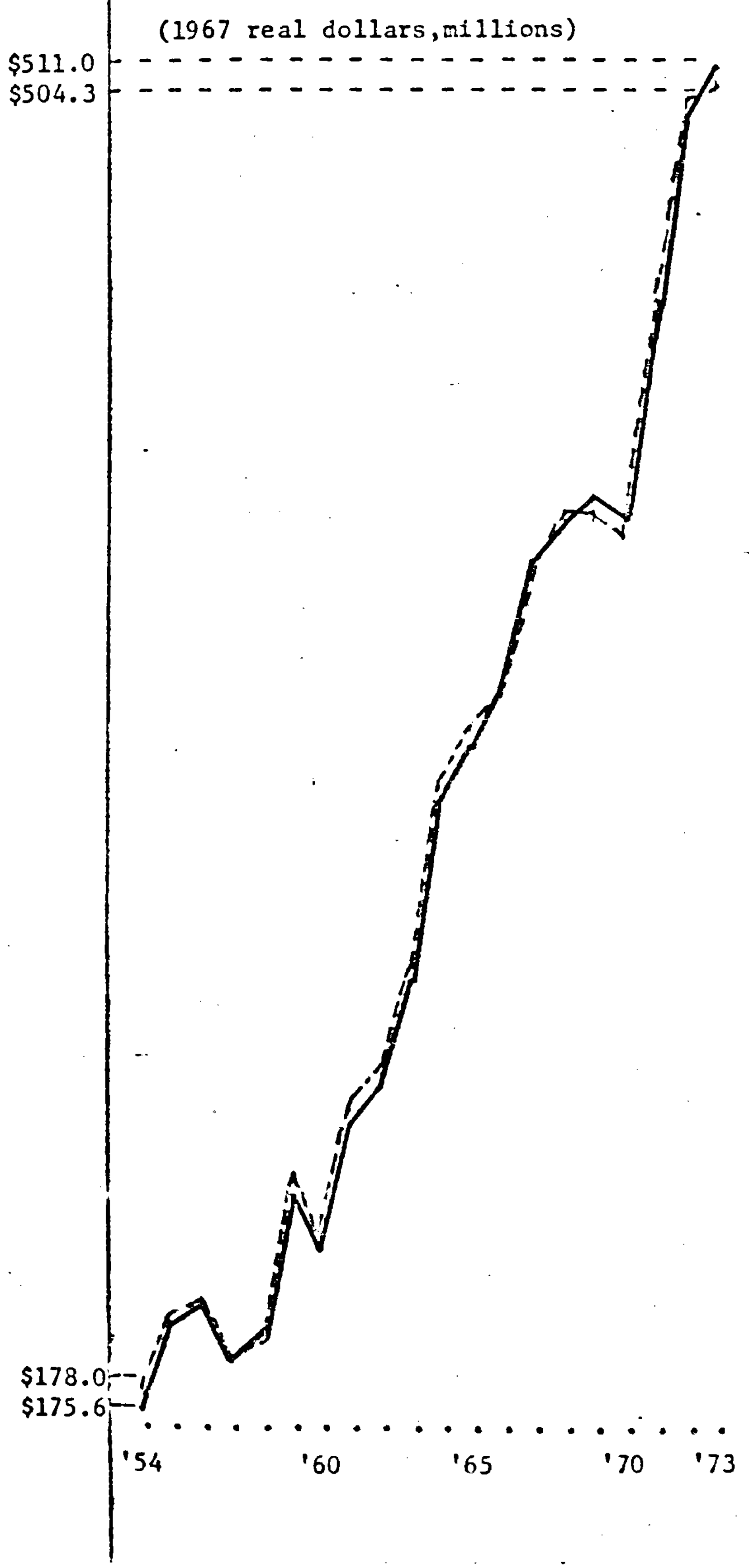
Table A.I: Ratio of Variability of Real Profits with Indexed Interest Payments to Variability with Actual Interest Payments, 1954-73

	Firm	Rates
1.	U.S. Steel	.918
2.	Mobil Oil	.938
3.	Union Carbide	1.033
4.	Bethlehem Steel	.969
5.	I.B.M.	.974
6.	A.T.&T.	1.050
7.	Consolidated Edison	2.322
8.	Pacific G. & E.	2.589
9.	Public Service G. & E.	2.268
10.	Tennessee Gas Transmission	.893
11.	Eastern Airlines	.567
12.	American Airlines	1.011
13.	Baltimore + Ohio R.R.	.721
14.	Sears	.976
15.	May Co.	1.128
16.	Woolworth	1.011

Note: Eastern Airlines has mean profits close to zero and ratio is accordingly suspect as a measure of variability.

is that the variability measure is affected by the dates of issue of securities. Table A.I shows that a number of firms, including Mobil, I.B.M. and Sears, would have had slightly more stable after-tax profit streams over the last twenty years had they issued index bonds rather than nominal bonds on every occasion on which they issued debt. Figures A.1 and A.2 shows hypothetical and actual real profits for Sears and Consolidated Edison for the twenty year period.

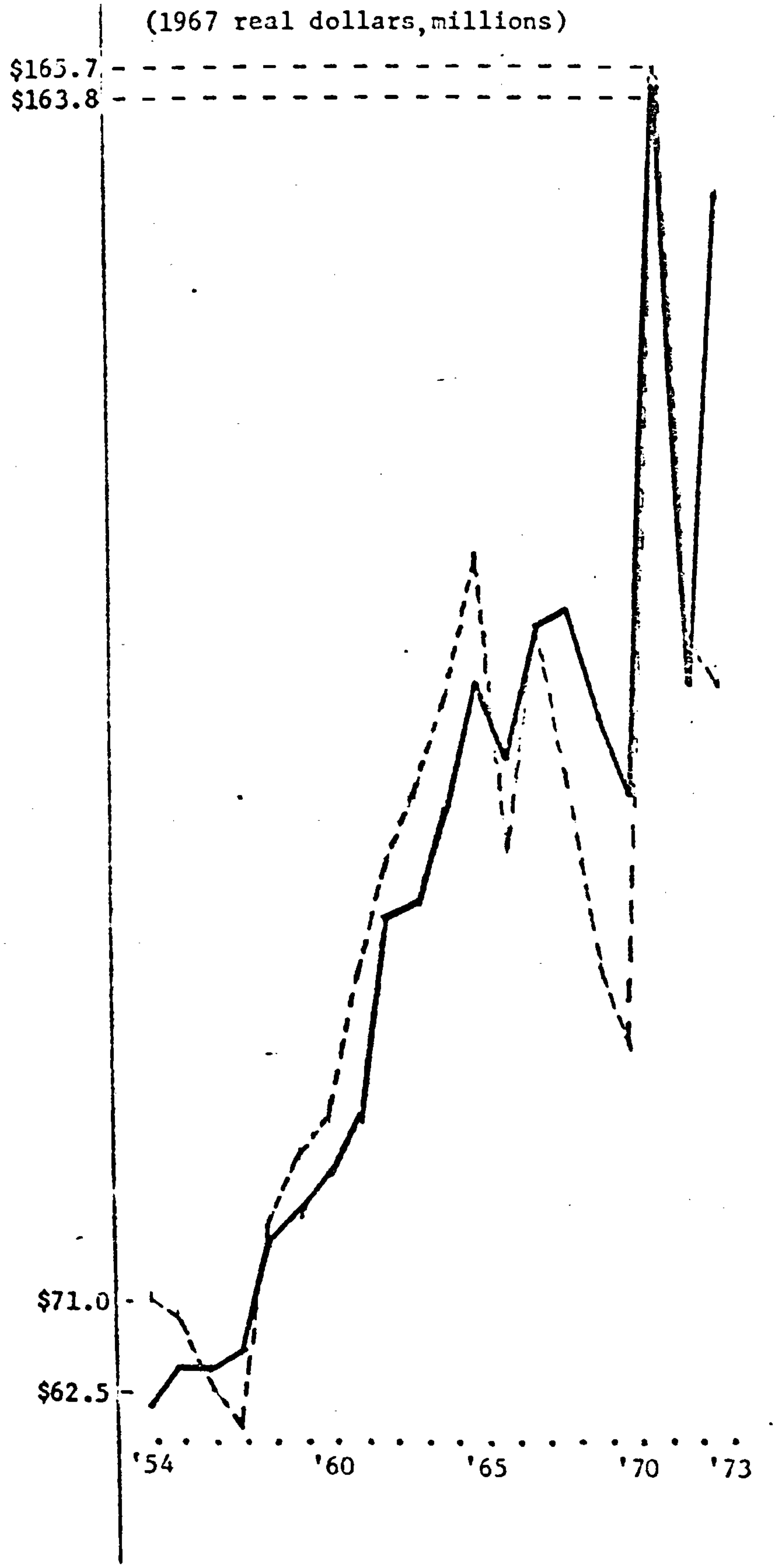
Figure A-1: Hypothetical and Actual Real Profits: Sears Roebuck & Co.



Key: ---- real profits (hypothetical indexed bonds)

—— real profits (actual)

Figure A-2: Hypothetical and Actual Real Profits: Consolidated Edison



Key: ---- real profits (hypothetical indexed bonds)

____ real profits (actual)

Footnotes

1. Much of the literature on index bonds has attempted -- but with little success -- to explain the non-existence of privately issued index bonds in developed capital markets. See, for instance, Arvidsson (1962), Fischer (1975), Levhari and Liviatan (1975).

2. Fischer (1975a).

3. In the sense that their real returns are positively correlated with inflation.

4. The indexation of labor contracts is well-documented; see, e.g. Sparrough and Bolton (1972). The existence of indexation in other types of contracts is known from anecdote and personal knowledge, but the extent of such indexation has apparently not been documented.

5. Modigliani and Miller (1958).

6. Kraus and Litzenberger (1973) use these two elements to develop a theory of optimal financial leverage in a model where there is a full set of contingent commodities. The model of this paper uses the mean variance version of the capital asset pricing model to avoid assuming a full set of contingent commodities, in which case the consumer or a mutual fund could construct an index bond.

7. Some of these arguments are contained in Arvidsson (1962) and Friedman (1974).

8. See, for instance, Jensen (1972).

9. We shall assume throughout that c is sufficiently large that $\pi \geq 0$; this is a matter of convenience.

10. Jensen's inequality therefore implies that the expected price level in period two exceeds that of period one -- the expected price level is $1/(1-\varepsilon^2)$. Since it is only uncertainty about the price level that matters for the analysis, no substantive results depend on the assumption that the average purchasing power of money is not expected to change.

11. The actual tax regulations are somewhat more complex in that no tax is paid on that portion of the distribution to equity holders regarded as repayment of principal.

12. It is possible that W be chosen such that the set M is empty. We shall assume that M is in fact non-empty; the reader may want to verify that the results are little different if M is empty, i.e. if W is chosen such that W < b.

13. This is the essence of the view advanced by Kraus and Litzenberger, op. cit. This theory fails to explain the existence of bonds before the corporate income tax. Interesting papers by Jensen and Meckling (1975) and Myers (1975) explore the determinants of debt capacity in a longer-run perspective.

14. In a more general version, I have worked with the specification $R_M = \beta(q - 1) + \lambda(x - \bar{x}) + \eta$ and obtained no more insight from this case than the one in the text.

15. See Body (1975).

16. Henceforth we shall refer to W as "the supply of index bonds" or "the amount of index bonds." It should be noted that W is in fact the payment promised to index bond holders and that while increases in W would be positively related to increases in sales of index bonds, the relationship is not linear.

17. See footnote 16.

18. See Black, Jensen and Scholes (1972).

19. It should be noted that we are not here allowing the firm to issue both types of bonds simultaneously, though it is quite likely that such an option would generate a greater stock market value for the firm than the issue of only one type of bond. Our major concern, however, is to show that neither type of bond dominates the other.

20. The locus $\dot{B} = 0$ is not extended as far as the values $\beta = \pm \mu/\lambda\varepsilon$ because we were not able to establish whether the $\dot{B} = 0$ locus intersects the $V_I^* = V_N^*$ locus.

21. An exponential could not be used because profits were negative for some firms in some years.

22. It is beyond the scope of this paper to speculate on reasons for this negative correlation. One obvious "explanation" which may be forthcoming is that all the results tell us is that profits fell over the late sixties and early seventies when the rate of inflation was high. Since both regressions treat the inflation rate as essentially constant over specified periods, residuals will be positive in the late 60's and early 70's. This explanation is probably statistically correct for the cases it fits but leaves open the question of why profits fell as the rate of inflation rose.

23. Of course it is possible that the financial officers of all firms believe, despite the evidence, that their real profits are negatively correlated with the price level. Presumably, though, the evidence, if it stays firm, will eventually change such beliefs.

24. We shall not discuss the important issue of how the tax system should be adjusted for inflation but rather remain within the confines of the present U.S. tax structure.

25. Standard Federal Tax Reporter, 1974, Vol. 2, p. 19,027.

26. In my previous paper on index bonds, I stated that indexed payments would be treated as dividends, this on the basis of verbal discussion with students of the question who were certain of the fact. On further examination, outlined above, I now believe that indexed interest payments would be treated as interest.

27. The only statement other than that quoted in the text which I have been able to find that appears to make the tax status of indexed interest unclear is "Thus, interest paid ... at an increased rate for which there is no consideration, is not deductible (.162 below)" Standard Federal Tax Reporter, 1974, Vol. 2, p. 19,009). Examination of .162 (on p. 19,044) suggests that indexed interest would not be regarded as a "gratuitous payment" (i.e. one for which there is no consideration) and would be deductible.

28. See Viaux (1955).

29. Fama (1975).

30. Friedman (1974).

31. Essentially this point was made by Arvidsson (1962).

32. See Body and Friedman (1974).

33. This point was suggested to me by Eugene Fama. See Black, Jensen and Scholes (1972) for estimates of the variance of stock market returns.

34. See Listing Application of the New York Stock Exchange, Inc., B-4337-D, July 24, 1974, by Citicorp.

35. Wall Street Journal, July 15, 1974, p. 4.

36. Irving Fisher (1934) attributed the failure of the Rand Kardex index bond to the unfamiliarity of the market with the instrument.

37. New York Times, July 6, 1974, p. 25.

38. See the model of hedging behavior by a financial intermediary in Cohn and Fischer (1974).

39. See Lessard and Modigliani (1975).

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