INDEXING THE ECONOMY THROUGH FINANCIAL INTERMEDIATION*

Alan S. Blinder

Econometric Research Program
Research Memorandum No. 196
March 1976

Econometric Research Program
PRINCETON UNIVERSITY
207 Dickinson Hall
Princeton, New Jersey

I. Introduction and Summary

This paper attempts to unravel the great mystery in the economic analysis on indexing: why have so few indexed contracts arisen in market economies, except under government instigation?

Part II provides a simple theoretical model of the "market" for indexed contracts, and points out why wage escalators and indexed financial instruments are substitutes in the perceptions of both workers and firms. While the model is very simple, the central point is, I think, very robust. With incomplete indexing in financial markets, real returns on assets decline with unexpected inflation. On general portfolio-diversification grounds, therefore, workers demand wage escalators as hedges against reductions in property income. Firms will be amenable to this idea because inflation reduces their real interest costs; they too find an element of insurance in escalators.[1] Where indexed bonds are more prevalent, workers have less to gain from indexing wages, and firms have more to lose. The suggestion, then, is that a scarcity of indexed bonds will create great incentives to escalate wage contracts.

Part III developes a parallel analysis of the market for indexed bonds; and reaches parallel conclusions. Workers who lack complete cost-of-living protection for their wages will be willing to pay a premium for an indexed bond or, better yet, a security whose real rate of return rises with inflation. Similarly, firms without wage escalators will gain from an inflation which erodes real labor costs, and thus would be eager to hedge these gains by issuing indexed bonds. When wage escalators are widespread, both incentives diminish. Theory thus suggests that a lack of wage escalators will encourage the use of indexed bonds.

Taken together, these models offer a neat explanation of a nonexistent world: one in which economies have either a great deal of wage indexing or a great deal of bond indexing. Unfortunately, the U.S. economy and, indeed, all the advanced market economies have surprisingly little indexing of any kind. Is it because the simple models are misleading? I think not. Their basic point -- that hedging against inflation is a good idea -- is too obvious to be wrong.

Part IV, the core of the paper, offers both an hypothesis for why things may have gone awry, and a policy prescription to set things right. I suggest that risk-averse firms would be happy to link factor payments to a price index which follows closely the movements of their own output prices, but shy away from contracts linking wages and interest to some broad price index whose movement might easily outstrip their selling prices. Conversely, workers and bondholders may be unwilling to bear the substantial risks of linking their factor payments to the prices of firms for whom they work or to whom they lend. Instead, they prefer linkage to a broad price index more or less representative of the things they buy. These asymmetrical perceptions of the risks caused by inflation may have resulted in the absence of both kinds of linked security.

But, if this is the reason, a new kind of financial intermediary can solve the problem. Let a mutual fund be established, holding as its assets bonds linked to the output prices of a broad collection of firms. The total interest received by the fund will then resemble the return on a bond indexed to a broad price index. Such receipts give the fund the wherewithal to issue deposits linked to such an index. Both firms and bondholders, therefore, can have the type of security they want. Of course, things are not quite so simple as this; the fund would have to fact several technical problems, and remedies for each are suggested in Part IV.

A more fundamental problem is verifying that firms and bondholders would want to borrow and lend in these forms. Taking a cue from the theoretical models of Parts II and III, I seek such empirical evidence by studying how rates of return on (unindexed) human and financial assets, and corporate profits, behave in inflation. The models of consumer-worker behavior suggest that there will be a substantial demand for indexed deposits if real returns to human and non-human capital decline with unanticipated inflation. The models of the firm suggest that businessmen will be eager to enter into contracts linking factor payments to their own industry price if the profit performance of a firm is best when prices in its industry are rising most rapidly. Part V marshals empirical evidence, some of it necessarily impressionistic rather than definitive, in support of these hypotheses.

Despite the apparent contradiction, then, the theory, the empirical evidence, and the policy prescription are all related. The theory views escalator clauses and indexed bonds as ways to hedge inflation losses; the evidence shows that such hedges are in fact needed; and the policy prescription suggests how they may be supplied through financial innovation.

II. The Demand and Supply of Wage Escalators

The major point of this section is that the prevalence of cost-of-living escalators in wage contracts is strongly conditioned by the presence or absence of indexed bonds. Specifically, when bonds are indexed workers will demand less wage escalation, and firms will supply less, because indexing wages is a substitute for indexing bonds for both workers and firms.

A. The Demand for Escalators

At first, firms are assumed to be risk neutral, and thus indifferent among wage contracts which offer the same expected real wage, $\bar{w}$. Workers, however, are risk averse, and therefore concerned with both the mean real wage and the dispersion around that mean. They must agree on a wage contract, which is a function, $w(\pi)$, stipulating how the real wage, w , depends on the rate of inflation, π . Since firms are indifferent among all functions satisying:

$$E(w(\pi)) = \bar{w}, \text{ a constant,} \tag{1}$$

which contract will workers select?

Suppose the worker lives and works for two periods, enjoys real consumption c_0 and c_1 in the two periods, earns w_0 and $w(\pi)$ in the two periods, has real assets of k_0 at the start of first period, and carries over k_1 in real assets to the second period.[2] Then his two budget constraints are:

$$c_0 = k_0 + w_0 - k_1 \tag{2}$$

$$c_1 = (1+r)k_1 + w(\pi) \tag{3}$$

where r is the real rate of return on wealth. The stochastic properties of r , especially its covariance with π , depend on whether or not financial instruments are indexed.

The worker's problem is to select k_1 and the form of the $w(\cdot)$ function so as to maximize his two-period utility, which is assumed to take the following simple form:

$$J = V(c_0) + E(U(c_1)) ,$$

subject to (1)-(3).

Since for any choice of a $w(\cdot)$ function, savings will be adjusted optimally to keep $\partial J/\partial k_1 = 0$, I can abstract from savings choices, treat k_1 as fixed, and find the optimal wage contract by maximizing $E[U(c_1)]$ subject to (1) and (3).[3]

Remembering that c_1 is random because both π and r are, the maximand can be expressed as:

$$E(U(c_1)) = \int_a^b \int_\alpha^\beta U(c_1) f(\pi,r)\,d\pi\,dr$$

where $f(\pi,r)$ is the joint density function, and where the integrals are taken over the relevant limits. Writing the joint density as $f(\pi,r) = f(\pi)f(r|\pi)$, the integral can be rewritten:

$$\int_\alpha^\beta f(\pi) \int_a^b U(c_1) f(r|\pi)\,dr \quad d\pi \equiv \int_\alpha^\beta f(\pi) g(\pi)\,d\pi \quad ,$$

which is to be maximized subject to the integral constraint:

$$\int_\alpha^\beta f(\pi) w(\pi) = \bar{w} \ .$$

This is a well-known problem in the calculus of variations which is solved by introducing the Lagrange multiplier, λ , a constant whose value depends on $\bar{w}$, and finding an extremum of the integral:

$$\int_\alpha^\beta f(\pi)[g(\pi) + \lambda w(\pi)]\,d\pi \ .$$

The Euler equation holds that:

$$\frac{\partial}{\partial w} [g(\pi) + \lambda w] = 0$$

for all π , or that $\partial g(\pi)/\partial w = -\lambda$ for all π . Using the definitions of $g(\pi)$ and c_1 , the Euler equation implies:

$$-\lambda = \int_a^b U'(c_1) f(r|\pi)\,dr \ .$$

Since this must hold for all π , we can take the derivative of each side with respect to π , viz.:

$$0 = \int_a^b w'(\pi) U''(c_1) f(r|\pi)\,dr + \int_a^b U'(c_1) \frac{\partial f(r|\pi)}{\partial \pi}\,dr \ . \qquad (4)$$

In the case of an indexed asset, the second integral in (4) vanishes because real returns are not conditional on the inflation rate.[4] Assuming that $U''(c_1) < 0$ and $f(r|\pi) > 0$ within the limits of integration, equation (4) then implies that the optimal contract has full cost-of-living escalation: $w'(\pi) = 0$ for all π.

Now consider the case of a nonindexed asset, and assume that the distribution of real returns shifts leftward when the inflation rate rises, as depicted in Figure 1. Examination of the figure reveals that $F(r|\pi_2) > F(r|\pi_1)$ everywhere, that is, the relation between the two distribution functions is one of "first degree stochastic dominance."[5] For infinitesimal changes, the dominance relation implies $\partial F(r|\pi)/\partial\pi > 0$. The second term in (4) can be integrated by parts to obtain:

$$w'(\pi) \int_a^b U''(c_1)f(r|\pi)dr = k_1 \int_a^b U''(c_1)\frac{\partial F(r|\pi)}{\partial \pi}\, dr \; .$$

The optimal wage contract can thus be characterized by the formula:

$$\frac{w'(\pi)}{w(\pi)} = \frac{k_1}{w(\pi)} \left[\frac{\int_a^b U''(c_1)\frac{\partial F(r|\pi)}{\partial \pi}\, dr}{\int_a^b U''(c_1)f(r|\pi)dr} \right]. \qquad (5)$$

Since the ratio of the two integrals must be positive, $w'(\pi)$ has the same sign as k_1.

In words, workers with positive net worth will demand more-than-100% wage escalation, workers with zero net worth will demand precisely 100% escalation, and workers with negative net worth will demand less-than-100% escalation. The intuition behind this result was provided in Part I. Since inflation lowers the real return on net worth (in a stochastic sense), workers with positive net worth will use their wage contract as "insurance" against this contingency -- recouping some of their losses in real property income by gains

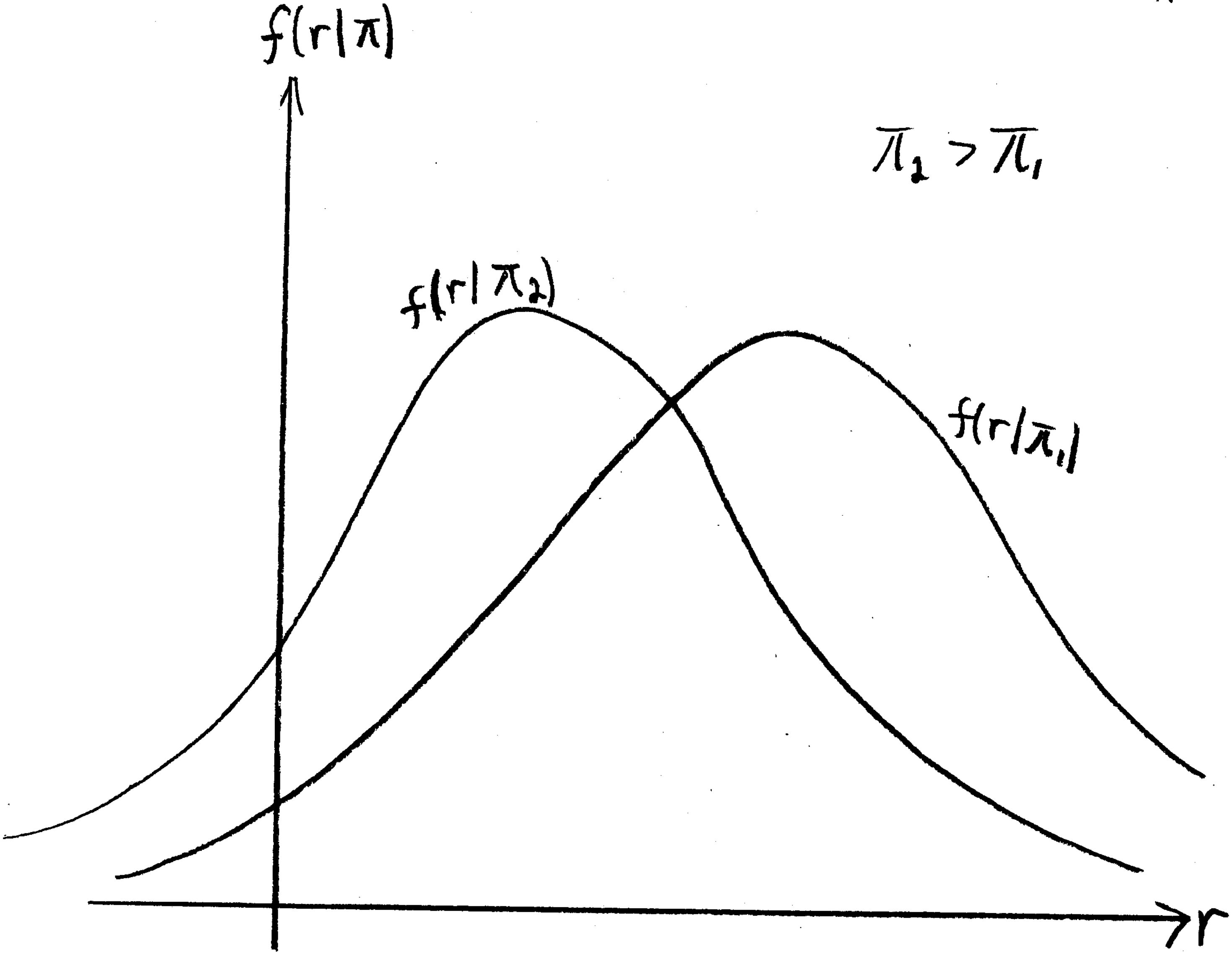

Figure 1
Effect on Distribution of Real Returns
of a Shift in the Inflation Rate

in real labor income. Workers with negative net worth are in the opposite position; since inflation raises (algebraically) their negative property income, they are willing to incur some losses in labor income to protect themselves against the possibility that inflation will be very low.

The percentage by which wages are escalated is $1 + w'(\pi)/w(\pi)$. By (5) this depends on the ratio of net worth to property income, and on the ratio of the two integrals. Not much can be said in general about the integrals; while the ratio is positive, its magnitude depends the curvature of the utility function and on the manner in which inflation alters the probability distribution of real returns. However, there is no reason to think it will be constant, either with respect to π or with respect to wealth.

Among workers with positive assets, the demand for escalation will be higher the higher is the ratio of assets to earnings. Thus, presumably, workers near retirement will want more inflation protection than young workers. More importantly, if most workers have positive net worth, indexed assets reduce the incentive to demand indexed wages.[6]

B. <u>The Supply of Escalators</u>

Thus far I have assumed that workers can have any type of escalator they choose, so long as it is actuarially fair. But if firms are averse to risk, they will not be so pliable at the bargaining table. In considering this complication, I simplify the problem somewhat by assuming that π , the inflation rate, is the <u>only</u> source of uncertainty; that is, r is stochastic only because of its dependence on π, as would be the case if all assets were risk-free money-fixed bonds. This enables me to adopt the results of a recent paper by Steven Shavell (1976).

Consider a worker and a firm bargaining over the form of the wage contract, $w(\pi)$. Let $R(\pi)$ be the nonwage income of the worker, and assume that $R'(\pi) < 0$. Let $Y(\pi)$ be the net income of the firm exclusive of wage payments; I shall discuss the sign of $Y'(\pi)$ presently. Shavell asks: what sort of wage function would be Pareto optimal for the two parties? For the case in which employer and employee have the same subjective probability distribution for inflation, he shows that the contract satisfies:

$$w'(\pi) = \frac{Y'(\pi)\rho_F - R'(\pi)\rho_W}{\rho_F + \rho_W} \quad \text{for all } \pi \ , \qquad (6)$$

where ρ_F and π_W are the (positive) degrees of absolute risk aversion of the firm and worker respectively.[7]

If firms are risk neutral $(\rho_F = 0)$, (6) implies that the wage contract completely insures the worker against income fluctuations: $w'(\pi) + R'(\pi) = 0$, a result that would have emerged from the previous analysis if inflation were the only source of uncertainty.

If firms are risk averse $(\rho_F > 0)$, but their other income is unaffected by inflation $(Y'(\pi) = 0)$, they will sell insurance to workers, but only on actuarially unfair terms. As a result, workers will find it optimal to buy less than complete insurance (i.e., $w'(\pi) > 0$, but $w'(\pi) + R'(\pi) < 0$) .

If the firm is both risk averse, and affected by inflation in ways other than through its wage payments, real wages will rise unambiguously in inflation only if $Y'(\pi) > 0$. This is the first instance of "supply side" responses in the "escalator market." Firms which tend to do well in inflation $(Y'(\pi) > 0)$ will be eager to give generous escalators as a form of insurance to workers -- in return for lower mean wages. Conversely, and for the same reasons, firms which tend to fair poorly in inflation $(Y'(\pi) < 0)$, will be reluctant to escalate wages very much, even though that implies higher mean wage costs.

What is the likely sign of $Y'(\pi)$? In Part V, some indirect empirical evidence on this question is presented. But it is indirect enough so that the issues merits some qualitative discussion. As is true of almost every question in the theory of indexing, the issues are very different in the cases of demand-induced versus supply-induced inflations. An approximate accounting identity for $Y(\pi)$ is:

$Y(\pi)$ = real sales revenue - real materials costs - real interest payments + real inventory profits - real profits taxes.

Consider first a demand-pull inflation. Presumably, in such a situation real sales revenues rise much faster than real materials costs. Real interest payments, at least on long-term debt, fall in any kind of inflation, so long as bonds are not indexed. Inflation also leads to inventory re-valuations, which represent genuine profits in the short-run. The only argument on the negative side of the ledger is that real corporate taxes increase because inflation erodes the real value of depreciation allowances. On balance, then, it seems safe to assume that $Y'(\pi) > 0$ in demand-pull inflation, and this means that firms will be eager to index wage payments. Note the role of indexed bonds in this analysis: indexing interest payments reduces $Y'(\pi)$, and thus reduces firms' willingness to index wages. To firms, as to workers, indexing bonds are indexing wages are substitutes.

Now turn to cost-push inflations, where things are quite different. Since the quantity of goods sold presumably falls in a supply-side inflation, real sales receipts drop (nominal sales rise less rapidly than prices). At the same time materials costs may rise faster than product prices. Interest payments, inventory profits, and corporate taxes behave in much the same way as under demand-pull inflation. On balance, then, it would not be surprising if $Y'(\pi) < 0$. If so, firms will be reluctant to exacerbate the burden of inflation by indexing wages; and if bonds are indexed their resistance to wage escalation will stiffen.[8]

III. The Demand and Supply of Indexed Bonds

The question addressed in this section is the mirror image of the question considered in Part II: how does the degree of wage escalation influence the demand for and the supply of indexed bonds? The demand for indexed bonds has been treated very elegantly by Stanley Fischer (1975).[9] What follows is really a highly simplified variant of Fischer's analysis which, I hope, preserves the intuitions while stripping away almost all of the mathematical complexities. I use this watered-down model to focus on the interaction of human and non-human capital, a point not stressed by Fischer although it is implicit in his analysis.

A. A Simple Model of Portfolio Choice

I adopt unabashedly both mean-variance analysis and a one-period horizon in order to simplify the mathematics. Consider a worker-investor deciding how to allocate his total wealth among three assets in such a way as to maximize the expected value of his von Neumann-Morgenstern utility indicator: $U = (\bar{z},\sigma)$, where $\bar{z}$ is the mean rate of return and σ is its standard deviation. The assets are:

(a) Human wealth. The unique feature of human wealth is that it cannot be sold. The total amount of human wealth, and therefore the fraction of start-of-period wealth held in human form, is given and not subject to choice. I call this fraction $\underline{a}$. The stochastic nature of the returns from human wealth can be parameterized in a convenient manner due to Zvi Body (1975). Let H be the nominal rate of return on human wealth, and $h = H-\pi$ be the real rate of return. Express the deviation of H from its mean, $\bar{H}$, as consisting of two stochastic components, one of which is proportional to unanticipated inflation, $u \equiv \pi-\bar{\pi}$, and the other of which is uncorrelated with unanticipated inflation.[10] In symbols:

$$H = \bar{H} + \alpha u + \varepsilon \ . \tag{7}$$

Treating these rates of return as continuously compounded rates,[11] the interpretation of the parameter α is the <u>degree of wage escalation</u> -- what I denoted by $1 + w'(\pi)/w(\pi)$ in Part II. Subtracting π from both sides of (7) gives an expression for the <u>ex post</u> real rate of return on human wealth:

$$h = H - \pi = \bar{H} - \bar{\pi} + (\alpha-1)u + \varepsilon \ , \text{ or}$$

$$h = \bar{h} + \beta u + \varepsilon \ , \ \beta \equiv \alpha-1 \ . \tag{8}$$

(b) <u>Indexed Bonds</u>. This is the simplest possible type of asset with a fixed, riskless, real return denoted by r. Let <u>b</u> denote the fraction of total wealth held in indexed bonds.

(c) <u>Nominal Bonds</u>. I assume that nominal bonds are riskless except for inflation risk. Thus, if the nominal return is $i = R + \bar{\pi}$, the real rate of return is:[12]

$$i - \pi = R + \bar{\pi} - \pi = R - u \ .$$

The fraction of wealth held in this form is $1 - a - b$.

Since the real rate of return on the entire portfolio is:

$$z = ah + br + (1-a-b)(R-u)$$

$$= \{a\bar{h} + br + (1-a-b)R\} + \{\alpha\beta - (1-a-b)\}u + a\varepsilon \text{ by (8)} \ ,$$

it follows that the mean and variance of z are:

$$\bar{z} = a\bar{h} + br + (1-a-b)R \ , \tag{9}$$

and

$$\sigma^2 = a^2V(\varepsilon) + (1-b-a\alpha)^2V(u) \ . \tag{10}$$

Remember that a is given, so the only choice variable is b, the fraction held in indexed bonds. The first-order condition for utility maximization is:

$$0 = \frac{dU}{db} = U_1 \frac{d\bar{z}}{db} + U_2 \frac{d\sigma}{db} , \quad \text{or}$$

$$U_1' \cdot (r-R) = U_2 \frac{V(u)}{\sigma} (1-b-a\alpha) . \tag{11}$$

A major point of Fischer's (1975) paper is that $r-R$ may actually be positive, though, for reasons explained below, my guess is that it would be negative. It is simplest to start with the case $R=r$.

The case where $R=r$.

$R=r$ means that the guaranteed real rate of return on indexed bonds is equal to the ex ante expected real rate of nominal bonds. If this is so, (11) simply implies that:

$$b = 1 - a\alpha . \tag{12}$$

Complete wage indexing would make $\alpha=1$, so that (12) would imply that the demand for nominal bonds is exactly zero; all financial wealth would be held in indexed bonds. This is because full wage indexing eliminates all covariances among the real returns. Since nominal bonds carry some risk, and bear no premium over indexed bonds, they are a dominated asset.

If there is literally no indexing of wages, not even tacit indexing, so that $\alpha=0$, (12) states that holdings of indexed bonds equal total wealth. Since the fixed stock of human wealth is presumably very large, this implies tremendous short sales of nominal bonds. The reason is again obvious. Human capital fares badly in inflation, as do nominal bonds, while indexed bonds are "inflation neutral." Selling short a volume of nominal bonds equal to one's human capital stock creates a perfect hedge, in the sense that the only remaining risk in the portfolio is the undiversifiable component of risk in human returns.

The case where there is partial indexing is intermediate between these two extremes. The central point is clear enough: the demand for indexed bonds falls as the degree of wage indexing increases.

The case where $R > r$.

This tendency is muddied by introducing an expected premium for holding nominal bonds, a premium which the previous case strongly suggests would exist. If $R > r$, equation (11) implies that $1-b-a\alpha$ is positive.

Under full wage indexing $(\alpha=1)$, then, there will be a positive demand for nominal bonds if they pay a premium. Will there be a demand for indexed bonds? One cannot say in general that b must be positive. For a large enough premium, the demand for indexed bonds would vanish. But this just means that the market premium would not have to be this large to induce consumers to hold nominal bonds.

For other cases, although at least one of the bonds must be held in positive amounts, we cannot establish which one that will be, nor whether both are held. Of course, in the limit as the premium gets small, we can apply the results of the previous case.

The case where $R < r$.

If indexed bonds pay a premium -- a possibility raised by Fischer (1975) -- the analysis is once again simple. Equation (11) states that $1-b-a\alpha < 0$, which, so long as $0 \leq a\alpha \leq a$, also implies that $1-b-a < 0$. That is, everyone will sell nominal bonds short because short sales of nominal bonds provide a hedge against inflation-induced losses on human capital. Only more-than-100% indexing of wages $(\alpha>1)$ could possibly induce worker-investors to hold nominal bonds in positive amounts. This suggests that $R < r$ is very unlikely to obtain.

Which case is realistic?

If indexed bonds existed, we could read the answer to this question from published tables of bond yields. The OECD (1973) reports, in fact, that indexed bonds paid consistently lower interest rates during the nine years in which they coexisted with nominal bonds in France. Given the absence of indexed bonds in the U.S., however, we are free to speculate.

Fischer's analysis guides our speculation. His investigation of the demand for indexed bonds concluded that the real return on indexed bonds would probably be below that on nominal bonds $(R>r)$ if (a) real returns on common stocks are negatively correlated with inflation, and (b) real wage income is negatively correlated with inflation. Some documentation that both of these conditions have held in the postwar United States is provided in Part V. I conclude that, if both types of bonds coexisted, R would exceed r.

B. The Supply of Indexed Bonds

Will firms want to borrow on an indexed basis, given that they can probably sell such securities at real interest rates below those which they now pay on nominal bonds? If they are risk neutral, they will, for risk-neutral firms simply want to float debt at the lowest expected real interest cost.

But, if firms are risk averse, certain complexities arise. We can turn Shavell's analysis on its head to analyze this problem in the same way we analyzed wage contracts. If $R(\pi)$ now denotes the non-interest income of the bondholder, and $Y(\pi)$ denotes the net income of the firm exclusive of interest payments, equation (6) will again hold with $w(\pi)$ now interpreted as the real value of debt service.

If most "other income" of bondholders is wage income, then $R'(\pi)$ will presumably be negative, and less so the greater the prevalence of wage indexing. The previous analysis of costs and benefits to the firm can be repeated, with real wage payments replacing real interest payments. Given only partial wage escalation, this item of costs also declines in inflation. Again, we may well have a situation in which $Y'(\pi) > 0$ for demand-pull inflations and $Y'(\pi) < 0$ for cost-push inflations.

In a word, risk-averse firms will be eager to sell indexed bonds if (a) they are not indexing wages heavily, and (b) they tend to do well in inflation. Risk-averse firms will be reluctant to issue indexed debt if (a) they have large wage escalators, and (b) they tend to suffer heavy cost increases in inflation.

IV. The National Inflation Mutual Fund

A. Recapitualtion

The models of the previous two sections have three main messages:

(1) There are good reasons to believe that workers will demand substantial escalation in wage contracts, perhaps even more than 100% escalation, and that bondholders would welcome indexed bonds even if they paid lower real interest rates than nominal bonds.

(2) The case for indexing is much less clear-cut for firms, but given the diversity of firms in the U.S. economy, there must be many who could profit by indexing their debt instruments and/or escalating their wage payments.

(3) Indexed bonds and escalated wages are substitutes, from the points of view of both workers and firms. Having more of one dulls the incentive to seek more of the other.

As noted in Part I, the theory explains a phenomenon that, unfortunately, does not exist in the world. The models suggest that economies with substantial wage escalation should have very few indexed loan agreements, while economies with many indexed bonds should have few escalated wage contracts. The world, however, seems to show that almost all economies have hardly any indexing of any kind.

There are, of course, no indexed bonds in the United States. And the notion that cost-of-living escalators are extremely widespread is really a myth. The latest BLS data show that, even after nine years of the worst inflation in modern U.S. history, just over half the workers covered by major collective bargaining agreements (those covering 1,000 or more employees) have any sort of cost-of-living escalator. And almost none of these contracts offer complete protection of real wages, not to mention the fanciful more-than-100% escalation discussed in Part II. Furthermore, major collective bargaining agreements cover only about 10% of the U.S. labor force, and wage escalators in smaller establishments are almost nonexistent.[13]

The models do, however, suggest one possible explanation for the dearth of indexing. The really virulent inflation of the past few years has certainly come from the supply side, and has been accompanied by falling profits. For the years 1972-75, indexed bonds and highly escalated wages would not have been in the best interests of stockholders. If firms foresaw these events (or had an irrational fear of cost-push inflation which proved true!), then this could explain the absence of indexing.

But surely this is stretching a point. Until just recently, demand-pull inflation has been the rule, not the exception. Certainly the 1966-1971 inflationary period fits this pattern. The absence of indexed bonds must have another explanation. Let me suggest one.

B. <u>Asymmetries in Risk and the Need for an Intermediary</u>

Workers and bondholders reduce risk by linking their nominal incomes to a broad price index, more or less representative of the things they buy. But the same may not be true of firms. In a world where relative prices change rapidly, no firm is sure that the prices of the product mix it sells will move in the same way as, say, the private GNP deflator. A firm considering an indexed bond will be worried -- and not without reason -- that its product prices will lag behind the deflator, leaving it with a burdensome level of interest payments.

The remedy for the firm is obvious. Suppose it could tie its interest payments to the prices of its own products, or at least to an index more closely tailored to its own sales. This type of indexed bond would offer a very safe way to borrow. But it would not be a safe way to lend. As viewed by consumers, such an instrument would be almost as risky as common stock, since its returns would depend on relative price fluctuations.

The outcome, then, of the operation of free markets may be that the <u>latent demand</u> for bonds indexed to a broad price index and the <u>latent supply</u> of bonds indexed to firm-specific prices both go unsatisfied. The fact that these very real <u>private</u> risks are not <u>social</u> risks -- because, on average, the selling prices of firms and the buying prices of consumers must move together[14] -- motivates my proposal for a new type of financial intermediary.

Suppose a "National Inflation Mutual Fund" (henceforth, NIMF) were created and instructed to:

(a) purchase bonds from firms, with the interest and principal linked to the specific price index applicable to each firm's industry;

(b) issue deposits to consumers, paying a guaranteed real interest rate in terms of some broad price index. Both firms and bondholders would find the instruments far safer than the present nominal bonds. NIMF itself would be simply an intermediary. Given the right set of weights for each industry in NIMF, the fund would be literally self insured.

C. <u>A Mutual Fund of Indexed Bonds</u>

While many different variants of NIMF might be designed, depending on the maturity structure of its assets and liabilities, I will concentrate --

solely for concreteness -- on a version in which NIMF purchases one-year bonds from firms, and simultaneously issues one-year certificates of deposit to consumers.

Let $i = 1,\dots,n$ denote the n industries. Let the price index of each industry at the end of the year, with all prices normalized to unity at the beginning of the year, be P_i. Let $I \equiv \sum_i \lambda_i P_i$ be the aggregate price index at the end of the year, so that λ_i represents the weight of industry i in the index. Let r_i be the real rate of interest which industry i pays into NIMF. Then if B_i is the face value of the bonds which industry i sells to NIMF at the beginning of the year, its nominal payments at the end of the year will be $(1+r_i)B_i P_i$. Deflating by the general price index, the real payment is $(1+r_i)B_i p_i$, where the $p_i \equiv P_i/I$ are henceforth called the "real prices" or "relative prices" of each industry, and are assumed to have well-behaved probability distributions.

The face value of the fund is $B = \sum_i B_i$. If $w_i \equiv B_i/B$ is the weight of industry i in NIMF, then total deflated receipts are:

$$\sum_i (1+r_i)B_i p_i = (\sum_i (1+r_i)w_i p_i)B \ .$$

In general, this will be a random variable since all the p_i are random. Payments from NIMF to bondholders at the end of the year would be simply $(1+r_0)BI$ in nominal terms, or $(1+r_0)B$ in real terms, where r_0 is the guaranteed real rate paid on NIMF deposits. Thus the real profit rate of NIMF is $\sum_i (1+r_i)w_i p_i - (1+r_0)$. Now, by the definition of the price index, the weighted sum of random variables, $\sum_i \lambda_i p_i$, is equal to unity <u>with certainty</u>. So NIMF will be perfectly self-insured if and only if $(1+r_i)w_i = k\lambda_i$, for all i, for some constant k.

Can a fund be designed which meets this requirement? I shall argue that it can.[15] However, if equal real interest rates (r_i) are charged to all firms, there is no reason to expect open participation in NIMF to result in $w_i = \lambda_i$. Indeed, there is every reason to expect w_i to differ from λ_i in a systematic way that would threaten the solvency of NIMF.

The reason is adverse selection, a phenomenon which is common to all insurance schemes. To cite just one prominent example, it is well-known that purchasers of health insurance are sicker on average than the population as a whole. The corresponding danger for NIMF is that firms which borrow from NIMF might have lower average rates of price increase than the economy as a whole, so that the fund's income would grow more slowly than its outlays. If NIMF posted equal real borrowing rates (r_i) for each industry, this would probably happen; for if every industry could borrow at a uniform real rate, r , linked to its own price index, industry i would view the real interest factor as being $(1+r)p_i$. Industries expecting small price increases $(E(p_i) < 1)$ would view this as "cheap," while industries expecting rapid inflation $(E(p_i) > 1)$ would find NIMF an expensive source of funds.

One way to cope with such adverse selection is to post a set of industry-specific interest factors satisfying $(1+r_i)E(p_i) = 1 + \bar{r}$ for all industries. If the price projections of firms correspond to (or deviate randomly from) the price projections made by NIMF, adverse selection would be eliminated. If the two sets of price expectations differed systematically, industries which expected price performance superior to NIMF projections would prefer to borrow elsewhere, while industries anticipating slower inflation than NIMF projections would participate actively in the fund. If businesses are better forecasters of relative prices than NIMF, this would present another -- though less serious -- adverse selection problem; but it is not obvious to me that they need be better.

However, even if some degree of adverse selection occurs, it need not be fatal to NIMF. Private insurance is a thriving industry in the United States today despite actual or potential adverse selection in virtually every line of insurance. Further, in coping with adverse selection, NIMF will have an important advantage over most commercial insurers. Because it will not continually be presented with applications from new industries, with which it has no past experience, NIMF will have an easier time identifying industries whose real price is likely to fall than, say, a commercial insurance company has in deciding which of a set of new drivers is more likely to have an accident.[16] New firms may, of course, seek to borrow from NIMF; but they will usually be from familiar industries. New industries are simply not born as frequently as new people.

Thus far I have enumerated two constraints on NIMF. If it is to be self-insured, it must satisfy,

$$(1+r_i)w_i = k\lambda_i ,$$

and, if it is to obviate adverse selection, it must set interest rates such that,

$$(1+r_i)E(p_i) = 1 + \bar{r} .$$

These two jointly determine the required NIMF-weights since

$$w_i = \frac{k\lambda_i}{1+r_i} = \frac{k\lambda_i}{1+\bar{r}} E(p_i) = \lambda_i E(p_i) ,$$

because k must equal $(1+\bar{r})$ if the w_i's are to sum to unity. There is no particular reason to expect the ratio of an industry's NIMF-weight to its weight in the price index to be equal to its expected relative price. So, if NIMF simply posts any vector of interest rates and accepts all comers, it probably will not acquire the risk-free weights.

But there is a simple alternative. Suppose it has been decided that a

NIMF of face value B should be established as a risk-free fund. This means that NIMF must buy bonds worth $B_i = \lambda_i E(p_i)B$ from industry i. It can achieve this by a "Dutch auction" whereby the rate r_i that NIMF charges to industry i is set by the requirement that the firms in the industry wish to borrow precisely this amount from NIMF. Call these the "market clearing" rates.

The perceptive reader will have noticed that I have now imposed two restrictions on the r_i: first, that they clear markets; and second, that they eliminate adverse selection. However, these requirements come to roughly the same thing because markets can only clear at rates that satisfy $(1+r_i)E(p_i) = 1 + \bar{r}$ approximately. If NIMF's lending rates were such that $(1+r_1)E(p_1)$ was very much less than $(1+r_2)E(p_2)$, it would be profitable for firms in industry 1 to borrow from NIMF at interest factor $(1+r_1)p_1$ and lend to firms in industry 2 at interest factor $(1+r^*)p_2$, where $r_1 < r^* < r_2$. Perhaps only a small spread between $(1+r_1)E(p_1)$ and $(1+r_2)E(p_2)$ would induce the two firms to enter into such a contract if their price expectations were basically alike. But such operations would raise industry 1's supply of bonds to NIMF, thus increasing r_1. And, as industry 2 borrows from industry 1 instead of from NIMF, r_2 would decline. The process would continue until the gap between $(1+r_1)E(p_1)$ and $(1+r_2)E(p_2)$ shrunk to the point where the incentive to "arbitrage" disappeared.[17] Thus competition automatically establishes relative interest rates which minimize adverse selection.

A similar "no arbitrage" argument establishes that $\bar{r}$ must be at least as large as r_0; that is, the NIMF cannot -- even by accident -- have a structure of borrowing and lending rates that would lose money! To see why not, suppose that $r_0 > \bar{r}$. Then firms could borrow from NIMF at expected interest factors $(1+r_i)E(p_i)$, use the funds to purchase a NIMF deposit with a guaranteed return of $1+r_0$, and earn an expected profit. As firms sought to exploit these possibilities, $\bar{r}$ would be driven up.

How big would NIMF be? The general equilibrium of the financial markets will provide the answer. There will be a supply function of bonds to NIMF, $B^s = B^s(\bar{r},R^f)$, where R^f is a vector of alternative rates at which firms can borrow, and where $\partial B^s/\partial\bar{r}$ is presumptively negative. And there will be a demand function for NIMF deposits, $B^d = B^d(r_0,R^c)$, where R^c is a vector of alternative rates at which consumers can lend, and where $\partial B^d/\partial r_0$ is presumptively positive. Figure 2 then shows how the profitability of NIMF -- the margin between its borrowing and lending rates -- depends on its size. A very small fund, like b , will have a large profit rate, while a much larger fund, like B , will be less profitable. In the long-run, of course, competition will insure that the margin between $\bar{r}$ and r_0 is just sufficient to cover the costs of operating NIMF. However, during the transitional period, there should be monopoly profits to be reaped by some enterprising financial institution.

D. A NIMF Miscellany

Now that general equilibrium issues have been raised, it is worth pointing out that NIMF would probably have side effects of both the financial and real sectors of the economy. First, the establishment of NIMF would obviously affect other financial institutions, and this would affect both vectors of "alternative rates" mentioned above. Second, by changing the terms on which firms can borrow, NIMF would affect relative prices and resource allocation. Both of these are familiar, though complex, phenomena in general equilibrium analysis which merit no further comment here.

There are many variants on the NIMF theme. In order to secure wider participation, NIMF might foreswear the requirement that it be risk-free, and

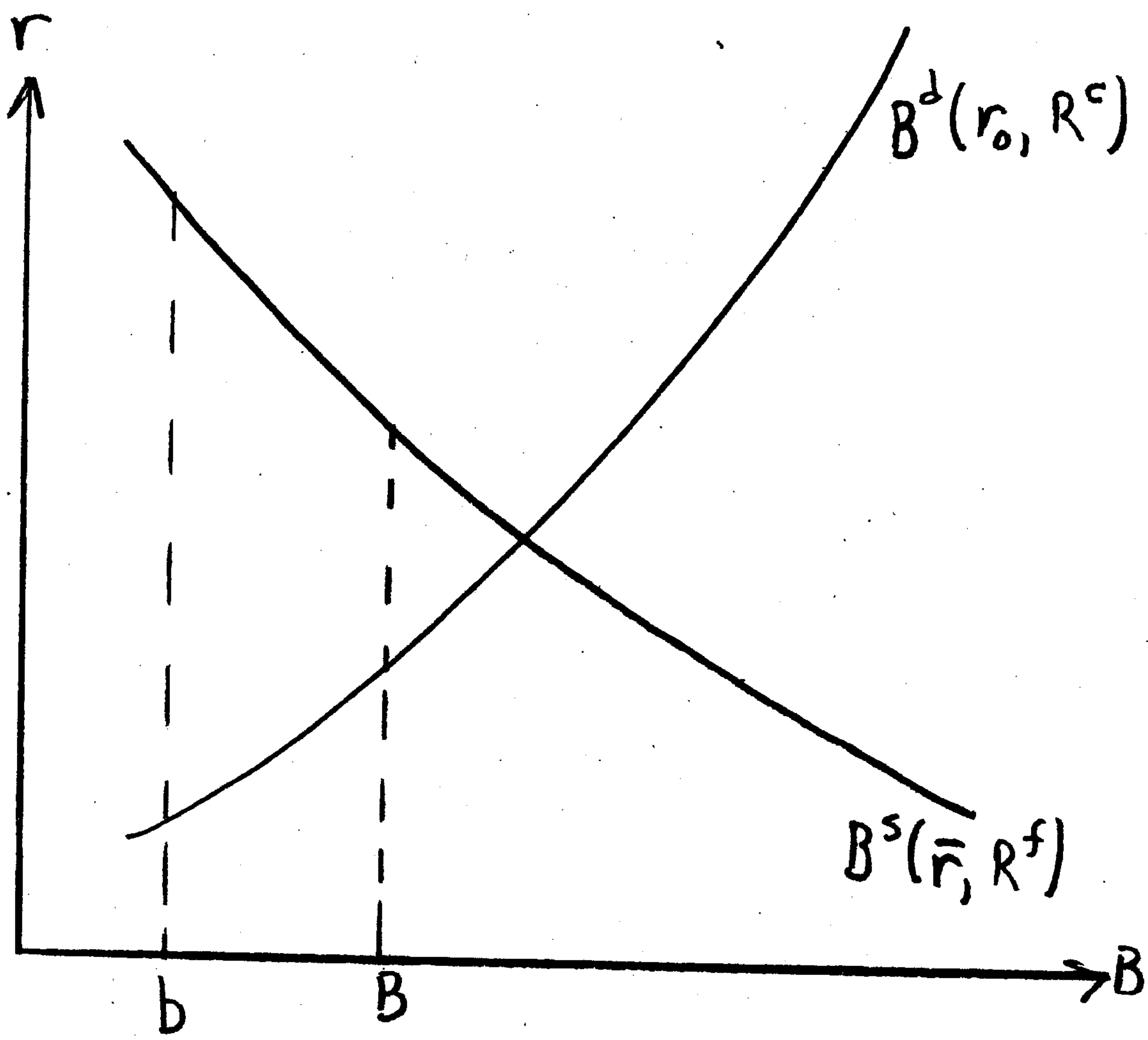

Figure 2
The Demand for NIMF Deposits and Supply
of NIMF Loans

let the weights, w_i, be determined through open participation by firms. In this case, either the return to NIMF deposits would have to be risky (a proportionate share in NIMF receipts), or some other institution (the government?) would have to underwrite the risk. As a large mutual fund investing in a diversified portfolio of securities linked to specific commodity prices, it is reasonable to suppose that most (though not all) of the risk could be eliminated by pooling. The law of large numbers should rescue this variant of NIMF just as it rescues commercial insurers.

Another variant would be to establish a NIMF which paid interest linked to the CPI or other index of consumer prices, rather than to the private GNP deflator used as an illustration here. I have not concentrated on such a fund here -- though consumers might prefer it -- due to a desire to open participation to all firms. A NIMF with deposits linked to the CPI, for example, could not lend to industries with no weight in that index. However, there is no real reason why NIMF need be monolithic. Different NIMF's, each linked to a distinct price index, could well be established. Indeed, this arrangement would be preferable to a single NIMF since different households purchase different market baskets of goods and services.

With what sort of index would NIMF work best? I have used the private GNP deflator as an illustration, but the deflator for nonfarm business product might be a more likely candidate unless farmers also borrowed from NIMF. It is arguable whether exports and imports should also be excluded on the grounds that domestic wage earners and bondholders ought not to be insulated from changes in the terms of trade.[18] In some instances (e.g., the 1973-74 oil debacle) such protection would have been most welcome.

Some readers may wonder why I propose to index loans to the <u>industry's</u>

price rather than to the firm's price. The reason is that the latter alternative invites abuses -- a kind of "window dressing" in reverse whereby firms, by manipulating specific commodity prices and/or sales weights, attempt to make their average price performance look worse than it really is. Industry price indices are far less subject to manipulation by firms, although some care would have to be taken in highly concentrated industries. This suggests that NIMF should use a fairly coarse level of industrial classification. Monopoly typically disappears as we aggregate industries.

Just as industries dominated by few firms pose problems for NIMF, so do firms participating in many industries. NIMF could create for such firms a weighted average of the industry-specific price indices for those industries in which the firm does business. But this assumes that multi-industry firms are willing to reveal their sales weights to NIMF; it could be that some of them wish to keep this information from public view.[19] In that case, I suppose, NIMF could offer to let the firm borrow with payments linked to any of the P_i for industries in which it participates, relying on the firm to apportion its borrowing weights to its sales weights. However, even this procedure involves a (tacit) revelation by the firm of some aspects of its business and, rather than do this, some firms might simply shun participation in NIMF. I make no pretense of knowing how big a problem this might be in practice.

Finally, there is the question of matching the maturities of NIMF assets and liabilities. In the illustration, I assumed perfect matching in that NIMF only borrowed and lent for precisely one year. In reality, firms might want to borrow for various durations -- as they now do from banks and in the bond market. And the popularity of NIMF deposits would be enhanced greatly if the deposits were of no fixed maturity, like passbook savings accounts. Of course, if NIMF deviates from perfect matching of maturities of assets and liabilities, it can no longer hope to be literally riskless. Like banks and all other financial intermediaries, it would be subject to random deposit outflows. Of course banks and other intermediaries -- even thrift institutions -- manage to cope with this problem quite well. I imagine that NIMF could too.

E. Wage Escalation through NIMF

The theoretical discussion stressed the similarities between indexed bonds and wage contracts with cost-of-living escalators. Yet wages have not been mentioned in my discussion of NIMF.

If NIMF deposits were available with any starting date, or with any desired maturity, then firms could use NIMF to enter into escalated wage contracts linked to a broad price index with no risk to themselves. For example, \$I in wages (an uncertain nominal sum) could be paid at the end of a period by depositing $\$I/(1+r_0)$ in a NIMF account at the beginning of a period.

One objection frequently raised against any scheme for comprehensive wage indexation is that linking many (or all) money wage rates to the same index effectively freezes the relative wage structure, thus preventing relative wage movements from accommodating shifts in demand. However, this is true of any long-term labor contract, whether or not tied to a price index. With or without indexing, relative wages are free to adjust each time a contract expires. A difference would arise only if the average duration of labor contracts were lengthened by the advent of comprehensive indexing. It is not obvious that this need occur, though it might.

Indexing wages through NIMF, rather than through conventional escalator clauses, is especially beneficial to firms when prices rise due to an external supply shock as in 1974. In such an instance, workers' purchasing power is maintained, but most firms do not pay the costs of higher wages. NIMF does this instead, essentially by transferring income from firms with high P_i to firms with low P_i.[20]

F. NIMF and Wage-Price Controls

NIMF, or indexing in general, obviously has some bearing on the tradeoff between real output growth and inflation, not because it "shifts the Phillips curve," but because it significantly lowers the welfare costs of inflation. As such, it can be looked upon as an alternative to wage-price controls.

Yet wage-price controls may recur, so it is worth asking how the chance that controls might be reimposed affects the viability of NIMF. On the surface, the effect would seem to be devastating since the price index, I, and some (but not all) of the P_i would be artifically held down by controls. But who would gain and who would lose?

Until controls reached the point where the prices recorded in the index seriously understated true transactions prices, consumers would be neither helped nor harmed. While their interest receipts from NIMF would be lower under controls, so would commodity prices. Real interest received from NIMF would be unaffected.

Redistributions among firms, however, would be substantial. But they might be in a desirable direction. The firms which suffer most from controls are, presumably, those upon whom the controls are most binding, that is, those whose controlled P_i fall most short of the P_i expected before controls. But since firms borrowing form NIMF pay an *ex post* real interest factor

$$(1+\bar{r})\,\frac{P_i}{E(P_i)}\,,$$

NIMF loans would ease their burdens. Conversely, firms not subject to controls would have high $p_i/E(p_i)$ since p_i would be allowed to rise while I was held down. These firms -- the "winners" from controls -- would have to make larger payments into NIMF. Thus NIMF offers a unique form of (partial) insurance against the institution of price controls.

Wage-price controls could work against NIMF -- or against any indexed contract-- if they include provisions for vacating contract clauses calling for index linking, as was done, for example, to some wage contracts during the 1971 wage-price freeze.[21] Investor fears that government might make it <u>illegal</u> for NIMF to pay depositors $(1+r_0)I$ at the end of the period, even at the artifically depressed level of I, could damage seriously the attractiveness of NIMF deposits. On the other hand, if firms think that the government may mandate payments into NIMF less than the $(1+r_i)P_i$ specified in the contract, borrowing from NIMF would be made more attractive. Whether these two forces, on balance, enhance or undermine the viability of NIMF is unclear on *a priori* grounds. However, my guess is that they would be very harmful.

G. <u>The Gulf between Theory and Practice</u>

Given enough supply and demand, then, NIMF can obviate the problem of asymmetrical risks which, I suggested, may explain the dearth of indexed contracts. But would firms and workers want to participate?

To me, it is obvious that worker-savers would be eager to subscribe, at least if the reduction in mean wage and interest payments were not too large. Part V attempts to provide some reasons to believe that NIMF would be well received by consumer-workers. The idea behind the "evidence" is simple. Workers and savers have an incentive to participate in NIMF to the extent that (a) the real returns to human capital suffer from unanticipated inflation, and (b) the existing menu of financial instruments offers an inadequate hedge against inflation. I argue that both of these have been true in the postwar United States in Sections V.A and V.B.

The story is more difficult for firms. They will be eager to link factor payments to their own prices if profits and prices tend to move together (as in demand-pull inflation), but not if profits and prices tend to move in opposite directions (as in cost-push inflations). Section V.C presents an initial attempt to shed some light on this question for U.S. manufacturing corporations.

V. Empirical Evidence on the Need for NIMF

A. Inflation and the Returns on Human Capital

How does unanticipated inflation affect the rate of return on human capital? Given the paucity of complete escalator clauses in our economy, it would be very surprising if the answer were anything but: it falls.

Before examining the data, let me clarify one point that may be confusing. Asserting that wages fare badly in unanticipated inflation does not imply that inflation hurts labor in the long run. The indexing issue is only a live one in the short run; in the long run everything is effectively indexed de facto, if not de jure. For the period I consider, the U.S. in 1948-1975,[23] compensation per manhour in the private nonfarm economy rose at a compound annual rate of 5.56% while productivity (output per manhour) rose at 2.27% per annum. The excess of wage growth over productivity growth was thus 3.27% per annum, which slightly exceeds the average compound growth rate of the CPI (3.02% per annum). In a word, wages kept pace with inflation in the long run.

But there is no such close correspondence over shorter periods. From 1973:4 to 1974:4, for example, compensation per manhour grew 9.7% while consumer prices rose 12.1%. As measured by the CPI, the five years of greatest inflation in the 1948-1975 period were (in order of inflation rates) 1974, 1975, 1951, 1948 and 1973. Over these five years, inflation averaged 8.4%

while compensation per manhour grew at an average rate of 8.6%. The margin is obviously well below trend productivity growth. Conversely, the five years of lowest inflation were (in inverse order of inflation rates) 1949, 1955, 1954, 1953 and 1959, during which time inflation averaged a scant 0.1% per year. Over the same five years, compensation per manhour averaged 3.9% growth per annum; the difference is well above trend productivity.

These gross statistics may or may not be compelling. A more serious job of answering the question requires an empirical counterpart to the theoretical concept of "rate of return on human capital" for the overall economy. Very little thought is necessary to see that compensation per manhour will not do. Its drawbacks are many. No allowance is made for the cyclical variation of hours of work per week, nor for weeks of work per year. Neither is allowance made for changes in tax burdens on labor income (payroll taxes and income taxes).

But what is a satisfactory empirical proxy? Conceptually, a "rate of return" is calculated by dividing the sum of the intra-period income flow ("dividend") plus the change in the market value of the asset ("capital gain") by the beginning-of-period asset value ("market price"). Problems abound in applying this definition to human capital. How does one value the stock at the beginning and end of the period? Even if this is answered, should capital gains be included? On the one hand, such gains cannot be cashed in. But, on the other hand, any revaluation of the human capital stock presumably means higher earnings ("dividends") at some future date; so by omitting the capital gains we attribute these returns to subsequent years. Worse yet, human investment -- not capital gains -- accounts for some of the year-to-year increase in the market value of the human capital stock .

Because I could neither isolate the "capital gains," nor know what to do with them had I succeeded in measuring them, I decided to concentrate on getting a more refined series for "dividends". As a representation of human capital returns, the series is obviously too smooth.

Existing BLS data do most of the work for me. Their series on "average spendable weekly earnings in the total private nonagricultural sector" adjusts average gross hourly earnings for both variations in the work week and changes in payroll and income taxes (based on a worker with three dependents). Furthermore, it does not make any correction for inter-industrial movements of labor, which are, after all, elements of the return to human capital. I made just one adjustment to this series. Because it represents the return on human capital only to employed workers, I multiplied each yearly figure by one minus the unemployment rate.[24] The rate of change of the average earnings series so derived is my empirical proxy for the rate of return on human capital.

A simple regression of the real rate of return on human capital on the rate of inflation[25] yields the following result:

$$h_t = \underset{(.64)}{2.84} - \underset{(.15)}{0.61}\pi_t$$

where h is the real rate of return on human capital, π is the inflation rate, and standard errors are in parentheses. The simple correlation between h and π is -0.62, which connotes a substantial negative covariance. The suggestion is clearly that real human-capital returns decline in inflation -- and by quite a considerable amount (0.6% for each additional 1% of inflation).

Of course, it might be objected that the correlation between real returns on human capital and unanticipated inflation would be a more revealing statistic. More revealing, but difficult to obtain, because the desired correlation is between two variables which are terribly hard to measure. I made an attempt to compute this correlation from data on expected inflation recently constructed by George de Menil (1974). An annual series on unanticipated inflation, from 1955 to 1972, was constructed by the identity:

$$u_t = \pi_t - \bar{\pi}_t ,$$

where $\bar{\pi}_t$ is de Menil's series for expected inflation.[26] A simple regression of h_t on u_t yields the following result:

$$h_t = \underset{(.58)}{1.51} - \underset{(.64)}{1.10}u_t .$$

The correlation in this case is -0.40. Given the wide margins of error in measuring each variable, the point estimate accords remarkably well with the notion that the expected rate of inflation is incorporated exactly into nominal human capital returns, so that real human capital returns decline point-for-point with unanticipated inflation.

William Poole (1976), however, recently suggested an alternative hypothesis: "that U.S. experience has been for inflation surprises to be associated with lower real yields on human and physical capital independently of whether the inflation is higher or lower than anticipated." This can be tested, in a very rough way, by replacing u_t in the preceding regression by its absolute value. The result is:

$$h_t \quad \underset{(1.17)}{3.75} - \underset{(1.28)}{2.90}\,|u_t|$$

and the simple correlation between h_t and $|u_t|$ is -0.49. While the standard error on the slope coefficient is regrettably large, the correlation does slightly exceed that between h_t and u_t, thus lending some credence to Poole's conjecture. However, the issue clearly cannot be decided on the basis of a difference of 0.09 between two correlation coefficients.

B. Inflation and the Returns on Financial Instruments

To what extent are the financial instruments held by the typical household hedges against inflation? For some assets the answer is painfully obvious.

Deposits in thrift institutions, for example, often do not even compensate the holder fully for anticipated inflation because of interest rate ceilings. Short-term money market instruments such as Treasury bills and commercial paper probably offer adequate compensation for expected inflation, but none for unanticipated inflation; these instruments would have to be sold short in great volume to hedge against inflation. The practical difficulties of carrying this out need not detain us here, for there is a far more fundamental point. Households with positive financial net worth must take a long position in some asset; they cannot sell everything short. Thus inflation hedging requires the existence of some asset which actually gains from unanticipated inflation. Is there any?

Jeffrey Jaffe and Gershon Mandelker (1975) report strong negative correlations between monthly inflation rates and holding period returns on short-duration Treasury bills in the 1953-1971 period, but very little correlation between inflation and holding period yields on long-term obligations. The more important question, however, concerns the correlation between real bond returns and unanticipated inflation, u_t . Both Zvi Body (1975) and Jaffe and Mandelker find almost no correlation between u_t and the nominal returns on bonds of various maturities, which must imply a negative correlation between real returns and u_t .[27]

Common stocks are the financial asset traditionally touted as a hedge against inflation. Yet Philip Cagan's comparison of 24 countries over the 1939-1969 period turned up a negative association between real stock market values and inflation rates.[28] Recently, there have been three studies, varying somewhat in statistical techniques and in period of coverage, but all pointing to the conclusion that even nominal returns on common stocks in the U.S. are negatively correlated with unanticipated changes in the Consumer Price Index.

Real stock returns, therefore, must be affected extremely adversely by unanticipated inflation. Studying the U.S. from 1953 until the early 1970's, Body (1975), Jaffe and Mandelker (1975) and Charles Nelson (1976) all found either a zero or negative correlation between nominal stock market returns and unanticipated inflation. The latter two studies even reported that anticipated inflation hurt common stock returns.[29]

The case for assuming that returns on households' financial portfolios decline with unanticipated inflation, then, seems quite strong. However, we have ignored one important asset in the portfolio of many consumers: owner-occupied homes.[30] Since prices of houses generally rise with the rate of inflation, while nominal payments on nonindexed mortgages do not, unanticipated inflation provides a windfall gain to homeowners. Essentially, homeowners enjoy a capital gain as the market value of their mortgage indebtedness falls.

C. Inflation and Corporate Profits

The last two sections suggest that the typical household -- one which has positive net worth and receives most of its income from wages and salaries -- stands to lose from unanticipated inflation. This, in turn, suggests that there would be substantial demand for NIMF deposits, and also ample supply of labor to firms which promised perfectly indexed wages (accomplished through NIMF, as explained earlier).

But will firms wish to participate? If they are risk neutral, they surely will because workers and bondholders will be willing to pay for inflation protection by accepting lower expected real wages and expected real interest rates. However, the theoretical analysis reveals that risk-averse firms may or may not wish to participate, depending on their degree of risk aversion and on how their "other income" fares in inflation.

The latter can be assessed empirically, at least in principle. Ideally, one would like several time series of complete income statements, aggregated to the industry level, in order to see how some concept like "net income before wage and interest payments" behaves in inflation. Unfortunately, such ideal data are not available.

An indirect test can be designed as follows. The theory points out that firms whose positions improve when their industry's prices rise will be eager to hedge their positions by borrowing from NIMF, while firms who suffer when industry prices rise will want to avoid NIMF. The correlation between profits and prices, then, is an important datum in guessing whether or not NIMF would be well received by firms.

Matched profit and price data by industry are not readily available, but a close approximation can be created by linking the Federal Trade Commission's (FTC) quarterly data on profits of manufacturing corporations with the Bureau of Labor Statistics' (BLS) detailed breakdown of the Wholesale Price Index (WPI). These data are particularly suitable for this problem because the industrial classification is roughly at the level of disaggregation that I imagine NIMF would want to use (approximately two-digit SIC industries). However, there are shortcomings. First, multi-industry firms are assigned to a single industry, which is not the way I imagine NIMF would handle them. Second, precise matching of FTC and BLS classifications was not always possible. Judgment was exercised in deciding where a tolerably close match-up could be created; the appendix explains the details. Third, profits as defined for corporate income tax purposes may be far from the ideal definition. Finally, the manufacturing sector may not be representative of the entire private business sector.

The FTC data offer two measures of profits. The rate of return on stockholders' equity is generally regarded as superior to profits per dollar of sales for most purposes. However, for getting an indication of the sign of $Y'(\pi)$, the profits/sales ratio may be just what is wanted. For this reason, both measures are used; fortunately, the two alternative measures rarely disagree.

Correlations between industry-specific profit rates and percentage increases in industry-specific price indices, using both quarterly and annual data, are reported in Table 1.[31] Which time period is more appropriate? Since indexing is meant to cope with short-run price fluctuations, it would seem that quarterly data are more suitable. Yet accounting quirks and other "noise" can distort quarterly figures on profits; and this argues for using annual data.

The table contains a number of surprises. For example, I expected supply-side fluctuations to predominate over demand-side fluctuations in the processed food industries (industry group #1) leading to a negative correlation between prices and profits. Yet the data show that not to be the case, except for bakery products. Similarly, I did not anticipate that the automobile industry (industry #13a) would be among those with a negative price-profit correlation. However, the magnitudes of the correlations are negligible. Finally, three industries -- petroleum refining (#6a), electrical equipment (#11), and stone, clay and glass products (#9)--display rather conflicting evidence.

What generalizations can be made from these correlations? Using the profits/sales ratio as the measure of profits, price change and profitability are positively correlated in 17 of 23 cases in the quarterly data and in 18 of 23 cases in the annual data. This looks highly favorable to NIMF, but is an unfair way to keep score. First, because it double-counts, and second because among the industries showing the "wrong" sign is the very large motor vehicle industry. A more relevant way to summarize the results is to compare the fractions of total sales accounted for by industries showing positive versus negative correlations.[32] Making this comparison using 1973:4

Table 1

CORRELATIONS BETWEEN PROFIT RATES AND RATES OF PRICE INCREASE FOR U.S. MANUFACTURING CORPORATIONS, 1947-1975

Industry groups[b]	Period	Profits/Sales	Profits/Equity
(1) Food and kindred products (.145)	Quarterly: 1947:1-1975:1[a]	+.30	+.42
	Annual: 1948-1974	+.12	+.52
(a) Dairy products (.017)	Quarterly: 1963:1-1973:4	+.05	+.29
	Annual: 1963-1973	+.05	+.59
(b) Bakery products (.010)	Quarterly: 1962:1-1973:4	-.48	-.34
	Annual: 1962-1973	-.81	-.63
(c) Alcoholic beverages (.012)	Quarterly: 1956:2-1973:4	+.16	+.21
	Annual: 1957-1973	+.31	+.38
(2) Tobacco manufactures (.012)	Quarterly: 1951:2-1975:1	+.37	+.23
	Annual: 1948-1974	+.10	+.21
(3) Apparel and other finished textile products (.030)	Quarterly: 1947:1-1973:4[a]	+.62	+.59
	Annual: 1948-1973	+.26	+.35
(4) Paper and allied products (.025)	Quarterly: 1947:1-1975:1[a]	+.55	+.73
	Annual: 1948-1974	+.35	+.64
(5) Chemicals and allied products (.080)	Quarterly: 1947:1-1975:1[a]	+.32	+.56
	Annual: 1947-1974	+.27	+.53
(a) Industrial chemicals and synthetics (.038)	Quarterly: 1956:2-1975:1	+.12	+.55
	Annual: 1957-1974	+.10	+.63
(b) Drugs (.015)	Quarterly: 1956:2-1975:1	+.36	+.05
	Annual: 1957-1974	+.57	+.26
(6) Petroleum and coal products (.107)	Quarterly: 1957:1-1975:1	+.26	+.65
	Annual: 1948-50, 1957-74	+.30	+.80
(a) Petroleum refining (.105)	Quarterly: 1954:2-1973:4	-.15	+.24
	Annual: 1951-1973	-.22	+.28
(7) Rubber and miscellaneous plastic products (0.26)	Quarterly: 1951:2-1975:1	+.35	+.33
	Annual: 1947-1974	+.66	+.73

Table 1
(continued)

Industry groups[b]	Period	Profits/Sales	Profits/Equity
(8) Leather and leather products (.005)	Quarterly: 1947:1-1973:4[a] Annual: 1947-1973	+.48 +.53	+.48 +.48
(9) Stone, clay and glass products (.025)	Quarterly: 1951:2-1975:1 Annual: 1947-1974	-.28 -.06	-.11 +.20
(10) Primary metal industries (.064)	NA	NA	NA
(a) Iron and steel (.039)	Quarterly: 1947:1-1975:1[a] Annual: 1947-1974	+.22 +.36	+.41 +.68
(b) Nonferrous metals (.025)	Quarterly: 1947:1-1975:1[a] Annual: 1947-1974	+.46 +.47	+.56 +.62
(11) Electrical and electronic equipment (.092)	Quarterly: 1951:2-1975:1 Annual: 1947-1974	-.20 +.40	-.01 +.47
(12) Machinery, except electrical (.086)	NA	NA	NA
(a) Metalworking machinery and equipment (.007)	Quarterly: 1956:2-1973:4 Annual: 1957-1973	+.33 +.32	+.37 +.44
(13) Transportation equipment (.119)	Quarterly: 1969:2-1975:1 Annual: 1969-1974	-.34 -.61	-.32 -.57
(a) Motor vehicles and equipment (.083)	Quarterly: 1947:1-1975:1[a] Annual: 1947-1974	-.16 -.15	-.09 -.04
(14) Furniture and fixtures (.011)	Quarterly: 1947:1-1973:4[a] Annual: 1947-1973	+.58 +.71	+.55 +.60
(15) Lumber and wood products except furniture (.026)	Quarterly: 1947:1-1973:4[a] Annual: 1947-1973	+.53 +.79	+.55 +.86

[a]Omitting 1951:2.

[b]Numbers below each title are the 1973:4 sales weights.

sales weights[33] shows that the set of industries with positive correlations is about 2.8 times as large as the set of industries with negative correlations.[34]

Using the profits/equity ratio instead, price change and profitability are positively correlated in 18 of 23 cases in the quarterly data, and in 20 of 23 cases in the annual data. The 18 industries with unambiguously positive correlation now account for 3.3 times as much sales volume as the three industries with unambiguously negative correlation.[35]

In brief, then, a substantial majority of manufacturing industries, but certainly not all of them, are characterized by the positive correlation between prices and profits which is necessary if NIMF is to work.

The theoretical discussion of Parts II and III suggest that we might learn more by looking separately at periods of "supply side" versus "demand side" inflation. A preliminary investigation of this was not terribly conclusive. Specifically, the notion that correlations will be algebraically larger in "demand pull" periods was verified in 14 of 22 cases using the profits/sales measure, and in 12 of 22 cases using the profits/equity measure.[36]

A number of reasons for the inconclusive results can be advanced. First, the hypothesis may be wrong. Second, my rather arbitrary division of calendar years into "cost push" versus "demand pull" categories -- I labelled 1956-58 and 1971-75 as the cost-push years, 1947-55 and 1959-70 as the demand-pull years -- may be inappropriate. But I think the problem goes deeper than this. Not every industry follows the trend of the overall economy. While 1957 may have been a cost-push year "on the average," many industries doubtless enjoyed classic demand-pull inflation. In another year of general demand-pull inflation, some of these same industries may have suffered annoying increases in costs despite weak demand. In a word, a proper dichotomization of the postwar period into cost-push and demand-pull subperiods must be made on an industry-by-industry basis. But if we adopt this attitude it is hard not to be tautological. That is, it is tempting to label those years when profits fell with rising prices as "cost push," and those years when profits rose with rising prices as "demand pull."

One final shred of evidence pointing to a willingness of firms to borrow from NIMF is the apparent popularity of some recent financial innovations which can be viewed as halfway houses between conventional and index-linked borrowing. The best known of these are probably the floating-prime-rate loans now being made by First National City Bank of New York.[37] If these types of instruments are attractive to businessmen, then perhaps NIMF loans would be too.

D. Conclusion: Would NIMF Work?

In Part IV, I argued that NIMF can be made to work if there is sufficient demand for NIMF deposits and a sufficient supply of bonds to NIMF. To me, the evidence cited above on the returns to human and financial assets in unanticipated inflation provides tentative support for the notion that consumers would welcome NIMF. The case for believing that firms would want to borrow from NIMF is given mild support by the data, but remains weak enough so that the skeptic rightfully will remain unconvinced. The proof of this particular theoretical pudding will most assuredly come in the empirical tasting.

APPENDIX

This appendix explains the procedures used to match FTC data on profits by industry to components of the WPI. For convenience, the information is given in tabular form. The first column lists all industrial categories used by the FTC since 1947 to which a price series could be matched; some of them do not go back to 1947, others were eliminated before 1975. The second column gives the component of the WPI which was used as a proxy for each industry's price. The final column ("Comments") explains imperfections in the matching, gaps in the data, and so on.

Table A-1

MATCHING OF PROFITS AND PRICE DATA

FTC Industrial Classification	Component of WPI	Comments
(1) Food and Kindred products	Processed Foods and Feeds	
(a) Dairy products	Dairy Products	FTC carried this classification only from 1963 to 1973.
(b) Bakery products	Cereal and Bakery Products	FTC carried this classification only from 1962 to 1973.
(c) Alcoholic beverages	Alcoholic Beverages	FTC carried this classification only from 1956:2 to 1973:4
(2) Tobacco manufactures	Tobacco Products	Prior to 1951, insufficient data were available to construct quarterly price series.
(3) Apparel and other finished textile products	Apparel	This FTC industry includes non-apparel textile products made <u>outside</u> of textile mills. Products manufactured in textile mills constitute a separate industry in FTC's classification to which no price series could be matched.

Table A-1
(continued)

FTC Industrial Classification	Component of WPI	Comments
(4) Paper and allied products	Pulp, Paper and Allied Products	
(5) Chemicals and allied products	Chemicals and Allied Products	
(a) Industrial chemicals and synthetics	Industrial Chemicals	
(b) Drugs	Drugs and Pharmaceuticals	
(6) Petroleum and coal products	"Petroleum products, Refined" and "Coal"	A price series was created by averaging (with BLS weights) the WPI components "petroleum products, refined" and "coal." Monthly data on the former began only in 1954. 1951-56 are omitted because FTC did not use this industrial classification for those years.
(a) Petroleum refining	Petroleum Products, Refined	Monthly price data began only in 1954.
(7) Rubber and miscellaneous plastics products	Rubber and Plastic Products	Monthly price data began only in 1951.
(8) Leather and leather products	Hides, Skins, Leather and Related Products	
(9) Stone, clay and glass products	Nonmetallic Mineral Products	Monthly price data began only in 1951.
(10) Primary metal industries	NA	No suitable price index.
(a) Iron and steel	Iron and steel	
(b) Nonferrous metals	Nonferrous Metals	
(11) Electrical and electronic equipment	Electrical Machinery and Equipment	Monthly price data began only in 1951.
(12) Machinery, except electrical	NA	No suitable price index.
(a) Metalworking machinery and equipment	Metalworking Machinery and Equipment	
(13) Transportation equipment	Transportation Equipment	Monthly price data began only in 1951.
(a) Motor vehicles and equipment	Motor Vehicles and Equipment	

Table A-1
(continued)

FTC Industrial Classification	Component of WPI	Comments
(14) Furniture and fixtures	Furniture and Household Durables	
(15) Lumber and wood products, except furniture	Lumber and wood Products	

FOOTNOTES

*This proposal has gone through several drafts, and many people have contributed helpful criticisms and insights. In addition to those cited directly in the text, I wish to thank William Baumol, William Branson, Lester Chandler, Stephen Goldfeld, Edward Gramlich, Martin Hellwig, Dwight Jaffee, Burton Malkiel and Stephen Salop. This draft has benefited from seminar presentations at Rutgers University, University of California at San Diego, and the University of Florida, in addition to the Carnegie-Rochester conference. William Newton provided exceptionally fine research assistance, and financial support was provided by the National Science Foundation.

[1] The argument clearly assumes that firms are risk averse. If they are risk neutral, the relative absence of indexed contracts is truly mysterious. The note by Clifford Smith in this issue uses the possibility of bankruptcy to rationalize risk-averse behavior by firms.

[2] The assumption of a two-period life probably is not restrictive if the forms of the wage contracts in different periods are not limited by some institutional constraint, e.g., a three-year contract which must involve the same escalator clause for all three years. In the latter case, since r and π may be serially correlated, the two-period problem misses some intertemporal linkages which might upset the conclusions.

[3] This is just an application of the "envelope theorem." If γ is any parameter of the wage contract:

$$dJ/d\gamma = \partial J/\partial\gamma\Big|_{k_1 = \text{constant}} + dk_1/d\gamma \cdot \partial J/\partial k_1\Big|_{\gamma = \text{constant}}$$

$$= \partial J/\partial\gamma \quad \text{because} \quad \partial J/\partial k_1\Big|_{\gamma = \text{constant}} = 0 \ .$$

[4] A riskless indexed bond is a special case where the density function of real returns collapses to a spike. But one can conceive of other indexed securities which retain some risks unassociated with price-level fluctuations.

[5] This is the technical representation of the notion that inflation lowers the real rate of return. Some empirical evidence supporting the proposition is presented later in the paper.

[6] The relations between net worth and wage escalators are statements about <u>correlations</u>, not about <u>causation</u>, because both k_1 and $w(\cdot)$ are selected in the same maximization process.

[7] In general ρ_F and ρ_W are not constants, but depend upon the income levels of firm and worker respectively, and thus upon π. I note in passing that equation (6) can be modified to account for differences in subjective probability distributions (see Shavell).

[8] $Y'(\pi) < 0$ does not mean, however, that no escalation will be offered, nor even that $w'(\pi) < 0$. See equation (6).

[9] Jeremy Siegel (1974) presents a similar argument in less mathematical form, using the capital assets pricing model.

[10]The mean return, $\bar{H}$, may well depend on the expected rate of inflation, $\bar{\pi}$, but that is not of direct concern here.

[11]Which is what validates writing $h = H - \pi$.

[12]This is not meant to imply that R is a constant unaffected by $\bar{\pi}$. That question is irrelevant for present purposes.

[13]See Kuhmerker (1976) and David (1974) for documentation of this paragraph.

[14]This proposition is stated rather too badly; most of what follows is concerned with qualifications.

[15]The reader may have noticed that the question of self-insurance has no inherent connection with the aggregate inflation rate. Relative prices change with or without inflation, so the viability of NIMF is subject to the same questions in either regime. The difference is that the existence of money -- or any other asset with a sure nominal return -- makes NIMF superfluous if there is no inflation. NIMF deposits will be a "riskless" asset for consumers in an inflationary environment only in the same limited sense that money is riskless in a world of zero inflation. Neither asset will move precisely in accord with the particular bundle of commodities any individual consumer might purchase, that is, neither asset offers insurance against relative price fluctuations.

[16]This assumes that the recent past given some ability to predict the near-term future, i.e., that relative prices are not a random walk. It should be noted however, that while a misclassification of a new driver is an inconsequential error to an insurance company, many industries will be of nonnegligible importance to NIMF.

[17]Literally, there are not arbitrage operations, for there is some risk.

[18]The "isolation" would only hold for the short run; nothing can insulate them in the long run.

[19]I owe this point to Philip Friedman.

[20]I owe this point to Edmund Phelps.

[21]See Poole (1976).

[22]The size of these "insurance premia" depends, of course, on the willingness of firms to participate.

[23]Data cited here and elsewhere in this section are from various tables in Economic Report of the President, 1976.

[24]The labor force data and the wage data are not strictly comparable. See the footnote to Table B-7 in Economic Report.

[25]The CPI is used both to deflate the nominal return on human capital and to measure inflation. The period of the regression is 1949-1975.

[26]de Menil's series is quarterly, 1953:4-1972:3. An annual series was constructed as follows. Each quarterly expectation reported by de Menil pertains to the average inflation rate for the following four quarters. Since I seek expectations of the year-over-year inflation rate, it seems most appropriate to take an average of the expectations in the four quarters of year t as indicating the expected inflation rate from year t to year $t+1$. I wish to thank George de Menil for furnishing me with his data.

[27]One caveat must be entered here, although I do not know how important it is. Jaffe-Mandelker rely exclusively on, and Body makes substantial use of, Fama's (1975) analysis which suggests that the Treasury bill rate is the sum of a constant real interest rate plus the unbiased estimator of future inflation. However, there are well-known theoretical reasons -- first spelled out by Mundell (1963) -- for expecting anticipated inflation to lower real interest rates, which suggests that changes in the nominal bill rate should understate changes in inflationary expectations.

[28]Using Cagan's data, I computed a rank correlation of -0.64 between real stock market appreciation and inflation.

[29]Nelson proxied anticipated inflation by various leads and lags on actual inflation. Jaffe and Mandelker used the Treasury bill rate (see footnote 27 above). Body used both the bill rate and a variant of adaptive expectations.

[30]I am grateful to Robert Barro for pointing out this oversight.

[31]WPI data are, of course, reported monthly. Quarterly and annual inflation rates are computed from appropriately averaged quarterly and annual price levels. Similarly, FTC quarterly profit rates were aggregated to years by separately averaging numerators and denominators.

[32]These two classes do not exhaust the manufacturing sector because some of the FTC industries could not be matched up with WPI price components, and because the electrical equipment and petroleum industries fall in neither category. The petroleum and coal products industry, 99% of which is petroleum refining, is not put in either category because of its puzzling behavior. Over some time periods, the correlation is positive; over others it is negative.

[33]This is the last quarter before several of the subdivisions listed in Table 1 were dropped from the FTC reports. It also avoids the distortions caused by 1974-75 recession.

[34]This ratio rises to 3.5 is petroleum is assigned a positive correlation and falls to 1.6 if petroleum is assigned a negative correlation.

[35]In this case, electrical equipment and stone, clay and glass products fall in neither group, but petroleum and coal products clearly gets a positive correlation. If electrical equipment is grouped in the positive category, the 3.3 ratio cited in the text rises to 4.

[36]For these correlations, the transportation equipment industry was droppen because of too few observations. The correlations were computed only from quarterly data. In many cases, the correlations were very close and would not

be significantly different from one another by conventional statistical tests.

[37] Thomas Huertas of Citibank pointed out to me the similarity between floating-rate loans and index-linked loans. However, I stress that it is only a loose kinship; floating-rate loans certainly are not indexed.

REFERENCES

Body, Z., 1975, Hedging against inflation, unpublished Ph.D. dissertation, MIT.

Cagan, P., 1974, Common stock values and inflation -- the historical record of many countries, Supplement to National Bureau of Economic Research Report.

David, L.M., 1972, Cost of living escalation in collective bargaining, Price and wage control: an evaluation of current policies, Hearings before the Joint Economic Committee, 92nd Congress.

Fama, E., 1975, Short-term interest rates as predictors of inflation, American Economic Review, 269-282.

Fischer, S., 1975, The demand for index bonds, Journal of Political Economy, 509-534.

Jaffe, J.F. and G. Mandelker, 1975, The Fischer Effect for risky assets: an empirical investigation, unpublished, Carnegie-Mellon University.

Kuhmerker, P., 1976, Scheduled wage increases and escalator provisions in 1976, Monthly Labor Review, 42-48.

de Menil, G., 1974, The rationality of popular price expectations, unpublished paper, Princeton University.

Mundell, R.A., 1963, Inflation and real interst, Journal of Political Economy, 280-283.

Nelson, C.R., 1976, Inflation and rates of return on common stocks, Journal of Finance, forthcoming.

Organization for Economic Cooperation and Development, 1973, Indexation of fixed-interest securities, (OECD, Paris).

Poole, W., 1976, Indexing and the capital markets, American Economic Review, forthcoming.

Shavell, S., 1976, Sharing risks of deferred payment, Journal of Political Economy 84, 161-168.

Siegel, J.J., 1974, Indexed versus nominal contracting: a theoretical examination, unpublished paper, University of Chicago.

U.S. Bureau of Labor Statistics, Handbook of labor statistics, 1974 (U.S. Government Printing Office, Washington, DC).

__________, Wholesale prices and price indices, various monthly issues (U.S. Government Printing Office, Washington, DC).

U.S. Federal Trade Commission, Quarterly financial report for manufacturing, mining and trade corporations (formerly Quarterly financial report for manufacturing corporations), various quarterly issues (U.S. Government Printing Office, Washington, DC).

U.S. President, Economic report of the President, 1976, 1976 (U.S. Government Printing Office, Washington, DC).