The Role of Price Level Uncertainty in Determining the Opportunity Cost of Holding Money

by

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ABSTRACT

This paper explores the role of uncertain price level movements in determining the opportunity cost of holding both fiat and commodity moneys. It is shown that a monetary medium whose opportunity cost fluctuates countercyclically to real asset values lowers interest rates for bonds denominated in that medium and hence lowers the cost to the economy of using that money. Empirical evidence in recent years indicates that fluctuations in gold have been decidedly countercyclical while those of U.S. fiat money have been procyclical. The paper also explains the role of uncertain inflation in generating a demand for nominally denominated contracts. Such demands may arise if capital markets are incomplete or non-diversifiable human wealth is a significant portion of an individual's assets.

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I. Introduction

Virtually all descriptions of money list "store of value" as one of its defining characteristics.[1] In 1958 Tobin demonstrated that money might be utilized as a means of reducing the risk in a portfolio. However, the existence of a sure, short-rate of interest above zero indicates that short-term bonds will always dominate non-interest bearing money in a portfolio and hence such money will always impose an opportunity cost on its holders. For that reason most modern monetary analysts have resorted to "transactions costs" as a means of explaining the demand for money and indicate that the gap between the short-rate on bonds and money is a "welfare burden" on society.[2] Because of this some monetary economists such as Friedman (1969) have recommended stopping inflation or even pursuing deflation in order to reduce nominal interest rates and make the monetary medium more efficient.

It is the purpose of this paper to show that there is an alternative method of reducing the opportunity cost of holding money. A monetary asset, whose real return, due to price level changes, fluctuates countercyclically to real assets in the economy, will possess a lower interest rate than one whose return is procyclical. This result is shown to be a direct application of the capital asset pricing theory for determining the equilibrium yield in nominal or money-denominated assets in an uncertain environment. Empirical tests demonstrate that some assets, such as gold, are far more successful in fulfilling this criterion than fiat money does currently in the United States. The paper then explores the implication of this analysis

for the existence of nominal or real contracting. In general it is shown that indexed bonds are a dominant trading asset unless there is a substantial degree of asset market imperfection involving human capital and the ability to effect short transactions in securities.

II. Equilibrium Yield on Nominal Assets

Rigorous derivations of the equilibrium yield between nominal and real assets under uncertain inflation have recently appeared in the literature (see especially Fischer (1975) and Friend (1976)). These derivations modify the traditional capital asset pricing model (CAPM) by emphasizing the covariance of the rate of inflation and real market returns. It is possible, under certain simplifying assumptions, to directly apply the CAPM to the pricing of nominally denominated assets.[3] Such an application assumes that the net quanity of nominal bonds and outside money assets are zero so that a nominal bond may be priced as an "incipient" asset in an economy of real assets. This assumption is particularly justified in the United States where virtually all bonds are "inside" and the net amount of outside money is less than one percent of total wealth. Furthermore, it is assumed that the variance of the rate of inflation, the term which Fischer shows can be troublesome in interpreting yield relationships, is small compared to expected returns. As shown in Table 1, this variance for the United States is less than 0.1% per year, much smaller than average market returns.

With these assumptions, let the CAPM be defined in real terms over a given (short) horizon. Let R_f be the real riskfree rate (the "indexed" rate on short-term securities), $\tilde{R}_m$ be the distribution of real market rates of return. Let R_n be the stated, sure, nominal return on an asset. The real return on this asset is a random variable $\tilde{R}_{rn} = R_n - \tilde{\pi}$, where $\tilde{\pi}$, is the distribution of the inflation rates over the period.

The CAPM indicates[4] that

$$(1) \qquad E(\tilde{R}_{rn}) = R_f + \frac{E(\tilde{R}_m) - R_f}{\sigma(\tilde{R}_m)} \cdot \frac{\text{cov}(\tilde{R}_m, \tilde{R}_{rn})}{\sigma(\tilde{R}_m)} .$$

Since $R_{rn} = R_n - \tilde{\pi}$, we have

$$(2) \qquad R_n - \bar{\pi} = R_f + \beta \text{ cov}(\tilde{R}_m, \tilde{R}_{rn}) = R_f - \beta \text{ cov}(\tilde{R}_m, \tilde{\pi}) ,$$

where $\beta = (E(\tilde{R}_m) - R_f)/\sigma^2(\tilde{R}_m)$ and $\bar{\pi} = E(\tilde{\pi})$. Therefore,

$$(3) \qquad R_n \gtrless R_f + \bar{\pi} \text{ if and only if } \text{cov}(\tilde{R}_m, \tilde{\pi}) \lessgtr 0 .$$

The nominal rate of interest will be less (greater) than the real rate plus the expected value of the anticipated rate of inflation if prices and real market returns are positively (negatively) correlated. Note

that the Fisherian Relation, that the nominal rate of interest is equal to the real rate plus the expected rate of inflation, popularized by Irving Fisher (1930), is only true in the special case when price level changes do not affect the real value of assets.

The intuition behind these results is clear. If unexpected increases in the price level are positively associated with real asset value changes, nominal contracts are a hedge in the sense that their real return fluctuates counter-cyclically to the market. Any asset which has this counter-cyclical property will be priced "favorably" by the market, in the sense of having a lower expected return than the market portfolio.

Under what conditions will the covariance between market returns and the expected rates of inflation be positive or negative or zero? This is an empirical question, since economic theory can give reasons for any of these correlations. If we accept the "expectational" Phillips curve hypothesis (expounded by Friedman (1968) and the Rational Expectationists, (see Lucas (1973)),namely that real output is positively dependent on the difference between the expected and actual rates of inflation, then real output would be positively correlated with realizations of $\tilde{\pi}$. If the expansion of real output, ceteris paribus, is associated with rising real market prices, then $\text{cov}(\tilde{R}_m, \tilde{\pi})$ is positive.[5] I will term this phenomenon demand induced price changes, and this situation will result in nominal contracts commanding a premium over real contracts, in the sense that the

expected real rate on nominal contracts will be below the real risk free rate.

Another reason for a positive correlation would be the existence of net nominally-denominated debts owed by firms to either labor or the government. In this case unexpected inflation would result in windfall gains to firms.[6]

An economic scenario for a negative covariance can also be constructed. Assume, for a fixed supply of money, there are stochastic changes in the supply of output (say, due to shifts in technology or creation of cartels). Then prices will move inversely to real output, and if we assume real asset values are positively linked to real output, then returns and real asset values will move in the same direction. In this case real market returns will be negatively associated with inflation. I shall term this phenomenon "supply-induced inflation."

Our current tax system, based on nominal values, would also indicate a negative correlation of real asset values and inflation. When nominal capital gains are taxed, then either an expected or unanticipated rise in prices will lead to an increase in the real tax on capital. Equity markets would respond negatively to the unexpected component of price changes since anticipated inflation will already be reflected in security prices. In addition, if inflation brings about increased government intervention into markets, particularly against capital interests, a negative correlation would result. In these cases $\text{cov}(\tilde{R}_m, \tilde{\pi}) < 0$ and nominal assets will sell at a "discount" compared to real assets, i.e., $R_n > R_f + \bar{\pi}$.

III. Empirical Findings and the Choice of the Monetary Medium

It has been shown that for a given expected rate of inflation, the opportunity cost of holding a non-interest bearing monetary medium is lowered if the monetary medium is a countercyclical asset, i.e., if $\text{cov}(\tilde{R}_m, \tilde{\pi}) > 0$. This is true since the equilibrium R_n, for a given $\bar{\pi}$ and R_f is affected by the covariance and R_n measures the opportunity cost of holding the monetary medium. Thus government could alter this covariance by changing the tax system, the state of indexed contracts, or its economic interventions during inflationary periods. These measures would encourage the countercyclical nature of the monetary asset.

If the society chooses a real commodity instead of fiat money as its monetary standard, then a similar analysis applies. In this case it may be important for the medium chosen to have low industrial demand so that its price would not be affected adversely by business cycles.

Table 1 presents data concerning the rates of return on six assets: fiat money (the negative of the rate of change of the consumer price index), the New York Stock Exchange Index, the Dow-Jones Commodity Spot Index, and the price of gold, silver, and platinum. The data was collected monthly from January 1972 through March 1978. This short span was partially necessitated by the fact that gold and silver have only recently been freed from government price fixing.

It is very significant that the rate of return on money and the stock market are strongly and significantly correlated, i.e., inflation, at least in the short run, has a negative impact on equities.[7] Although the rates of return on gold, silver, and platinum were positively correlated with inflation, only the return on gold had a negative correlation with the return

on the stock market. In addition, gold had the lowest variability of return of the three metals. Although the negative correlation was not highly significant it is important to note that virtually no American equity has a negative correlation, including those engaged in gold mining.[8]

Of course the fact that inflation is so negatively correlated with the stock market implies that commodities must be a good countercyclical asset. The Dow-Jones Spot Index of traded commodities has about the same negative correlation with the stock market as gold. Therefore diversification into this group of commodities was not any more effective than gold at hedging market movements.

The conclusion of this empirical investigation suggests that gold has favorable countercyclical qualities as a monetary medium. Aside from the fact that the limited supply of gold would lower the average rate of inflation, the metal's characteristic as a hedge asset means that interest-bearing contracts denominated in gold would have lower interest rates and hence the opportunity cost of holding gold is lowered. Of course, fiat money has the natural advantage that minimal resources are employed in its production. Gold production, which would occur in a growing economy with constant marginal extractions costs, ties up resources that would be freed under fiat money. In addition, as mentioned above, proper management of fiat money could lower its current procyclical return and hence the money rate of interest.

IV. Application to Nominal Contracting

It has been shown in the previous section that a desirable characteristic of money in an uncertain world is a return on money that is counter-

cyclical to the return on other assets. However, if individuals and firms possess utility and production functions which are not dependent on monetary variables then in a world where all capital markets are perfect and there is unrestricted borrowing and lending in all securities, nominal contracts would be dominated by indexed contracts.[9] This is simply a consequence of the basic mutual fund theorems of Tobin (1958) and Sharpe (1964) i.e., that all efficient portfolios can be formed by combinations of two assets--one being the sure (real) asset and the other being a "mutual fund" containing all the risky assets in the market. Individuals can form their most desired mean-variance portfolio just from combining the sure assets with varying proportions of the mutual fund containing all assets.

The demand for nominally denominated assets may arise in two situations. The first is where there is a positive net amount of outside money balances, which appear in either the firms' productions functions or individuals' utility functions in a differential manner. In these cases, economic agents have opportunities to hedge unexpected changes in their real money balances by trading nominally denominated assets among themselves. If individuals (or firms) have identical marginal utilities (productivities) of money no welfare improvement can result from trading in money-denominated assets.

A second source of demand for nominally denominated assets may arise in certain situationswhere human capital with uncertain returns is introduced. If a worker must hold his own human capital, then even with unrestricted short-selling of all assets, including the sure asset (often referred to as borrowing at the riskless rate), the mutual fund theorems will not in general hold. This is because an individual will attempt to purchase those assets

with a negative covariance with his specific human capital in order to minimize the variance (for a given return) on his entire portfolio of human and nonhuman assets. (See Mayers (1972)). This fact in and of itself would not necessarily cause a demand for nominal bonds. Assume, however, that due to information costs, moral hazard, and institutional constraints, an individual is not able to complete short-sales or to borrow freely at the riskless rate of interest. In order to minimize the variance of his total portfolio, he may wish to buy counter-cyclical assets, and if the covariance of r_m and π is positive, monetary assets may fulfill this role.

The case for a nominal asset may be applied to wage contracts as well as bond contracts.[10] A wage contract over time is an asset that is purchased by a worker in return for a specified output of labor effort. One can readily use the model developed in Section II to price an indexed wage contract as opposed to one that is nominally denominated. The nominal contract may yield a different expected present discounted value than the indexed one, but in terms of the workers' total portfolio, its "covariance adjusted" yield would be identical. If we assume, however, that human capital cannot be sold or collateralized in unlimited quantities, its variance cannot be totally diversified. A worker may hold more risk, for a given rate of return, than would be available from the general market.

Assume initially that a worker can only be "long" on assets--no short-selling or borrowing is allowed, and he must hold the variability of his own human capital. If one then allows him to sell a quantity of his human capital for a marketable asset, he should choose one that would lower the total variance of his portfolio, which would be accomplished by a money-

denominated asset if the covariance of the inflation rate and real market returns is positive. The nominal bond now provides him with a hedge or counter-cyclical asset.

In the case of supply-induced inflation, where $\text{cov}(\pi, r_m) < 0$, a real contract will be preferred since a nominal contract will increase the variance of his "portfolio" which consists of the nominal contract and human asset. Unfortunately, the use of the capital asset pricing model is more difficult to apply in this case. A wage contract is a major asset in one's portfolio, and hence "portfolio effects," where own variance adds to aggregate risk, becomes important. In this case a real, linked wage contract might be preferred to a nominal one, since the latter suffers price level risk no matter what its covariance with market.

An illustration might be useful. Assume $\text{cov}(\tilde{R}_m, \tilde{\pi}) > 0$. A worker contracts to sell his labor services linked to money, i.e., a nominal contract. Assume there is an unexpected increase in the price level. Although he will have "lost"on his nominal contract, the real value of his human capital will rise, due to the economic expansion. This makes the worker "better off" in terms of the opportunities that confront him. His real marginal product has risen, and hence his capitalized net worth is higher. The fact that he has suffered a loss because of past contracting in nominal terms is only an offset. Conversely, an unanticipated price decline has raised the value of his nominal contract, but lowered his real marginal product and capitalized net worth. In both these conditions, the nominal contract was "insurance" which the worker, on a corner solution in terms of his original portfolio, is more than happy to "buy."[11]

Of course, an individual may still be at a corner solution in "risk-return" space and still have a small amount of financial assets, which, as indicated above, he will probably invest in counter-cyclical assets. This fact may explain the large amount of gold and other precious metals that are hoarded by workers and peasants in many parts of the world. However, since the value of these counter-cyclical assets is very small, the worker, if he is to acquire financial assets, might wish to accumulate counter-cyclical nominal bonds. Nominal bonds will hence be issued by firms (ultimately by individuals who are well diversified in terms of their human and nonhuman capital) to satisfy the demands of workers, and, at the margin of satiation, they will be priced at the level indicated by the CAPM.

IV. Summary

There are two methods for reducing the opportunity cost of holding the medium of exchange. The traditional recommendation has been to lower to rate of inflation in order to reduce nominal interest rates. This paper demonstrates that a monetary medium whose real value fluctuates counter-cycically to real assets in the economy provides a second means of lowering money denominated interest rates. Over recent years in the United States, fiat money has not served this purpose well, showing market procyclical fluctuation in its real return. Gold has displayed the most marked counter-cyclical properties among the precious metals investigated. However government policies can be devised to lower the procyclical nature of fiat money, so that no *a priori* case can be made for the desirability of a commodity money over a fiat money standard.

The paper also discusses the reasons for nominal and indexed contracting. Although indexed contracting dominates nominal contracting in some cases, there would be situations where nominal contracting may be desired if perfect capital market do not exist. Individuals whose return on human capital fluctures procyclically may desire countercyclical nominal contract if short sales of equities are too costly.

Table 1

Monthly Returns on Assets

Asset	Correlation with return on Money	Correlation with return on NYSE	Mean Annual Return	Std. Dev. of Monthly Return
Money	--	.314*	-.070	.003
NYSE	.314*	--	-.014	.040
DJSpot	-.312*	-.103	.173	.068
Gold	-.069	-.098	.259	.071
Silver	-.178	.081	.256	.100
Platinum	-.086	.021	.186	.096

*indicate significant correlation at 95% level.

Time period - Jan. 1972 - March 1978.

Money - Rate of return measures as negative of the rate of change in the consumer price index.

NYSE - Rate of return on NYSE composite stock index.

DJSpot - Dow-Jones Spot Commodity Index.

Metals - All measures are spot, cash prices.

FOOTNOTES

[1]For example, see Chandler and Goldfeld (1977) p. 7, and Dornbusch and Fischer(1978), p. 209.

[2]See Barro and Fischer (1976) for a survey of such literature.

[3]The following specification is derived in Siegel (1974) and Siegel and Warner (1977). More complete specifications can be found in Fischer (1975), Roll (1973), and Friend, Landskroner, and Losq (1976).

[4]Refer to Fama-Miller (1972), p. 292.

[5]A recent paper by Barro (1978) rigorously analyzes this correlation.

[6]The existence of nominally denominated bonds only transfers wealth between equity and bondholders in the events of unanticipated price changes. If the market is defined to include bonds as well as equity, then unanticipated inflation will have no effect on <u>total</u> market returns.

[7]See Brenner and Galai (1976), Sarnat (1976), and especially Cagon (1974) for a discussion of this correlation.

[8]See "Common Stock Risk Measures," Rodney White Center for Financial Research (1977).

[9]See Modigliani (1974), Fischer (1975) and Blume (1976) for elaborations on this point.

[10]See Blinder (1977)

[11]Of course, purchasing a nominal wage contract does not always guarantee employment during the entire period, so the expected real wage must take this into account. The question of why workers may prefer uncertainty in employment to uncertainty in (nominal) wages is beyond the scope of this paper.

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