

**FOR RELEASE ON DELIVERY  
7 : 00 P.M. E.S.T  
MARCH 16, 1989**

**Paper presented by**

**Wayne D. Angell**

**Member, Board of Governors of the Federal Reserve System**

**at the  
Sixteenth Annual Meeting  
of the  
Virginia Association of Economists**

**March 16, 1989  
Charlottesville, Virginia**



# **Commodity Prices and Monetary Policy: Empirical and Theoretical Considerations**

by Wayne D. Angell\*

It is a pleasure to have this distinguished audience to review some issues in monetary policy, issues that have been of increasing interest to me and other economists during the last three years. As you probably know, in December 1987, in a speech at the Lehrman Institute, I proposed that the Federal Reserve give commodity prices an expanded role as a price guide to adjust target ranges for short-run money growth. I made this proposal so that the financial community would have a better understanding of the role I had given to commodity prices in my Senate confirmation testimony and subsequent policy statements. In the early 1980's, I became aware that the income velocity of money had lost much of its predictability. Increasingly, I found myself turning to commodity markets to obtain a better view on the scarcity of money. Without such a reliable guide, it had become difficult to assess the inflationary effects of alternative rates for money growth. Since the most important goal of the Federal Reserve is to stabilize the general price level, we had to find a way to recognize the first signs of impending inflation or deflation to help us avoid "stop/go" policies that may be unavoidable without timely information. So I welcome this opportunity to elaborate on my earlier remarks and place them in the broader context of some theoretical and practical issues that have been raised by my proposal.

The American economy has been experiencing one of the longest peacetime expansions in memory, and the question is increasingly asked, how long can this continue? Since the beginning of 1983, the economy has grown at an

\*In developing these ideas, I benefited greatly from the counsel and research efforts of John Rosine, Peter Tinsley, and Peter von zur Muehlen. Peter von zur Muehlen contributed to the research on this topic and to the drafting of this speech.

average annual rate of nearly 4 percent. The 3 percent average rise in consumer prices during the current expansion is encouraging, especially, since it followed a period of intolerably high inflation during the seventies. Judging by the last four years, matters seem to have settled down to a tolerable, albeit a somewhat uncomfortable pace. Why should anyone complain? The unavoidable fact is that while the well-being of the American economy requires stable prices, in 1986 it also needed a readjustment of dollar exchange rates from a level that had rendered the economy non-competitive in international markets. A secondary consequence of these exchange rate adjustments can be seen in the recent up-ticks in producer and consumer prices to year-over-year rates of around 4 1/2 percent, suggesting that monetary restraint must be ever more vigilant during periods of downward exchange rate adjustments.

Given the Federal Reserve's commitment to price stability, we must consider what the central bank can do, not only to keep that promise but also to engage the collective will to stay on course. In that task, there is seldom agreement. The science of economics is not endowed with many certainties. It is instead a body of views and experiences with a common language, a discipline with its own dialectic, a science with theories that seem to have built-in half lives equal to the length of a typical business cycle. In coping with a world that changes faster than opinions about it, we need a monetary policy guide that allows us to keep our view focused on the future rather than the past, to keep us from always having to fight the last war.

Our understanding of the nature of business cycles always seems precarious, although we have made progress. We now have only three classes of competing theories: the traditional Keynesian model based on nominal wage rigidities, the "new" Keynesian paradigm based on imperfections in product and capital markets, and real business cycle theory, which views random

shocks to technology as the single cause of persistent, economy-wide fluctuations. As soon as we discover a new insight, the world seems to have changed, once more. I wonder if the focus of business cycle theory is always relevant. Business cycle theories tend to concern extremely aggregate phenomena so that in watching the forest, the trees that make up the forest may remain unnoticed. Is it necessary for all purposes to take a strictly synchronized view of the various “natural” cycles in sectors and even firms? Are we not sometimes looking at macro cycles that are no more than the effects of “stop/go” monetary policy? It is possible that by looking at speculative auction markets, perhaps even disaggregated ones, we may gain another perspective that would help us discern future inflationary trends.

Policy makers are rarely theoreticians, and vice versa. Nevertheless, my perception does reflect a certain theoretical conviction, even if informal, because all of us subscribe to some economic view that could be given a recognizable label. In a sea of often conflicting information and in light of what we only imperfectly know about the workings of this world, monetary policy is charged with keeping prices stable without also sinking the ship. My model affects my interpretation of the facts on which we act. It is some of these views that I want to share with you now.

Let me give you some very recent historical background. The supporting evidence is illustrated in the charts at the end of the printed remarks. Between the second quarter of 1984 and the end of 1986, money, as measured by M1, accelerated to a growth rate of close to 18 percent. This episode looks like one in which the Fed supplied unduly easy money. But during that same period, the growth of nominal GNP remained quite low and stable, while inflation, as measured by the annual rate of growth of the consumer price index (or the GNP deflator), actually declined, from above 4 percent to below 2 percent. In

other words, the income velocity of money declined sharply during that same period, a phenomenon that is commonly attributed to deregulation of financial markets and to innovations which led to large portfolio shifts from real to financial assets. From my own perspective, I anticipated the decline in velocity from the behavior of commodity prices; the economy required much more liquidity to maintain the same amount of real activity than it had before these changes. Put differently, the definition of *monetary scarcity* had been revised, as commodity price deflation increased the store-of-value usefulness of money.

With the caveat that evidence from single episodes after the fact is not strictly scientific, let me nevertheless tempt you with the following example from recent history. The scenario for 1986 and 1987 is fairly well agreed upon. In 1986, M1 continued accelerating until its growth reached a peak during the first quarter of 1987. The federal funds rate, considered by some to be a measure of tightness or looseness of monetary policy, fell during that period. The growth rate of the **Journal of Commerce** commodity price index fell until mid-1986 and then began a year-long and fairly steep rise. The inflation rate of the consumer price index continued its decline until the first quarter of 1987, its turning point following that of the commodity price index by half a year. In mid-1986, prices were still decelerating. A tightening of monetary policy looked to those not watching commodity prices as quite unnecessary. But from hindsight, almost everyone might now conclude that raising short-term rates would have been exactly the right thing to do. It would have meant an increase in real rates, and that would have choked off the rapid rise in commodity prices, and possibly inflation, half a year later. My gut feeling at the time was that such an action would have been advisable. Since all com-

modity price indexes had risen by March of 1987, I was sure that considerable monetary restraint had become necessary.

I made the original proposal for greater reliance on commodity prices in monetary policy making as a way of introducing a category of information that might be useful in monitoring inflation, especially future inflation. Since the effects of monetary policy on the general price level tend to be long and possibly variable, some mechanism of obtaining advanced warnings would be desirable. Why commodity prices? There are several arguments, some advanced by Irving Fisher in 1914. More recently, in 1975, Arthur Okun drew a distinction between manufactured goods and services on the one hand and basic commodity goods on the other. The distinction was based on the way they are bought and sold. Finished and intermediate goods are traded in conventional imperfectly competitive markets featuring product differentiation. In some cases, their prices tend to exhibit Keynesian stickiness. Commodities, by contrast, are for the most part easily stored and traded, and so take on certain properties of speculative assets. Indeed, commodity prices are determined in competitive auction markets and are much more responsive to changing market conditions, particularly exogenous “supply shocks,” such as weather, war, currency developments, changes in cartels, and—most important—changes in monetary policy. Since day-to-day movements in commodity prices are driven principally by arbitrage, the distinction between the markets for commodities and financial assets is in some sense superficial. Market expectations of future inflation, and therefore indirectly of future monetary policy, are important determinants of commodity prices. Accordingly, if traders expect an increase in inflation, the demand for commodities will rise, causing an increase in current commodity prices. If final product prices are somewhat fixed in the short run, adverse supply shocks will first cause reduc-

tions in output. However, commodity prices are free to react instantaneously. They are then a part of the transmission mechanism for inflation by which final product market prices eventually adjust to a new equilibrium.

The close relationship of commodities with financial assets can be further illustrated. Consider an increase in the supply of money. A sudden 1 percent increase in the supply of nominal money implies a rise in real money. Eventually, all prices must rise, so that the amount of real money in the economy will remain as before. Money market participants know this, of course, and expect prices to rise eventually. But that's the future. For the moment, while prices have not yet adjusted, an increased demand for bonds will put pressure on bond prices and cause short-term nominal interest rates to fall. Being asset markets, commodity and foreign exchange markets respond as well, given exploitable profit opportunities. If interest rates have fallen, the principal short-term cost of carrying commodity stocks must also have fallen, and the prospect of profit from those stocks has been enhanced. Likewise, the drop in the nominal short-term rate opens a gap between foreign and domestic interest rates, putting pressure on the price of foreign currencies. Since the expected return to Treasury bills can be no less than the expected return to holding commodities or foreign currency, spot prices of Treasuries must rise. But, since prices in the rest of the economy are less flexible, these asset prices must rise more in the short run than they are expected to in the long run. The lesson we learn from this example is that **when some sectors cannot adjust freely during the short run, other sectors will tend to adjust more than proportionally to a monetary disturbance.** An interesting by-product of this distortion is that **commodity and exchange markets are able to offer highly visible signals of future price events that the central bank may wish to exploit.**

Given that commodity prices, monetary events, and general prices are linked over time, we may also consider the effects of policy. I will first mention an *ad hoc* decrease in the expected long-run growth of money, a kind of pure and nonvolatile version of what was attempted during the early eighties. Eventually, long-run inflation and hence nominal interest rates tend to drop in the same proportion, and the market expects them to do so. If there are simultaneous changes in the velocity of money, the interest rate adjustment will be correspondingly more or less. In any case, changes in velocity would precede changes in real GNP. However, in the short run, nominal rates do not fall by their full expected amount, since current inflation cannot adjust instantaneously. So, the real interest rate actually rises. This means that the cost of carrying stocks remains higher than the expected appreciation of commodity prices, forcing those prices to drop below the equilibrium value implied by the new money growth rate. Here too, then, commodity prices (and exchange rates) are able to signal the course of expected inflation: **a future rise or decline of the general price level is anticipated by an exaggerated movement in commodity prices.**

In the early eighties, I and others in the financial community noticed that Friday afternoon surprises in money growth—the differences between expected and published amounts—tended to be followed by changes in short-term rates in the same direction. A positive surprise, an unexpected increase in the growth of M1, for example, was met with an increase in the short-term interest rate. But did this phenomenon appear because market participants expected the Fed to maintain its targets and attempt to return money to path by selling treasury bills? Or was it because market participants, believing the Fed to be flagging in its resolve to maintain monetary targets, expected future inflationary pressures? In either case one might have seen interest rates rise,

although the two cases would have different consequences for the yield curve. Then how could one make a distinction? One answer is provided by the behavior of commodity and foreign currency prices. For example, if, upon a positive monetary surprise, short-term rates rose while commodity prices and the dollar price of foreign currency fell, then we could consider such reactions additional evidence that the market expected the Fed to tighten up. Historical evidence suggests that between December 5, 1980, and November 1, 1982, positive money surprises led to reductions in commodity and foreign currency prices. In what looks like an affirmation of the Fed's credibility, the market responded to positive money surprises by expecting future monetary contraction and a consequent increase in the real interest rate.

Given the theoretical and empirical evidence that commodity and foreign currency prices play such important roles as bellwethers of market expectations and signals of future inflation, it is natural to consider their place in formulating monetary policy. As I outlined in 1987, commodity prices might be most useful, not as targets per se, but as aids in setting ranges for short-term money growth. My colleague at the Board, Governor Johnson, has clearly joined me in utilizing price information from asset markets for the very reasons I have mentioned. In a speech to the Cato Institute in 1988 he had this to say:

*Changes in monetary policy should be reflected in these financial auction market prices well before they affect the broader price measures. Thus, there is reason to believe they may give advance warning of impending change for important concerns such as inflation.*

In fact, it was my friend Ernest Fleischer who suggested to me in 1977 that commodity prices are relevant to the behavior of the general price level. My first professional skepticism gave way to understanding when I realized

that commodity prices are determined in auction markets, making them very sensitive to current and expected market conditions, especially to expected inflation. Also, since current commodity stocks are the basic inputs to future manufacturing; current commodity prices may be expected to give some indications of future production costs and final product prices. Finally, while product price information becomes available only monthly at best, commodity price data are published every single day.

Even though intuition and experience may be insufficient to make a case, those who make policy and those who watch policy makers may wish to review some evidence that commodity prices can serve as useful indicators of inflation. The evidence is statistical and quite new and ongoing, so one should regard it with the usual reservations.

First, let us look again at the visual evidence I presented in 1987. Plots of the consumer price index and the **Journal of Commerce** commodity price index (which excludes fossil fuel, food, minerals, and precious metals), and the relative price of commodities measured by the ratio of the two, tell us the following. Consumer prices have been trending upward with little volatility. Nominal commodity prices have been trending up at a lower rate but with far greater variability. As a consequence, relative commodity prices have had a downward trend and considerable volatility. On the surface, volatile and unstable relative commodity prices suggest an unstable relationship between nominal commodity prices and the price level, thereby seeming to cast doubt on the proposal to tie monetary policy to movements in commodity prices. But this conclusion is not necessarily valid. First, questions of trend are easily addressed by appropriate detrending, as illustrated in Chart 4 showing the growth rates of the consumer price index, the **Journal of Commerce** commodity price index, and the relative commodity price. Second, an apparent

relationship between the growth rate of past commodity prices and current inflation can be seen if one compares the growth patterns of these two series. The separate plots of the CPI and commodity price inflation rates suggest a broad correspondence in movements of the larger cycles with a lag, although the phasing is perhaps not constant over the indicated historical period. The relative commodity price, which only measures contemporaneous behavior of these two prices, does not reflect this correlation. I believe that research into the usefulness of commodity prices as leading indicators of general prices might address the apparently time-varying relationship of these series.

Much of the econometric research is being conducted either at the Federal Reserve Board or at various District banks, and there is a growing stock of academic work. A bibliography appears at the end of the published version of these remarks. The research falls into five broad categories: (1) structural, reduced-form, and vector autoregressive regressions to test whether commodity prices help explain the behavior of some measure of inflation, such as the CPI or the GNP deflator; (2) out-of-sample forecast trials to see how well particular regressions with commodity prices predict inflation; (3) Granger causality tests exploring via statistical analysis the direction of "causation," that is, whether from general prices to commodity prices, or vice versa; (4) co-integration tests based on the idea that if general inflation is economically related to commodity price inflation, then the errors obtained from a regression must not tend to become infinitely large over time; and (5) a probabilistic turning-point analysis that attempts to derive a rule for predicting when inflation has reached a turning point based on the past cyclical behavior of commodity prices. The results are mixed but not discouraging.

Traditional reduced-form regression models indicate changes in commodity prices might be useful for *predicting* changes in general prices and

that this cannot be said for their respective levels. It has also been found that commodity price changes were more helpful in *explaining* inflation after 1974 than they were before, when the growth rate of money appeared to be a better predictor. One reason may be that after 1974 the increases in money volatility tended to increase the correlation between past commodity prices and inflation. I will propose another reason toward the end of my talk, one having to do with the behavior of asset prices and the diligence of monetary policy. Current staff work at the Board with modeling of the inflation process provides additional evidence that commodity prices can affect the inflation-unemployment trade-off to a small degree and that they contribute marginally to better forecasting of inflation.

In light of the previous finding of a reversal of roles between money and commodity prices in predicting inflation, current research is investigating how the relationship between inflation and commodity prices may vary over time. The answer to that question may also yield improved methods for forecasting inflation using past commodity prices. In vector autoregressions, one relates sets of variables like inflation, commodity prices, money, and interest rates jointly to past values of the same variables. Studies using this method do not purport to be motivated by any theory of economic behavior. But they do give marginal support to the view that commodity prices have predictive usefulness.

The widely used method of *Granger "causality"* testing also lends mild support to the hypothesis that commodity prices, individually or in the form of some index, can be used to forecast inflation. Interestingly, these tests reject gold as a plausible predictor.

Earlier, I mentioned that commodity prices tend to be more volatile than general prices, although during the past twenty years, their inflation rates

have had little trend. I have suggested that commodity prices are determined in auction markets and thus reflect expectations of future prices and that their movements are closely related to disequilibrium in the real rate of interest. Thus, the short term correlations between the general price level and commodity prices may mask the inherent equilibrium relationship specified by theory. To investigate underlying economic relationships among economic variables, econometricians have turned to testing the presence of co-integration. Time series, like general prices and commodity prices may appear *non-stationary* when viewed separately. For example, they may exhibit non-zero trends. Their relationships may, however, be *stationary*. That is, they may never move very far away from each other. If that is the case, then despite outward appearances, such series may well be causally related to each other in a deeper way than is captured by the usual correlations or regressions. So far, co-integration tests have failed to verify the existence of a long-run relationship between the general price level and commodity price levels. I might add that there is controversy concerning the validity of using these tests to uncover the existence of equilibrium relationships.

A final, related approach tries to find ways of predicting the important turning points rather than every movement in the general price level. We all want to know, for example, whether inflation has reached or is about to reach a turning point. To find out, researchers have developed a method of calculating the probability of an impending turning point, given past and current observations of a leading indicator series, which in our case could be one or another commodity price index. If these test are able to demonstrate a predictable relationship between the turning points of commodity prices and inflation, then we should also be in a position to fine-tune an optimally weighted commodity price index.

We do not know what would happen if we were to incorporate commodity prices in a formal decision framework. But having cited some evidence that encourages me and a growing group of researchers and policy makers, in the belief that commodity prices could play a useful role, we may speculate on what the consequences might be, at least approximately. Let us then imagine an economy subject to disturbances in its real and financial sectors. Imagine also two policy regimes. In the first regime, the central bank is monetarist and sets a constant rate of money growth. As in the real world, it may do so with an error. In the second regime, the authority amends its constant-growth rule by responding optimally to deviations in a commodity price index from its desired—or equilibrium—level. It has an incentive to look at commodity prices because information about them becomes available one period earlier than it does for other prices. We may assume that the central bank wishes to minimize the volatility of inflation, which it cannot observe in the current period. It turns out that with a purely monetarist rule, the volatility of prices is completely determined by all the disturbances in the economy without being offset by the central bank. In the second regime, when the authority restricts the supply of money whenever it observes that commodity prices exceed a desired level, the central bank is doing something to offset the effects of disturbances on the volatility of prices. Further, because the central bank is assumed to be acting optimally, total price volatility can actually be reduced. The two most important assumptions in this scenario are that commodity prices can be observed when the general price level is still unknown and that the two sets of prices are related to each other. The first assumption is an institutional fact; the second is justified by some encouraging statistical evidence.

Having said so, we owe it to ourselves to consider some opposing arguments. I know there are some caveats to interpreting relationships based on

historical evidence, when the effects of policy are under consideration. Our understanding of the effects of using commodity prices as a guide comes from a reading of the past when such a guide was not used. Our knowledge of the past may therefore not encompass the full extent of market reactions to this kind of shift in policy. Once the public learns of this change, it may react in ways that one cannot fully predict beforehand. We may (or may not) find that the relationship between commodity prices and general prices will be different from one estimated during times when commodity prices did not serve as indicators or targets. This supposition is based on the well-known *Lucas* critique, which holds that one cannot use historical evidence in reduced-form relationships among variables to make assertions about the consequences of hypothetical changes in the economic environment. This critique, in turn, is based on the plausible claim that individuals and organizations are rational and form expectations using all available information, including news about a policy change. Economists have responded with models of economic behavior based on consistently formed expectations, the so-called *rational expectations hypothesis*. But generally, except in the simplest of cases, the conclusions are not unique. In our case, after we know more about the present relationship between commodity prices and the general price level, we will then want to learn how—in principle—auction prices in asset markets tend to react to announced shifts in monetary policy regimes.

To understand how asset markets respond to policy and how market reactions affect the general price level one must resort to exercises in theory. Let us then imagine the extreme case in which the public is suddenly endowed with perfect foresight, with the ability to understand how the Federal Reserve operates and how the economy works. In this example of a deterministic, mechanical world, the timeliness of information about commodity prices would

bring no advantage. Redirecting attention to commodity prices would be a mere distraction that might even raise the variability of prices. Nevertheless, this abstract example has value. It tells us that commodities share certain properties with asset markets that make their prices behave in certain ways depending on policy. When product prices are sticky, the first response to a policy change is a realignment of the real interest rate. Other prices being fixed, asset prices will respond as long as there are rational auction markets. The result is overshooting of commodity prices. Interestingly, the more clearly defined the Fed's inflation goals are, and the more diligently the monetary authority pursues them, the smaller the overshooting phenomenon becomes. The relationship between commodity prices and the general price level diminishes; the signal weakens. But that is as it should be. A successful inflation policy relieves us of the need to monitor extraneous events. I am convinced that market reception of the role of commodity prices enabled the Fed to get double mileage out of the restrained tightening during the Spring of 1987, when we allowed the federal funds rate to increase by 75 basis points and when market responses caused the yield of 3-year Treasury notes to rise nearly 150 basis points.

The simple economy to which I allude shares with the real world the important role of perfectly competitive asset markets. But, unlike this product of the imagination, our **real** world lacks perfect foresight. My proposal at the Lehrman Institute was addressed to the needs of an imperfectly informed society in this real and fallible world, where the threat of inflation is perennial, and where the timely and instantaneous nature of commodity price information can be exploited.

Earlier, I referred to regressions for data spanning the sixties, which appear to show little predictive usefulness of commodity prices for general

prices. For data of that period, M1 turns out to be the better predictor. But that period was also one of inflationary calm. For a sample period starting later, in the early seventies, the conclusion is far different. As we know, that later period was one of considerable inflation. Could it be that commodity markets sensed a diligence and even the success of monetary policy during the earlier period?

For the sake of completeness, I will mention an often cited reason for caution in adopting a commodity price rule. It is the difficulty of identifying sources of instability in the relative price of commodities. While a sharp upward movement in the commodity price caused by an increase in inflationary expectations might well justify opposing actions by the central bank, a fully countering response would not be called for if the movement originated in a real supply shock, such as drought or a rise in OPEC prices. But usually, supply-side shocks, being market specific, cause price changes predominantly in affected commodity markets. By focusing on groups of commodities via an index, the issue of identifying sources of instability can be easily avoided. As a further aid, it may even be desirable to look at diffusion indices of commodity prices to give us some idea of the pervasiveness of price changes in commodity markets.

As I said in the Lehrman Institute talk, I view my proposal as a means to re-establishing not only a stable price level, but equally important, a stable relationship between money and prices. We have passed through an epoch of financial deregulation and innovation—an epoch that saw the internationalization of real and financial markets in the U.S. economy, and increasing interdependence among primary and finished good markets in the world. We should all hope that the time has returned in which the relationship between money and prices will re-assert itself. In the meantime, the additional com-

pass of a commodity price guide, to help us in the dead reckoning, may speed us along to our goal.

## Bibliography

- Baillie, Richard, T. "Commodity Prices and Aggregate Prices: Would a Commodity Price Rule Be Worthwhile?" **Working Paper**, Michigan State University, Department of Economics, October, 1988.
- Boughton, James, D., and William Branson. "Commodity Prices as Leading Indicators of Inflation," **IMF Working Paper**, International Monetary Fund, Research Department, October, 1988.
- Durand, Martine, and Sveinbjorn Bloendal. "Are Commodity Prices Leading Indicators of OECD Prices?" **Working Paper**, OECD, Department of Economics and Statistics, February, 1988.
- Fisher, Irving. **Why the Dollar is Shrinking**, MacMillan, New York, 1914.
- Fullerton, M. Thomas, Jr., Richard A. Hirth, and Mark, B. Smith. "Inflationary Dynamics and the Angell-Johnson Proposals," **Working Paper**, University of Pennsylvania, Department of Economics, 1989.
- Garner, Alan, C. "Commodity Prices: Policy Target or Information Variable?" **Working Paper**, Federal Reserve Bank of Kansas City Research Division, 1988.
- Horrigan, Brian, R. "Monetary Indicators, Commodity Prices, and Inflation," **Working Paper No. 86-7**, Federal Reserve Bank of Philadelphia Research Department, 1986.
- Klein, Lawrence, R., and Matild Horvath. "Early Warning Signals for Inflation and Exchange Rate Fluctuations," **Working Paper**, University of Pennsylvania, 1988.
- Okun, Arthur. "Inflation: Its Mechanics and Welfare Costs," **Brookings Papers on Economic Activity**, no. 2, 1975.
- Webb, Roy. "Commodity Prices as Predictors of Aggregate Price Change," **Economic Review**, Federal Reserve Bank of Richmond, November/December, 1988.
- Whitt, Joseph, A. "Commodity Prices And Monetary Policy," **Working Paper 88-8**, Federal Reserve Bank of Atlanta Research Department, December 1988.

Chart 1  
Growth of GNP and its deflator  
Three-month moving averages of year-to-year percent changes

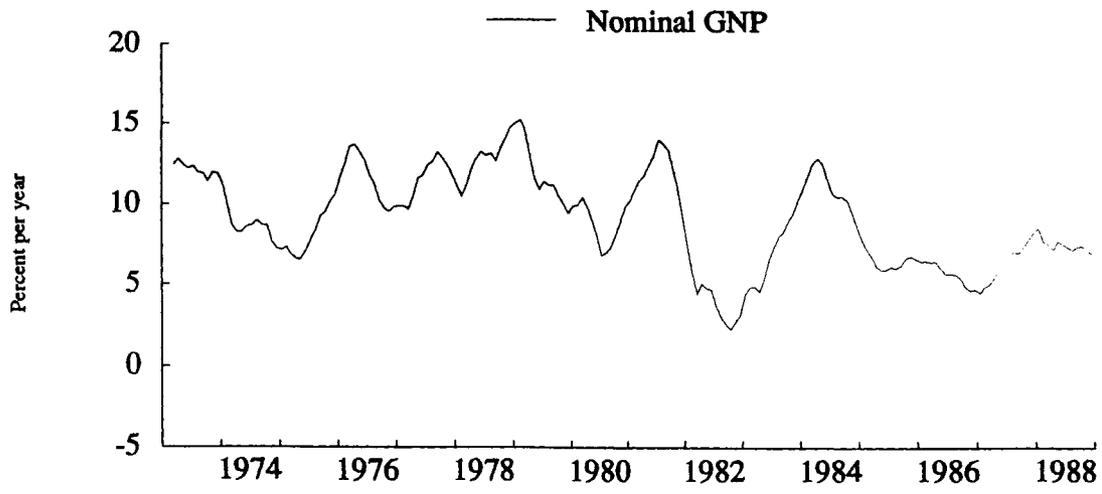
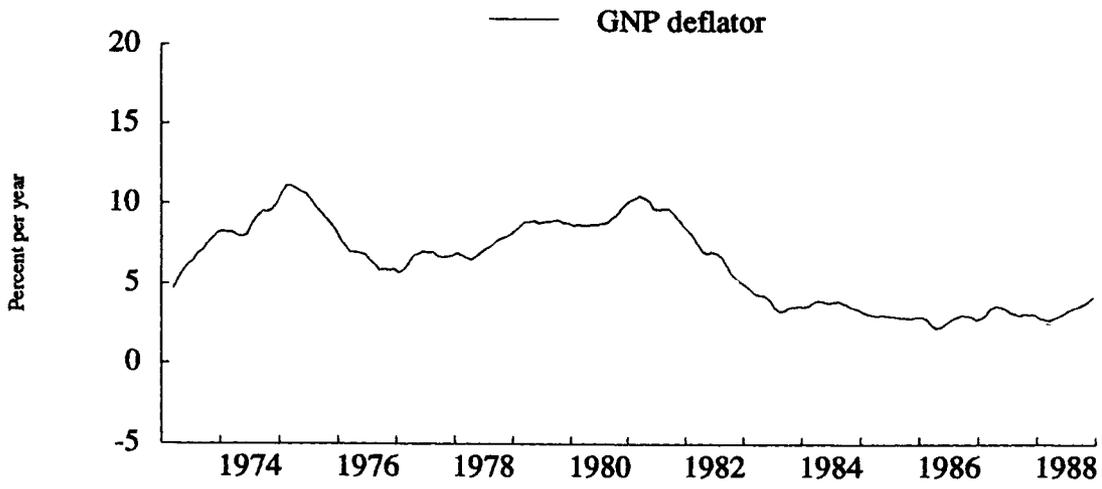
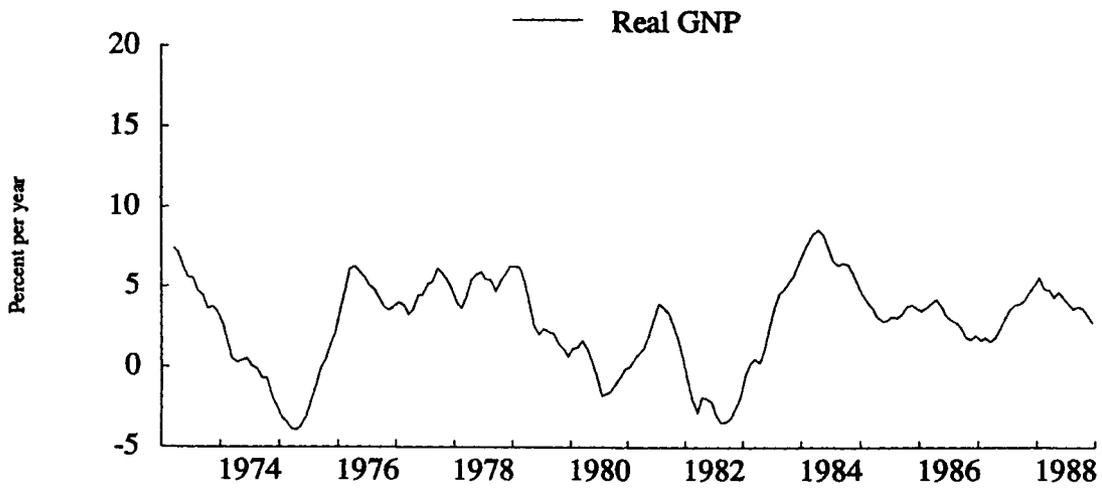


Chart 2

### M1 growth, M1 velocity, and the federal funds rate

Three-month moving averages of year-to-year percent changes

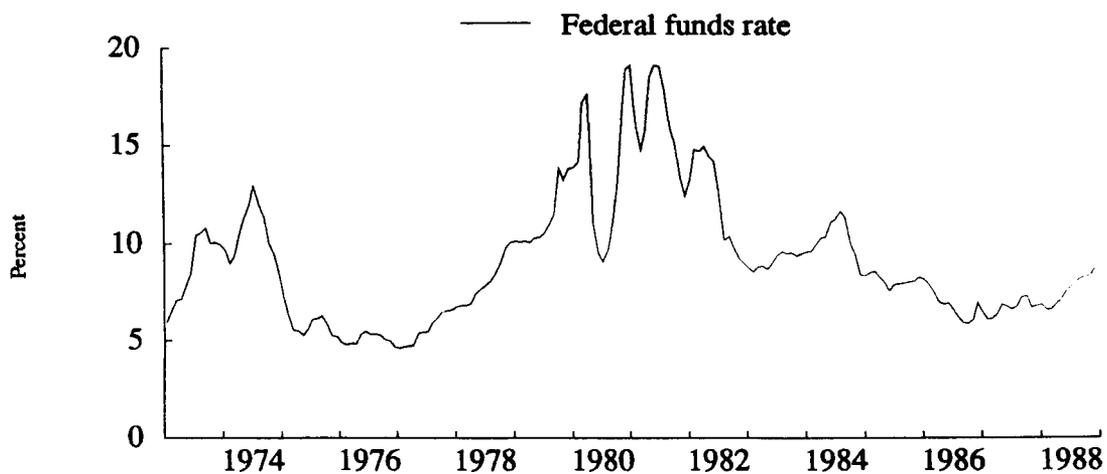
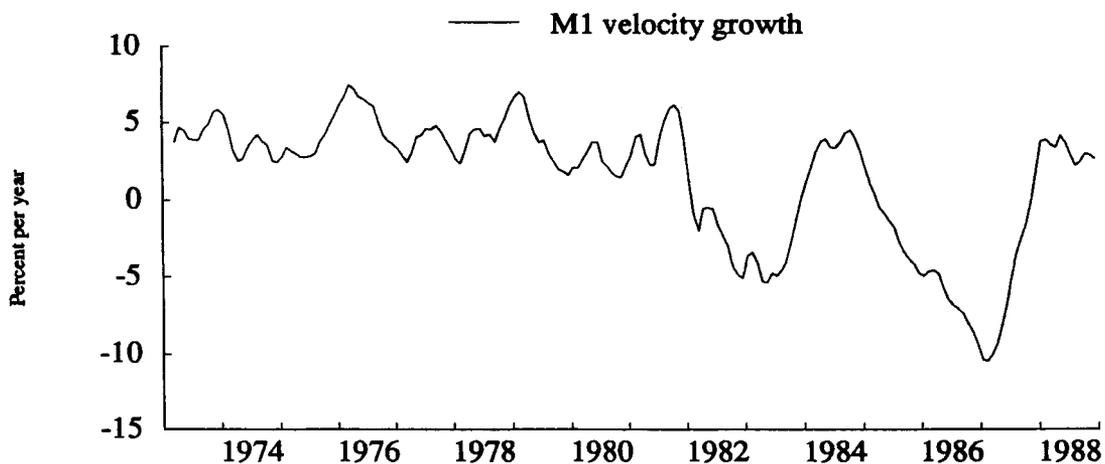
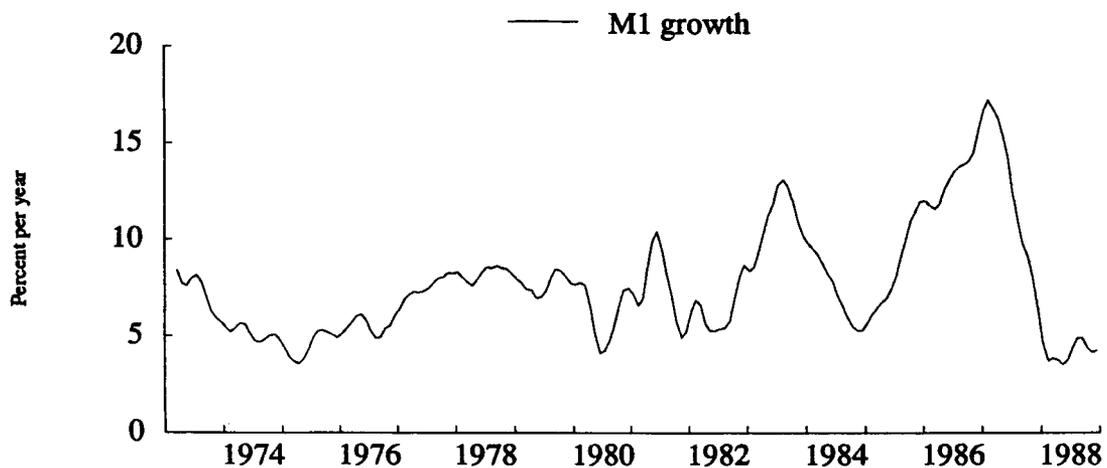


Chart 3

# The Consumer Price Index, and Nominal and Relative Commodity Prices

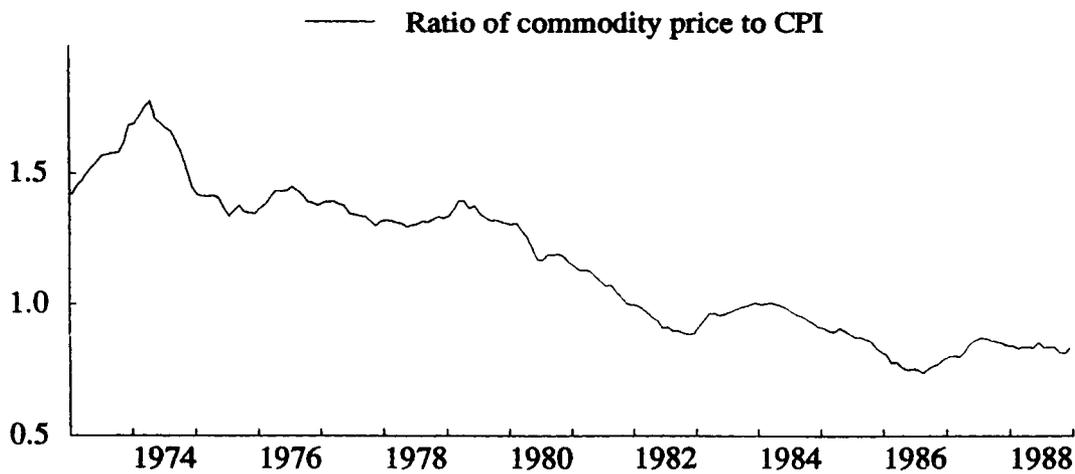
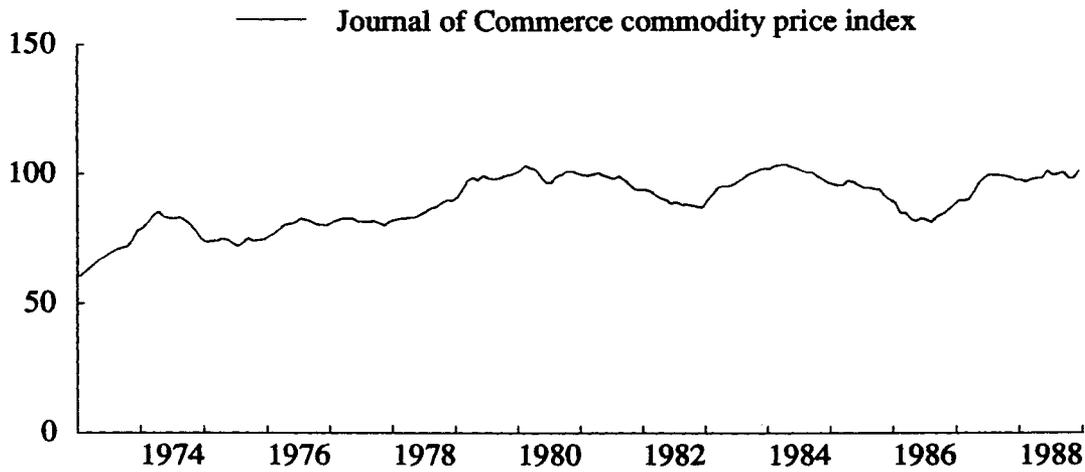
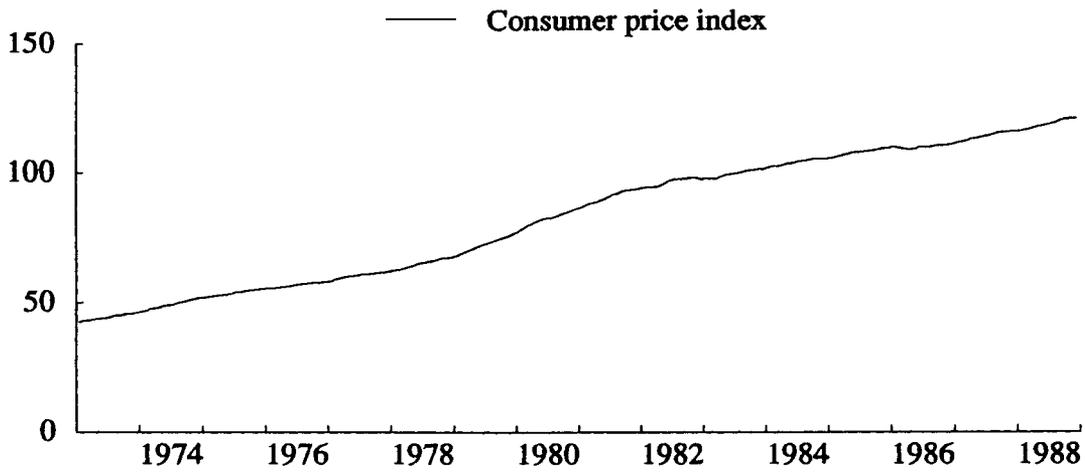


Chart 4  
**Inflation Rates**  
Three-month moving averages of year-to-year percent changes

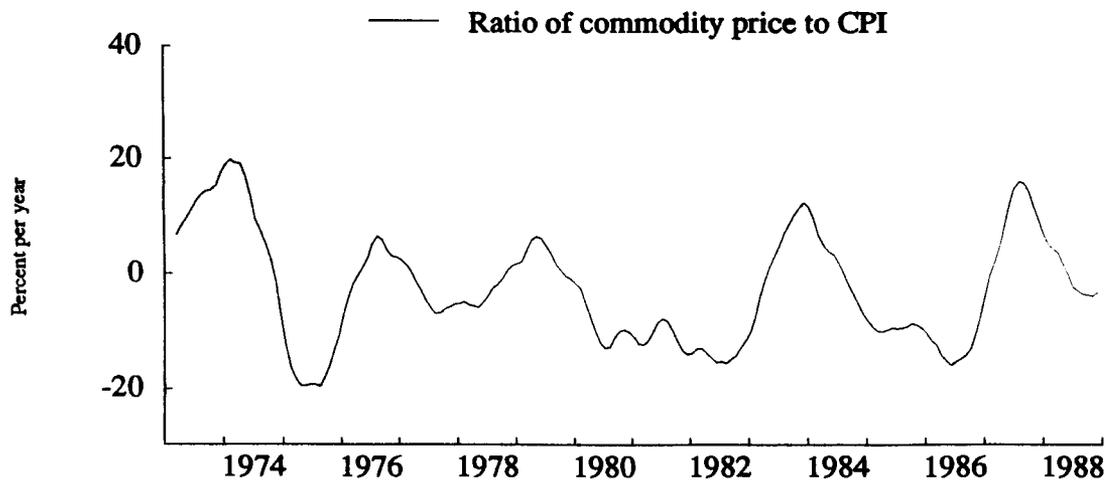
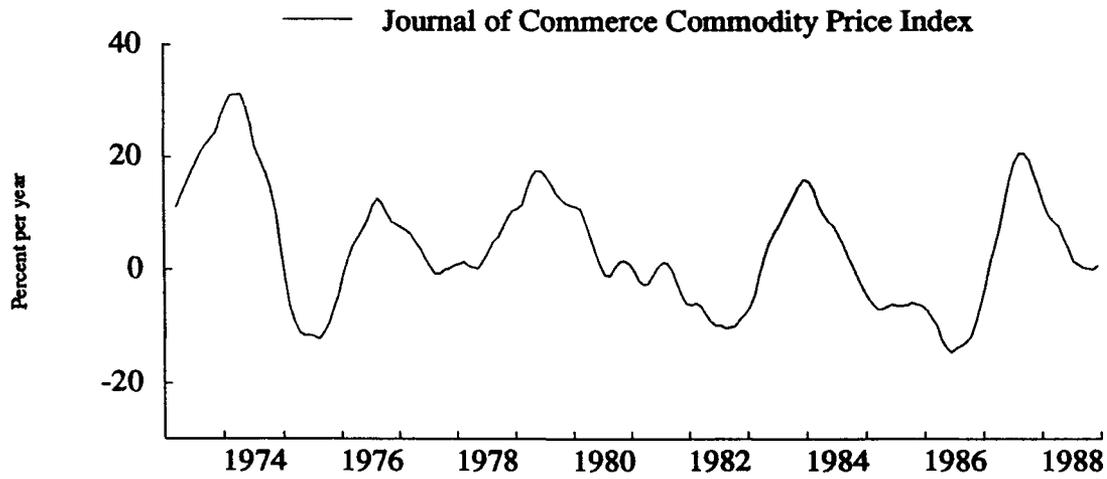
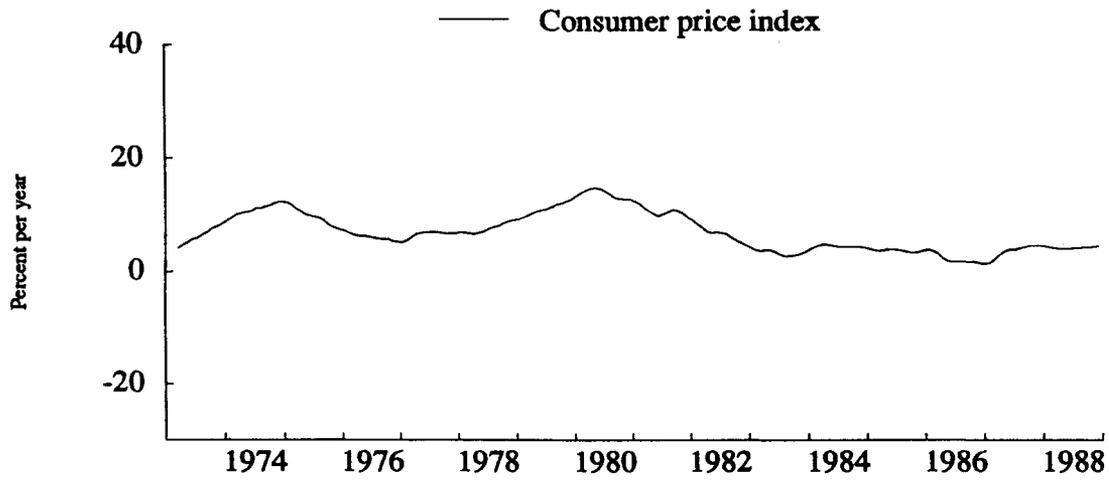


Chart 5

### Nominal and Real Interest Rates

