Commodity Prices and Money: Lessons from International Finance

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Many commodity prices have been falling rapidly recently. As of Thursday, 31 July 1984 the Journal of Commerce's Index for Raw Industrial Materials had declined 10% relative to March and 20% relative to its peak value in 1980. In the current lull between political conventions this counts as something of a hot topic in Washington.

Some "supply-siders" like Alan Reynolds (from Jude Wanniski's firm Polycenomics) are warning that the large decline in commodity prices is signalling a general deflation throughout the economy, and the possibility of widespread defaults reminiscent of the 1930s. Congressman Jack Kemp wants the Federal Reserve Board to adopt a monetary policy rule that would automatically expand whenever commodity prices are low, as now, and automatically contract whenever commodity prices are high, as in the late 1970s. There has even been talk about embodying such a monetary rule as a plank in the Republican Party platform in Dallas this month. Seldom before have steel scrap, cotton, and hides seemed so glamorous.

My topic today is the determination of the prices of basic commodities, everything from agricultural commodities to the gold and other metals so precious to the supply-siders.

Microeconomists and Macroeconomists

If one had to choose two subspecies of economists that have had the least interaction, those who study agricultural economics and those who study international finance would be fairly high on the list. I should not have much difficulty convincing you that international trade is increasingly important for U.S. agriculture; farmers currently derive around 25% of their gross revenue from exports. But when I say "international finance," I mean the macroeconomics or monetary economics of open economies as opposed to international trade. Agricultural economics has always been overwhelmingly dominated by microeconomists. Many of you may think that you are safe in leaving macroeconomics to the macroeconomists. But international finance has changed a lot in the last ten or twenty years; I hope to convince you this morning that recent developments in the field hold some useful lessons. The obvious metaphor is crossfertilization between fields. At the end of the guided tour, we will return to the starting point where I will have some thoughts on implications for the current policy debate in Washington.

Let us begin by asking why agricultural economics has always been an overwhelmingly microeconomic field. The reason is that the classical economic paradigm applies to agricultural markets better than anywhere else. The commodities are relatively homogenous, storable, and transportable and are traded on competitive markets. One does not normally inquire into who the original producer was before buying an agricultural commodity, Arbitrage insures that, for example, soybeans sell for the same price in New York as in San Francisco or London. If there is an increase in demand for soybeans, it is instantaneously reflected everywhere as an increase in the price. None of these propositions applies to automobiles or haircuts.

The key development in the field of international finance in the last ten or twenty years has been the recognition that the classical paradigm applies also to financial assets. International financial markets are highly efficient today, at least among those countries

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prices, so as to keep relative prices unchanged, a property referred to as the homogeneity of the system. Internationally, a doubling of one country's general price level is in turn said to cause a doubling of its exchange rate, so as to keep relative prices of domestic and foreign goods unchanged when expressed in a common currency, a property referred to as purchasing power parity. In short, money is said to be neutral with respect to relative prices.

This dichotomy would seem to have the advantage that it provides an easy division of responsibility between the microeconomist and the macroeconomist. However, I will take the position in a moment that the neutrality of money is a property that holds only in the long run and does not accurately describe the world in the short run.

The second concept is interest rate parity. Assume that speculators—or, less pejoratively, investors—choose their investments so as to maximize expected return. Interest rate parity tells us that, in order for an asset to be willingly held by investors, there must be an expectation on the part of investors of future increases in the dollar price of the asset; this rate of expected appreciation is tied to the interest rate on, say, treasury bills. The two need not be precisely equal: there can be an extra term representing direct costs or returns to holding the asset beyond the expectation of an appreciation in its value. But when the interest rate increases, there must be a corresponding rise in the expected rate of future appreciation of the alternative asset. When the asset in question is a foreign currency, the expected rate of appreciation is the expected rate of change in the dollar exchange rate and the extra term I mentioned is the foreign interest rate. In other words, the expected rate of appreciation of the foreign currency against the dollar is equal to the U.S. interest rate minus the foreign interest rate. For example, in the late 1970s, the U.S. nominal interest rate was higher than the German nominal interest rate, reflecting an expectation of future depreciation of the dollar against the mark—an expectation, incidentally, that was borne out in the event. When the asset in question is a storable commodity like gold or wheat, the extra term is any utility derived directly from holding it (which is likely to be relevant for gold, but not for agricultural commodities) minus the cost of storage including insurance, spoilage, and so on. In the late

Seven Concepts from International Finance

I propose here to consider seven concepts that have become prominent in the literature on the determination of asset prices in international financial markets. The seven concepts are (a) the neutrality of money, (b) interest rate parity, (c) rational expectations, (d) the magnification effect, (e) overshooting, (f) reactions to news, and (g) the risk premium.

First, the neutrality of money. In the study of price determination, there is a long-standing and explicit dichotomy between the determination of relative prices and the determination of the general price level. Relative prices of goods within a system are said to be determined by real supply and demand factors, such as climate, tastes, and so forth, without regard to the general dollar price level or other monetary factors. The general price level, for its part, is said to be determined by the supply of and demand for money without regard to relative goods prices. A doubling of the money supply results in a doubling of all nominal

![Graph of Commodity Prices and Money](https://example.com/graph.png)
1970s, the U.S. nominal interest rate reflected an expectation of future increase in the prices of gold, wheat, and other commodities, an expectation again that was borne out at the time. The appreciation of the deutschmark, gold, wheat, and commodities corresponded to a high rate of inflation and money growth in the United States, as we would expect from the money neutrality proposition.

The third concept, rational expectations, is one that originally germinated in agricultural economics. (I am referring to Muth's celebrated 1961 analysis of the hog cycle.) Ten years later it was transplanted to macroeconomics, where its prescriptive abilities have continued to be remarkable. The proposition that investors' expectations are rational is of course the proposition that they are as accurate as the forecast of any economists' model based on contemporaneously available information. When we combine the rational expectations proposition with the proposition that there are no large transactions costs or government controls to separate investors from the assets they wish to hold, we get the proposition that the market is efficient; all available information is reflected in market prices.

In the context of monetary economics, rational expectations imply that anything known about the probable future money supply will be reflected in market prices today. If there is reason to believe that monetary growth will be rapid during the coming period, the expectation that prices will increase, and thus that the value of money will fall, causes investors today to shift out of money; the demand for, and therefore the prices of, alternative assets and commodities increase today. Even if the money supply is not expected to increase until some point further in the future, say the year 2000, under rational expectations there will still be an upward effect on prices today. The reasoning goes as follows. In the year 1999 rational investors will expect an increase in the money supply over the following year, will seek to shift out of money to protect themselves against the anticipated inflation, and so will bid up the prices of goods, foreign exchange, and other alternative assets in 1999. In the year 1998, rational investors will foresee that goods, foreign exchange, and other alternative assets will be higher in price in 1999 and so will bid up their prices in 1998. But then we consider 1997, and so forth. By recursive substitution, we can see that market prices in 1984 will reflect a present discounted sum of the entire expected future path of the money supply.

In practice, people's expectation about the future path of the money supply can be described fairly simply, for example by a trend growth rate and a transitory current deviation around that trend. If the trend money growth rate follows a random walk, then every time the money supply is observed to increase more than had been expected, rational investors will assign some positive probability to the possibility that the trend growth rate has increased, as opposed to the possibility of a purely transitory deviation from the previously existing trend rate. At such a time, prices of foreign exchange and commodities may go up more than proportionately to the observed increase in the money supply. The reason for this is that prices would have to increase proportionately just to keep the real money supply from changing. But with higher expected rates of future money growth, inflation, and exchange depreciation, there will be a lower demand for real money balances. For real money balances to fall, the general price level must rise more than proportionately to the current increase in the money supply. In the international finance context, the more-than-proportionate effect of the increase in the money supply on the exchange rate has been called the magnification effect.  

Throughout the four concepts we have considered so far—neutrality, interest rate parity, rational expectations and the magnification effect—the division of labor between the microeconomist and the macroeconomist has remained intact. I have not yet given you any reason why you need to pay attention to money if you are interested only in the relative price of soybeans and automobiles as opposed to the overall price level. But I am about to do so.

It is well-established that prices of most goods and services that enter the consumer price index are not in fact free to respond to changes in demand in the short run. In this class of goods, which were called customer goods by Okun and fix-price goods by Hicks, prices are sticky in the short run. The reasons for this are not completely understood, but possible factors include imperfect information, costs to changing prices, inertia, explicit

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1 The term "magnification effect" is used in some of the papers in Frenkel and Johnson (1978).
contracts, and implicit contracts. An increase in demand is reflected in higher prices only with the passage of time. Thus the money neutrality proposition holds only in the long run.

The other class of goods, called auction goods by Okun and flex-price goods by Hicks, are those with prices that are free to respond to fluctuations in demand. They clearly include most agricultural commodities. Why then need agricultural economists worry about monetary factors? Precisely because the prices of most other goods are sticky. Because the general price level is not free to respond fully in the short run, changes in the nominal money supply are also changes in the real money supply, and thus induce changes in the real interest rate, which in turn induce changes in relative prices. This is the most central point I would like to convey.

Let us say there is a one percent decrease in the U.S. money supply that in the short run increases the interest rate. Consider first the effect in the foreign exchange market. The higher real interest rate available in the United States than in Germany causes an increase in demand for the more attractive U.S. bonds: a capital inflow from abroad, at the initial exchange rate. As a result, the dollar appreciates against the mark both in nominal terms and real terms. But market investors know that the changes in the real money supply, real interest rate and real exchange rate, are only temporary. In the long run the appreciation of the dollar will have to be proportionate to the decrease in the U.S. money supply because money is neutral. In the long run, the appreciation of the dollar will be more than proportionate. Only when the dollar is sufficiently overvalued, will investors rationally expect a future rate of depreciation that is sufficient to offset the interest rate differential, so that the interest rate parity condition holds and investors are willing to hold foreign currency. In the short run the exchange rate overshoots its long-run equilibrium. This is what happened from 1980 to 1982, when the Federal Reserve adopted a more stringent monetary policy. Interest rates rose sharply. Unlike in the 1970s, the higher nominal interest rates did not reflect higher expected inflation but rather represented higher real interest rates. As a consequence the dollar appreciated sharply.

The overshooting model, originally developed by Dornbusch to describe the market for foreign exchange, can equally well be applied to the market for storable agricultural commodities. The decrease in the money supply is in the long run reflected in a proportionate decrease in the prices of agricultural commodities, as of other goods and services. But in the short run the increase in the real interest rate induces investors to shift out of storable commodities, at the initial prices, and into the now more-attractive bonds. As a result, commodity prices decline. Again, they decline more than proportionately, i.e., they overshoot their long-run equilibrium. Only when commodities are sufficiently undervalued will investors rationally expect a future rate of appreciation back toward long-run equilibrium, a rate that is sufficient to offset the higher interest rate, so that the interest rate parity condition is met and investors are willing to hold the commodities. One can think of commodities as similar to equities or other financial assets: for a given known value at some date in the future, an increase in the interest rate today means that the present discounted value falls. Or one can think of the flow demand for commodities as being determined in part by inventory demand; the interest rate is one of the costs of carrying inventories, so that when it increases, the demand for the commodity, and therefore the price, drops. One can also view overshooting as an application of the Le Chatelier principle from physics: because one variable in the system—the CPI—is fixed at a moment in time, those variables that are free to move—exchange rates and commodity prices—must move that much more to compensate.

As I mentioned at the outset, relative to 1980 the Journal of Commerce's index of raw industrial commodity prices has declined, 16% as of mid-1984 (and 20% as of July 31). Of course one can get very different figures, depending on the composition of a particular index, but I think the overall tendency is clear. If this decline in commodity prices had been matched by a decline in the general price level so that there was no change in the relative price of commodities, then we would not need the overshooting model. In a model with all prices flexible, a decline in the rates of money growth and inflation would be sufficient to ex-
plain a decline in nominal commodity prices but not a decline in real commodity prices. The commodity price index has declined in real terms, by 33% from 1980 to mid-1984 alone. Thus, if we are to explain the decline by macroeconomic factors we must rely on the overshooting model. In 1980 the real interest rate on treasury bills was about 2%. By mid-1984 it had risen to over 5%. The rise in long-term real interest rates was even more dramatic, from 3% to over 7%. So there has been a clear increase in real interest rates to explain the decrease in real commodity prices.

The sixth concept I want to cover is reactions to news in the market. An implication of the hypothesis that markets are efficient is that investment and future prices will react when information on relevant economic variables is released to the public, but only to the extent that the variable deviates from what was previously been expected. Observations on how the market reacts to government announcements constitute a valuable opportunity to test out different macroeconomic views as to how the world works. Empirical macroeconomics is usually plagued by serious econometric difficulties: low explanatory power and ubiquitous endogeneity (or simultaneous equations bias). We do not usually have the benefit of unambiguously exogenous variables like rainfall that agricultural economists have. But when a government announcement is made, if we can observe market prices immediately before and after the announcement, then we can hope to have isolated its effect and to minimize the magnitude of the other developments that go into the error term. Furthermore we can argue with a clear conscience that the announcement is predetermined with respect to the error term.

One nice example of what I am talking about is the weekly money announcement effect. Every week, the Federal Reserve Board announces what the money stock was in the preceding week. In 1981 and 1982 the announcements were made at 4:10 p.m. on Friday afternoons and referred to the money stock nine days earlier. Each week at the witching hour, market analysts and investors gather nervously around the newswire, or computer-age equivalent, and trading slows or stops until the numbers come out. When the announcement is made, trading resumes, generally at discontinuously changed prices.

The most widely known empirical fact is that when the money stock announced is greater than what was expected, interest rates tend to jump in the same direction. Clearly they are responding to revised expectations about the future path of the money supply. But nominal interest rates are an ambiguous indicator of expectations. One school of thought is that market investors respond to an unanticipated large money announcement by revising upward their estimate of the Fed’s target money growth rate, and thus their expected inflation rate. In this case the increase in the nominal interest rate is explained as an increase in the inflation premium. The alternative point of view is that the increase in the nominal interest rate is not an increase in the expected inflation rate, but rather an increase in the real interest rate. This would be the case if market investors retain confidence in the Fed’s commitment to stick with the same money growth target. The investors interpret the unanticipated change in the money stock as a fluctuation—due to money demand or banking behavior—that was unanticipated by the Fed as well. They believe that the central bank will quickly act to offset the deviation from its target by contracting, thereby increasing the real interest rate.

One cannot choose between the two alternative views by looking at the reaction in the money market, because both have the same implications for interest rates. But one can choose between them by looking at the reactions in the foreign exchange and commodity markets. If the expected inflation rate rises, investors should shift out of dollars and into foreign currency and commodities, thereby driving up the prices of foreign currencies and commodities. On the other hand if the real interest rate rises, investors should shift out of these alternative assets, thereby driving their prices down as in the overshooting model.

When one runs regressions of market price reactions against the money announcements for the 1981–82 period, the second of the two hypotheses emerges as the correct one. Of nine commodities—soybeans, corn, wheat,
feeders, cattle, cocoa, sugar, silver, and gold—all prices react negatively. The average of the nine reactions is highly significant statistically. When the money stock is announced to be 1.00% higher than expected, commodity prices on average decline by 0.8%. Clearly such a reaction is not consistent with an increase in the expected inflation rate. It must be that the market views unexpected announcements as transitory deviations from the Fed's target path that will soon be corrected.

We come now to the seventh and last concept on our tour: the risk premium. You may have noticed that when I was discussing interest rate parity, there was no mention of risk. If an investor is risk averse, he will not in fact be indifferent between holding treasury bills and taking an open position in commodities or foreign exchange with the same expected return.

Since commodity prices and foreign exchange prices are both highly volatile, it is often presumed that holding forward contracts is highly risky for all investors, and that therefore a positive risk premium must be paid to induce the market to hold them. But this presumption is not necessarily correct. There is always somebody on the other side of the contract. In the case of agricultural commodities, for a food processor who must use a commodity as an input, it is risky not to buy it forward. Similarly, in the case of foreign exchange, for an importer of German products, it is risky not to buy deutschmarks forward. One man's open position is another's covered position. The risk premium could be either positive or negative, depending on the number of people on each side of the market. My conjecture is that farmers who wish to sell their crops on the forward market can in theory get a price for them that is, if anything, higher than the expected future spot price. Such a conjecture comes out of the Capital Asset Pricing Model (CAPM): the American wheat crop can be viewed as a national asset with a value that is positively correlated with the value of the aggregate portfolio. But one conclusion that has emerged from some of the recent international finance literature is that risk premiums may in any case be small in magnitude. With conventional estimates of the coefficient of risk aversion and the variances of asset prices, the model suggests that the risk premium cannot be much more than a few basis points. If investors optimize with respect to their portfolios, they will quickly move in and buy an asset with a higher expected return unless the variance is truly enormous, until the discrepancy in expected returns has been reduced. This is one argument why much of what I have said about interest rate parity, over- and underánhopping, and the market reactions to news, goes through with only minor modifications in a world of risk-averse investors.

Current Policy Questions

I hope I have convinced you that the general decline in the prices of commodities since 1980 can be attributed to the sustained rise in real interest rates. I have tried to do this through what may have been the less obvious of two possible routes: drawing an analogy from the dollar price of foreign exchange to the dollar price of commodities, an analogy that applies even in an economy closed to international trade. The more obvious route would have been to point out that in an open economy, the dollar price of soybeans is equal to the foreign price of soybeans times the exchange rate. If the price of foreign exchange falls, the price of soybeans can be expected to fall as a result.

Of course the existence of American monopoly power in many agricultural commodities, and the existence of government protection in many others, means that U.S. agriculture does not fit the model of a small price-taking country particularly well. However, we are closer to the closed-economy model than we have been during most of our history. The increasing dependence of U.S. agriculture on international variables, ranging from the yen/dollar exchange rate to debt problems in Latin America, has many important implications for policy. One example is that because American agriculture holds a comparative advantage in international trade, its interests lie in an open world trading system, not in protection. Only if we buy Chinese textiles, Japanese cars, Chilean copper, Brazilian steel, and Italian...
shoes, will foreigners have the dollars with which to buy American wheat and all the other goods and services in which we have a comparative advantage.10

But my point here, that U.S. commodity prices are depressed because U.S. real interest rates are high, is equally valid regardless of whether our model is a closed economy or an open one, i.e., regardless of whether the effect on the exchange rate is used as an analogy for the effect on commodity prices or as the actual channel of transmission.

Let me now return to the current macroeconomic policy debate in Washington. The key question is, "Why are real interest rates so high?" I think almost everyone agrees on the reason for the increase in real interest rates from 1980 to 1982. After 1979 the Fed switched to a regime of more tightly controlled money growth. What followed was equally explained by the standard macro models: two recessions, a large decline in actual and expected inflation, and an increase in the real interest rate. But what about the last two years? I do not believe it is possible to explain the fact that real interest rates are as high or higher in 1984 as they were in 1982 by continued monetary stringency. All the signs point to adequate money growth since 1982. As of mid-1984, M1 and nominal GNP are right on target, and the economic recovery after six quarters is the strongest we have had in three decades. Indeed, monetary growth has been sufficiently rapid since 1982 that the monetarists have been warning that virulent inflation will break out at any moment, though I do not believe that any more than I believe the dire warnings of deflation from the supply siders.

Ingenious observers have come up with a number of other explanations. One, for example, tries to pin the blame for high real interest rates on the Fed through a different route. It is claimed that uncertainty about the money supply makes dollar assets risky to hold in real terms; a heightened risk premium is thus built into U.S. interest rates. The problem with this story is that such uncertainty should cause investors to shift out of dollar assets and into commodities and foreign currencies as inflation-hedges, thereby driving up their prices — the precise reverse of what has in fact happened.

What then does explain our current real interest rates? I believe that the answer is evident to most observers. The federal budget deficit was 6% of GNP last year. Private saving and state and local budget surpluses did begin to recover in 1983. But, overall, net (of depreciation) national saving was still a puny 1.8% of GNP. Only a high real interest rate can equilibrate the demand for funds to the supply currently available. Only action to reduce public dissaving, i.e., the budget deficit, is likely to bring real interest rates back down.

References


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