The Commodity–Consumer Price Connection: Fact or Fable?

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Interest in commodity prices as indicators of consumer price inflation has ebbed and flowed with the rise and fall in commodity prices themselves. True to form, as commodity prices have surged in the last two years (Chart 1), interest in their predictive power has returned. Inflation hawks point to an outpouring of studies in the late 1980s showing a strong empirical connection between commodity prices and subsequent consumer inflation. Indeed, the concern over commodities has grown to the point where even two previously obscure commodity indexes—the National Association of Purchasing Managers price index (NAPM) and the Federal Reserve Bank of Philadelphia's prices paid index (PHIL)—have begun to capture considerable attention among economists and market analysts.

Is this renewed attention warranted? In this article, we argue that none of the channels through which commodity prices signal more generalized inflation are operating as well as they did in the past: commodities have become less important as an input to production, some of the inflation signals from commodity prices may be sterilized by offsetting monetary policy, and commodities have become less popular as an inflation hedge. We also present evidence that the recent commodity movements are a reaction to swings in dollar exchange rates rather than a signal of generalized inflation pressures.

Our empirical results underscore the diminished signaling power of commodities in the last eight years. Drawing on data for the 1970-94 period, we examine five major U.S. commodity indexes and three subgroups of commodities—gold, oil, and food. We use vector autoregression models (VARs) to test whether commodity prices are useful in predicting subsequent movements in both the finished goods producer price index (PPI) and the core—that is, nonfood and nonenergy—consumer price index (CPI). These VAR methods allow us to isolate the predictive power of commodity prices while controlling for other determinants of inflation. We find that:

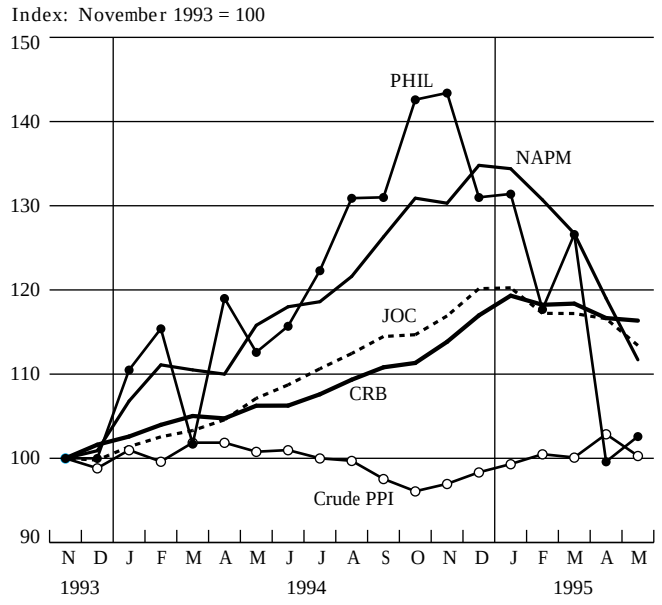
- Contrary to conventional theory, there is no long-run link between the level of commodity prices and the

level of consumer prices, but there is a link—or cointegrating relationship—between the *level* of commodity prices and the *rate* of consumer price inflation.

- During the full 1970-94 sample period, all of the traditional commodity indexes have some ability to predict short-run changes in core CPI inflation. However, this relationship weakens considerably starting in the mid-1980s. The breakdown extends beyond commodity prices: even the finished goods PPI cannot help predict changes in core CPI inflation in the recent period.
- Adding monetary variables and the dollar exchange rate to the models helps eliminate some perverse findings, suggesting that some inflation signals from commodities are being obscured by offsetting changes in exchange rates and monetary policy.
- Commodities that are particularly sensitive to major supply disruptions (such as food and oil) appear to have retained more explanatory power than those influenced primarily by input demands (industrial materials) or those used for inflation hedging (gold).

Chart 1

Recent Commodity Price Movements



Sources: Authors' calculations, based on data from Bureau of Labor Statistics, Commodity Research Bureau, *Journal of Commerce*, National Association of Purchasing Managers, Federal Reserve Bank of Philadelphia.

Note: Chart shows the price movements tracked by five major commodity indexes. PHIL is the Federal Reserve Bank of Philadelphia's prices paid index; NAPM, the National Association of Purchasing Managers price index; JOC, the *Journal of Commerce* index; CRB, the Commodity Research Bureau index; crude PPI, the crude producer price index.

Our examination of the signaling power of commodities begins with a review of the theoretical linkages between commodity prices and subsequent consumer price inflation.

The Tortoise and the Hare and Other Commodity Fables

Most arguments for a signaling role for commodities rest on the fact that commodity prices are set in auction or flexi-price markets and therefore can sprint ahead quickly in response to actual or expected changes in supply or demand. By contrast, prices of most final goods and services, restrained by contractual arrangements and other frictions, respond slowly and steadily to supply and demand pressures, only gradually gaining ground on commodity prices. Like the hare in Aesop's famous fable, commodity prices tend to take a quick, early lead in inflation cycles, but ultimately lose the race, falling in real terms.

Formal theoretical models, such as Boughton and Branson (1991) and Fuhrer and Moore (1992), are based on this notion of commodity behavior, building on Dornbusch's (1976) classic exchange rate model. In these models, commodities are assets whose price "jumps" to equilibrate the money and goods markets. Thus, a surge in aggregate demand (for example, an unexpected increase in the money supply) causes commodity prices to shoot upward while final goods prices respond only with a lag.[1]

The empirical literature on commodities expands on this simple theoretical framework and presents three different accounts of the linkages between commodity prices and broad inflation. These accounts—or commodity "fables"—explain why commodity prices could be a useful leading indicator of inflation.

First, as illustrated by the tortoise-and-hare fable, commodity prices may give early warning signals of an inflationary surge in aggregate demand. Higher demand for final goods increases the demand for commodity inputs and, even though the inflation impetus may start in final goods markets, the first visible increase in prices may be in the flexi-price commodity markets.[2] Because commodities are widely traded internationally, this aggregate demand signal would most likely occur when strong domestic

demand is not offset by weak foreign demand. Indeed, in empirical models, commodity prices are often modeled as a function of global economic activity. These demand-induced commodity price run-ups presumably will be concentrated in industrial materials.

Second, commodity prices and broad inflation may be directly linked because commodities are an important input into production, representing about one-tenth of the value of output in the United States. Thus, all else being equal, an increase in commodity prices should eventually be passed through to final goods prices. Historically, large direct input price effects have tended to be concentrated in food and energy commodities.

The third linkage between commodity prices and future inflation stems from the first two. Because commodity prices respond quickly to general inflation pressures, investors may see them as a useful inflation hedge. This perception tends to be self-fulfilling: the more that commodities are seen as an effective hedge, the more likely investors are to turn to them in anticipation of inflation. Traditionally, precious metals have been singled out as the most convenient commodities for hedging inflation.

Like the hare in Aesop's famous fable, commodity prices tend to take a quick, early lead in inflation cycles, but ultimately lose the race, falling in real terms.

VAR Literature

These three fables motivate empirical studies of the commodity–consumer price connection. Most studies, however, avoid the complications of a formal structural model and instead use VAR models to test for a positive correlation between commodity prices and subsequent consumer price inflation. The VAR methodology assumes that each variable can be best explained by using past values of both itself and all other relevant variables. Using this approach, a very active literature in the late 1980s established the following:[3]

- Although commodity prices and consumer prices tend to diverge over time, commodity price *levels* and consumer price *inflation* tend to move together over time—that is, they are cointegrated (Boughton and Branson 1991; Cody and Mills 1991).
- Commodities have significant predictive power in explaining short-run movements in CPI inflation, even when researchers control for information contained in monetary aggregates, real output, interest rates, and exchange rates (Horrigan 1986; Webb 1988; Durand and Blondal 1991; Cody and Mills 1991; Garner 1989).
- The economic magnitude of these signals, however, may be small (Horrigan 1986; Furlong 1989; Garner 1989).
- There is some evidence that these relationships have shifted over time, with stronger linkages in the late 1970s and early 1980s than in the earlier period (Whitt 1988; Furlong 1989).

Despite the empirical consensus, there are reasons to believe that the commodity-CPI connection may have weakened since the mid-1980s. First, with commodities playing a smaller role in U.S. production, and in the absence of major food and oil price shocks, recent commodity price fluctuations may not have been big enough to be passed through to consumer prices. Second, the theoretical literature on commodity prices suggests that the recent attention of monetary authorities to commodity prices may have diminished commodities' signaling role.[4] This would occur if monetary authorities eased or tightened policy in response to the inflationary signals of commodity prices and thereby mitigated the actual inflation outcome. Third, because commodity investments have yielded a poor return in recent years, they have lost some appeal as inflation hedges, making them less sensitive to inflation expectations. Finally, recent commodity movements may have little to do with underlying inflation pressures and instead may reflect a rebound in very depressed markets and the impact of movements in dollar exchange rates.

Testing Commodities' Signaling Power

Eight Commodity Price Indicators

For our empirical tests, rather than focus on a single commodity index, we consider five popular alternative indexes and three key subgroups of commodities. Each of the indexes has advantages and disadvantages relating to the properties of its construction and its correspondence to the various commodity fables.

The most popular indicators in past empirical research have been the Commodity Research Bureau (CRB) spot index, the *Journal of Commerce* (JOC) index, and the crude PPI:

- The CRB index is a simple, equally weighted average of twenty-three commodities, including foodstuffs and industrial materials. It is updated instantly on computer screens and is the most closely watched commodity index.
- The JOC focuses just on industrial commodities and is therefore presumably well suited to capture the tortoise-and-hare fable discussed above. It also has the advantage of being specifically weighted according to the inflation sensitivity of each of its components.
- The crude PPI is divided about evenly into three parts: food, energy, and other. It is weighted according to the actual value of commodity shipments and therefore presumably is the best index for exploring how commodity price increases are passed through to final goods prices.

In addition to these three traditional indexes, two survey-based measures of commodity prices have recently garnered attention—the NAPM and PHIL price indexes. Both of these indexes measure the diffusion of price increases across firms:

- The NAPM index measures the percentage of manufacturing firms reporting higher material prices, plus half the percentage of those firms reporting no change in prices. It therefore has a value of roughly 50 percent when aggregate prices are unchanged.
- The PHIL index, calculated a bit differently, is the percentage of firms in the Philadelphia region reporting higher prices, minus the percentage reporting lower prices; hence, it should have a value of roughly zero when aggregate prices are unchanged.

Historically, both of these diffusion indexes have proved to be quite sensitive to conditions in commodity markets.

Three subgroups of commodities are also potentially useful inflation predictors:

- Gold traditionally has been the commodity most associated with inflation hedging.
- Food and oil have both been subject to major supply disruptions and can be used to pinpoint the price pass-through scenario.

Impressionistic Evidence: Turning Points and Trends

The simplest, least technical test of the inflation-signaling power of commodity prices is to look at turning points in the inflation cycle. The top panel of Chart 2 plots core CPI inflation, with shading to indicate periods of falling inflation; the bottom panel plots inflation in the JOC index and superimposes the shaded regions from the core CPI chart. The chart illustrates why commodity prices gained popularity as inflation indicators in the 1970s: from the late 1960s to the early 1980s, JOC inflation peaks and troughs regularly predated peaks and troughs in core CPI inflation. There were no missing signals over this period and there was only one false signal: in 1976, JOC inflation peaked and then declined, but CPI inflation continued to trend up.

During the 1960s and over the last decade, the JOC index has been a poor leading indicator of turning points in inflation, sending more false signals than correct signals.

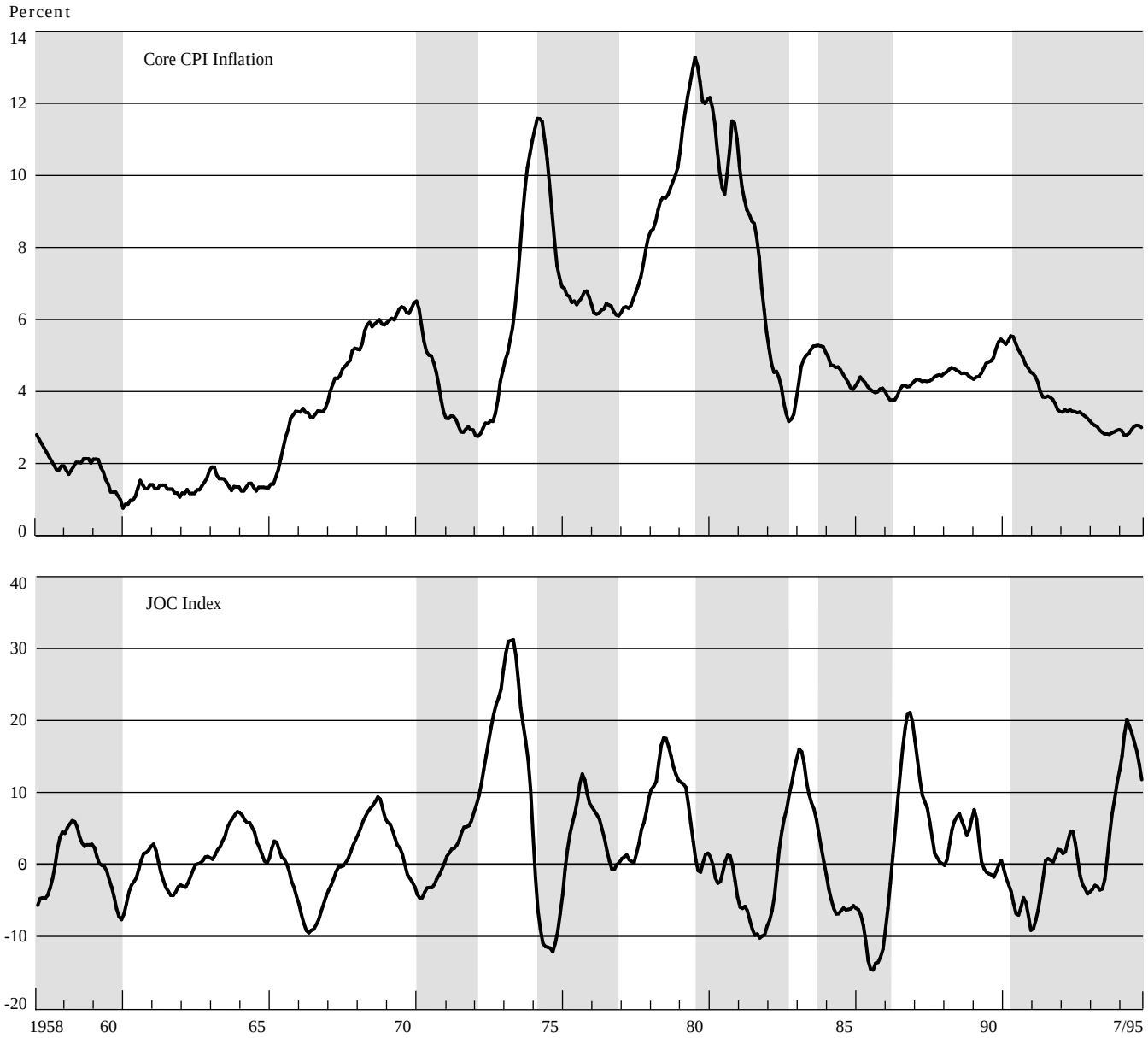
Chart 2 also underscores why we suspect that commodity prices have not always been reliable indicators of future inflation. During the 1960s and over the last decade, the JOC index has been a poor leading indicator of turning points in inflation, sending more false signals than correct signals. For the most recent period, strong false signals have occurred in 1987 and 1992. Even the correct signals have been somewhat misleading, with very sharp commod-

ity price surges preceding relatively mild inflation accelerations. Similar results hold for the other major commodity indexes. Thus, on a stand-alone basis, commodity price indexes appear to be relatively unreliable indicators of inflation in the recent period.

Another reason to suspect a breakdown in the commodity-CPI connection is the steady drifting apart of price levels. Chart 3 plots three stages of producer prices—the crude, intermediate, and finished goods PPIs—along with the core CPI since 1967. Note that each stage seems to be relatively tightly linked until 1980. After that, each index seems to drift apart, with the magnitude of the drift increasing at each stage of fabrication. Although this drift does not necessarily compromise the short-run commodity-

Chart 2

The JOC Index and Turning Points in Inflation

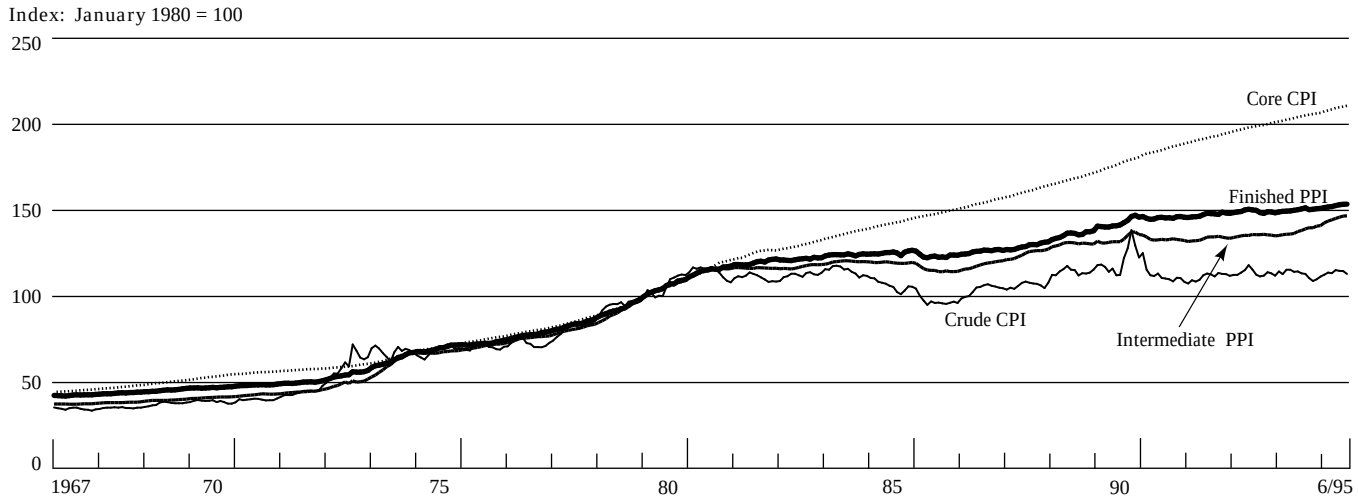


Sources: Bureau of Labor Statistics; *Journal of Commerce*.

Notes: Each series is a three-month moving average of twelve-month percentage changes. The shaded areas denote periods of declining core CPI inflation.

Chart 3

Prices by Stage of Fabrication



Source: Bureau of Labor Statistics.

CPI relationship, it does make the arguments for a long-run price pass-through more tenuous.

FORMAL TESTS: VARS

The impressionistic evidence suggests that the linkage may have broken down; we now present more rigorous evidence of a structural shift. We assess the overall performance of the commodity indicators using conventional VARs, which provide simple tests of the short-run causal relationship between these variables. In addition to using conventional VARs, we present in the appendix the results obtained by using two alternative VAR models: error correction models, which test for long-run as well as short-run linkages; and time-varying parameter models, which can be used to explore shifts in the relationships among the variables without having to divide the sample. These alternative models generally confirm the findings for the conventional VARs.

For our VAR tests, we regress core CPI on lags of itself and lags of a commodity index. Each equation also includes a constant, a time trend, and the prime-age male unemployment rate to control for business cycle impacts on inflation. All variables included in the models are appropriately differenced to ensure that the data are "stationary"; we also include twelve lags on each explanatory variable.[5] In addition to estimating our core CPI equations, we test for a two-stage link between commodity prices and core CPI inflation by first estimating the relationship between the commodity indexes and the finished goods PPI and then testing the impact of the finished goods PPI on core CPI inflation. This two-stage approach enables us to explore the commodity-CPI connection in more detail.

The results for the full sample[6]—January 1970 to April 1994—confirm some findings in the literature. The top panel of Table 1 shows tests of the joint statistical significance of twelve lags of the commodity indicators in predicting the change in core CPI inflation, as well as the sign of the sum of the coefficients. The bottom panel of the table shows the results when finished goods PPI inflation is the dependent variable. If the commodity indexes are useful predictors of final goods inflation, we would expect the sum of the coefficients to be positive and statistically significant (generally with p-values of less than .05). As in past studies, the CRB and JOC indexes are significant and have the correct sign in explaining both the core CPI and the finished goods PPI. Thus, they seem to provide information beyond that contained in the model's other variables.

Some of the full sample results, however, are sur-

prising. The crude PPI is insignificant not only in the core CPI equation, but in the finished goods PPI equation as well. This result is particularly troubling for the price pass-through view of the inflation process because the crude PPI—more than any other commodity index—is weighted to reflect the use of commodities in production. Our finding also contradicts studies such as Horrigan's (1986), which found that the crude PPI was significant in explaining the first difference of CPI inflation for the 1959-84 period. The finished goods PPI does help explain core CPI inflation, so there is only one weak link in the chain running from crude producer goods to finished producer goods to consumer prices.

The results for the diffusion indexes—NAPM and PHIL—also warrant some discussion since these indexes have garnered considerable attention among business economists and financial market analysts but have been largely ignored in the academic literature. These indexes have advantages and disadvantages relative to the JOC and CRB indexes. On the plus side, they reflect the actual prices companies pay for inputs—through long-term contracts and auction markets—whereas the CRB and JOC indexes include only auction prices. On the minus side, they are based on qualitative surveys and are not released to the public until weeks after the data are collected (by contrast, the JOC and CRB indexes are immediately available).[7] Thus, it is an empirical question whether the release of these diffusion indexes each month adds any information beyond that already reported in the market-based indexes. The full-sample findings in Table 1 suggest that the academics have been right to ignore the diffusion indexes: neither is useful in predicting either core CPI inflation or finished goods PPI. Indeed, in "horse races"—when the diffusion indexes enter in the same regression as either the JOC or CRB index—they are never significant.

Split Sample Results: A Break in the Commodity-CPI Connection

Table 1 also shows the results when we split the sample into two parts: an early period (January 1970 to December 1986), which roughly covers the period tested in many previous studies, and the more recent period (January 1987 to April 1994). Preliminary tests showed a significant structural break in these models in the mid-1980s, with the qualitative results insensitive to the particular date chosen.[8] The results for the earlier sample continue to support previous research: the sum of the coefficients for the commodity variables always has the correct sign and is highly statistically significant. In contrast to the full sample results and in conformity with Horrigan (1986), the crude PPI is also significant.

For the more recent period, the good news is that all of the commodity indexes except CRB have a significant positive relationship to the finished goods PPI. Indeed, in contrast to the full sample, the two diffusion indexes—NAPM and PHIL—have a significantly positive relationship with the finished goods PPI. The bad news, and perhaps this article's key finding, is that except for the JOC index, all of the commodity indexes have a perverse *negative* relationship to core CPI inflation. Even the finished goods PPI has developed a negative link, suggesting a breakdown in the relationship between the inflation process in the

Table 1
VAR Tests of Commodities as Inflation Predictors

Dependent Variable: Change in Core CPI Inflation

	1970-94		1970-86		1987-94	
Commodity Indicator	Sign	P-Value	Sign	P-Value	Sign	P-Value
JOC	(+)	.01	(+)	.01	(+)	.06
CRB	(+)	.01	(+)	.00	(-)	.02
PPI crude	(+)	.32	(+)	.06	(-)	.04
NAPM	(+)	.20	(+)	.00	(-)	.03
PHIL	(+)	.52	(+)	.04	(-)	.01
PPI finished	(+)	.00	(+)	.00	(-)	.01

Dependent Variable: Finished Goods PPI Inflation

	1970-94		1970-86		1987-94	
Commodity Indicator	Sign	P-Value	Sign	P-Value	Sign	P-Value
JOC	(+)	.00	(+)	.00	(+)	.00
CRB	(+)	.01	(+)	.00	(+)	.57
PPI crude	(+)	.61	(+)	.00	(+)	.07
NAPM	(+)	.24	(+)	.00	(+)	.00
PHIL	(+)	.23	(+)	.03	(+)	.00

Sources: Authors' calculations, based on data from Bureau of Labor Statistics, *Journal of Commerce*, Commodity Research Bureau, National Association of Purchasing Managers, Federal Reserve Bank of Philadelphia.

Notes: Table reports the sign and joint statistical significance of the coefficients for each commodity index. The explanatory variables in the regression include a constant, a linear time trend, and one to twelve lags of: the prime-age male unemployment rate, the dependent variable, and a commodity index. NAPM and the unemployment rate enter as levels; PHIL enters as a difference; and the CRB, JOC, crude PPI, and finished PPI enter as log differences.

manufacturing sector and the overall economy. In other words, for many indexes, an increase in commodity inflation has become associated with a future slowing in core CPI inflation.[9]

Out-of-Sample Forecasts

Although Table 1 suggests that commodity indexes have failed to correctly signal movements in core CPI inflation in the recent period, it tells us nothing about the magnitude of this signaling error. To get a sense of the size of this error, we take the parameter estimates for the 1970-86 period for the CRB and JOC models and simulate the models dynamically over the 1987-94 period (Chart 4). The out-of-sample errors from this forecasting exercise could reflect either shifts in the coefficients for the commodity variables or shifts in other relationships in the model. To pinpoint the impact of the weakened commodity connection, therefore, the chart presents three simulations: one excluding the commodity indexes, a second including the CRB index, and a third including the JOC index. The difference between the simulations with and without the commodity indexes is used to measure the additional error (or improvement) in the forecast due to the commodity variable.

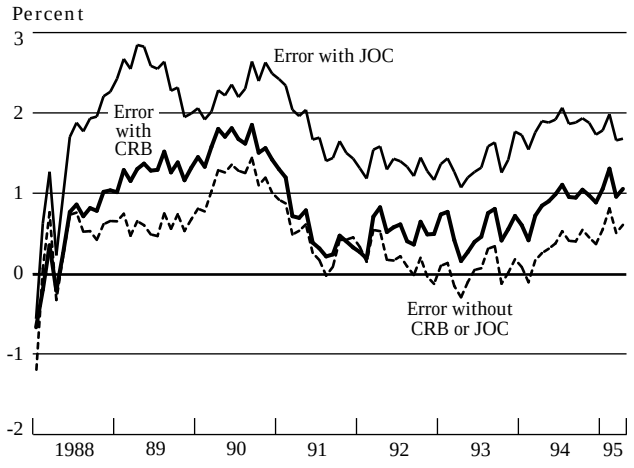
The simulations confirm that these models have a chronic tendency to overestimate the change in inflation in the recent period. This overprediction is due in part to misleading signals from the commodity indexes and in part to a shift in other relationships in the model. Chart 4 plots a twelve-month moving sum of the monthly forecast errors. It shows that the model without a commodity index predicted an earlier and more virulent acceleration in inflation in the 1987-89 period than in fact occurred; the model also suggested an uptick in inflation in 1994 rather than the actual downtrend. When the CRB index is included in the model, the overpredictions are even larger, particularly for 1989 and 1994, and the average annual error is about 1 percentage point over the entire 1987-94 period.

The bad news, and perhaps this article's key finding, is that except for the JOC index, all of the commodity indexes have a perverse negative relationship to core CPI inflation.

The results are more dramatic for the JOC index: the model significantly overpredicts over the entire period, with annual errors of more than 2 percentage points in the late 1980s and about 1 1/2 percentage points in 1994. This poor performance is particularly troubling because this index was designed specifically as an indicator of broad inflation. Moreover, similar results are obtained when the other commodity indexes are used, with an average annual overprediction of about 1 percentage point.

Chart 4

Model Prediction Errors Attributable to Commodity Indexes



Sources: Authors' calculations, based on data from Bureau of Labor Statistics, *Journal of Commerce*, Commodity Research Bureau.

Notes: The model for the acceleration in core CPI inflation is estimated through December 1986 and then dynamically simulated forward. The forecast prediction errors are reported as a twelve-month moving sum. The sums for the first twelve months include both in-sample and out-of-sample errors.

Are the Parts Worth More Than the Whole?

By lumping together a diverse group of commodities, the indexes could obscure their components' predictive power. This would be the case if some commodities were not good

inflation predictors or if the timing of the inflation signals varied among different kinds of commodities.

To investigate these possibilities, we subject three narrowly defined commodities—gold, food, and oil—to the same tests as the broader indexes (Table 2). Despite its reputation as an inflation hedge, gold shows the weakest results, sending unreliable signals for the full sample period and both subsamples. Indeed, in the earlier period, the sum of the coefficients on gold is negative and statistically significant, suggesting that rising gold prices are a signal of falling consumer price inflation.

By contrast, both oil and food—with positive, significant coefficients—appear to be good predictors of core CPI inflation in the earlier period. This is consistent with the idea that major supply disruptions in these markets fed through to general inflation in the 1970s and early 1980s. In the more recent period, both continue to have the correct sign. In the case of oil, this probably reflects the impact of the 1990 supply shock to oil prices. As we will explain later, one reason for this positive response may be that monetary policymakers are more reluctant to tighten when the commodity price rise is due to a supply shock rather than a demand shock. Supply shocks pose a dilemma for policymakers because inflation pressures increase at the same time that real economic activity weakens. Hence, supply-induced increases in commodity prices are more likely to be allowed to show through to increases in final goods prices.

Table 2
THE PREDICTIVE POWER OF THREE COMMODITY SUBGROUPS

	1970-94		1970-86		1987-94	
Commodity Indicator	Sign	P-Value	Sign	P-Value	Sign	P-Value
Gold	(-)	.31	(-)	.05	(-)	.18
Food	(+)	.01	(+)	.00	(+)	.00
Oil	(+)	.05	(+)	.01	(+)	.02

Sources: Authors' calculations, based on data from Bureau of Labor Statistics, *Journal of Commerce*, Commodity Research Bureau.

Notes: The dependent variable is the second difference of log core CPI. The table reports the sign and joint statistical significance of the coefficients for each commodity index. The explanatory variables in the regression include a constant, a linear time trend, and one to twelve lags of: the prime-age male unemployment rate; the dependent variable; and the price index for either gold, food (a subcomponent of the CRB), or oil (West Texas Intermediate posted price before 1982 and spot price thereafter). The unemployment rate enters as a level, gold enters as a log difference, and oil and food enter as second log differences.

EXPLAINING THE DIMINISHED SIGNALING POWER OF COMMODITIES

Commodity prices have clearly become a much less reliable indicator in the recent period. In this section, we combine impressionistic evidence, results from other research, and our own empirical findings to support three explanations for the shift:

- the diminished use of commodities as inflation hedges,
- monetary policy reactions to commodity prices, and
- the shift away from commodity-intensive production.

In recent years, commodities have lost much of their reputation as an effective tool for hedging inflation. Over the postwar period, all three major commodity indexes have failed to keep up with inflation and have been particularly poor performers during the last twenty years (Table 3). Some individual commodities have fared better but have still fallen well short of safer investments, such as Treasury bonds. For example, although gold prices have matched the CPI for the 1975-94 period as a whole, they have been a very volatile investment, skyrocketing in the late 1970s, then dropping sharply, and finally hovering around $400 per ounce for more than a decade. It is therefore not surprising that investors have generally rejected commodities as an inflation hedge and instead are using financial futures on interest rates or exchange rates. For

Table 3
THE ANNUAL REAL RETURN TO COMMODITIES

Commodity Indicator	Postwar	1975-94
JOC	-2.4	-3.1
CRB	-1.4	-3.0
PPI crude	-1.2	-1.8
Gold	1.4	0.1
Nonferrous metals	0.0	-1.0
Food and feed	-1.8	-2.8
Oil	1.1	-2.2
Memo: Ten-year Treasury bonds	2.6	3.5

Sources: Authors' calculations, based on data from Bureau of Labor Statistics, *Journal of Commerce*, Commodity Research Bureau, Board of Governors of the Federal Reserve System.

Notes: Each variable is deflated by the CPI. The postwar sample starts in 1947, except for JOC and CRB, which start in 1948 and 1967, respectively. Nonferrous metals and food and feed are components of the crude producer price index, and oil is the West Texas Intermediate posted price before 1982 and spot price thereafter.

instance, in 1993, trading in Treasury bond futures outnumbered trading in gold futures more than ten to one (Einhorn 1994). If gold and other commodities are not seen as reliable inflation hedges, then less of their movement will be due to changes in inflation expectations (and a larger portion will be due to factors specific to commodity markets).

A second explanation for the weaker predictive power of commodities is that they may be an example of Goodhart's law. Goodhart argued that "any statistical regularity will tend to collapse once pressure is placed on it for control purposes." Therefore, if investors believe that monetary authorities are reacting to the inflation signals from commodity prices, then the commodity price movements will begin to reflect market expectations of monetary policy rather than independent information on the economy. As an extreme example, Fuhrer and Moore (1992) show that if the monetary authorities include commodities in their "reaction function," even "mild targeting pressure" on commodity prices can lead to perverse results, with increases in commodity prices predicting a decline in final goods prices. In this case, the signal of *incipient* inflation pressures from commodities may be correct, but little *actual* inflation occurs because of offsetting monetary policy. To continue our tortoise-and-hare analogy: the hare sprints ahead, but the authorities cancel the race before it heats up.

To test whether monetary policy may have offset some inflation signals from commodity prices, we added a variety of monetary policy measures to our VAR model for the 1987-94 period. Table 4 shows the typical results when M2 and the dollar are added: controlling for monetary policy in this way causes the coefficients to switch signs from negative to positive for several commodity variables.[10] This finding suggests that some of the weakening in the commodity-inflation connection stems from policy reaction.

As Chart 5 shows, however, adding M2 and the dollar only partly solves the tendency of these models to overpredict the acceleration in inflation in the recent period. In particular, we repeat the out-of-sample exercise reported earlier, estimating the JOC and CRB models over the 1970-86 period and then simulating them over the recent period. Adding M2 and the dollar to each model does reduce the twelve-month sum of these out-of-sample forecast errors by an average of about 0.2 percentage points, but large overpredictions remain.[11]

These results complement the literature on the "price puzzle." Christiano, Eichenbaum, and Evans (1994) and others have pointed out that in a simple VAR framework, money tends to have a perverse relationship to aggregate prices—a tightening of policy raises the price level. They also note that if a commodity indicator is added to the model, the price puzzle tends to go away. Here we have turned this puzzle around and have shown that in the recent period, commodities have had a perverse link to aggregate prices—higher commodity prices predict a decline in final goods prices—but the puzzle is partially solved by including money in the model.

The final—and probably most important—factor in the diminished commodity-CPI connection is the sharp decline in the commodity composition of U.S. output. According to Rosine (1987), consumption of spot commodities as a share of nominal GDP ranged from 8 percent to 10 percent from 1973 to 1981, but fell to just 4 percent by 1986.[12] With the ongoing technological revolution, this

Table 4
COMMODITY COEFFICIENTS WHEN MONEY AND THE DOLLAR ARE ADDED TO THE 1987-94 MODEL

	Core CPI Model		Finished PPI Model	
Commodity Indicator	Sign	P-Value	Sign	P-Value
JOC	(+)	.00	(+)	.00
CRB	(+)	.00	(+)	.00
PPI crude	(+)	.00	(+)	.00
NAPM	(-)	.00	(+)	.00
PHIL	(-)	.03	(-)	.00
PPI finished	(+)	.00	NA	NA

Sources: Authors' calculations, based on data from Bureau of Labor Statistics, *Journal of Commerce*, Commodity Research Bureau, National Association of Purchasing Managers, Federal Reserve Bank of Philadelphia, Board of Governors of the Federal Reserve System.

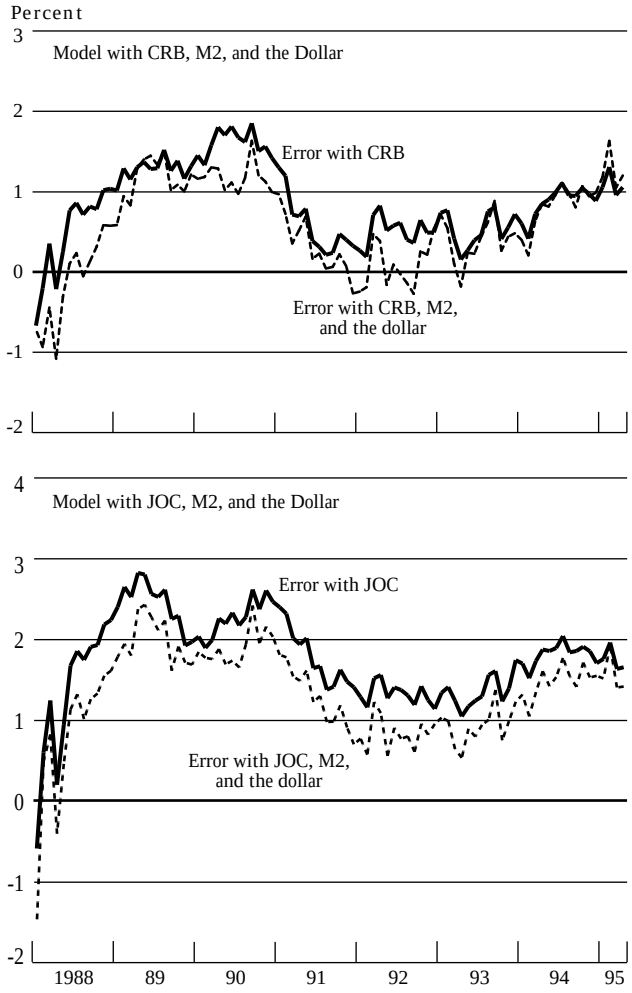
Notes: Table reports the sign and joint statistical significance of the coefficients for each commodity index. The explanatory variables in the regression include a constant, a linear time trend, and one to twelve lags of: M2, the trade-weighted dollar (Board of Governors of the Federal Reserve System measure), the prime-age male unemployment rate, the dependent variable, and a commodity index. NAPM and the unemployment rate enter as levels; PHIL enters as a difference; and M2, the dollar, CRB, JOC, crude PPI, and finished PPI enter as log differences.

decline has presumably continued into the 1990s.

This diminished role seems to reflect a sharp downward shift in demand for commodities that has lowered both the relative price of commodities and the growth in quantity consumed. Final demand has moved steadily away from goods with high commodity content (such as food, textiles, and furniture) toward sectors with low commodity content (such as engineering products, electronics, plastics, and services). For example, from 1948 to 1994, the share of services in consumer spending almost doubled, from 32 percent to 57 percent. Furthermore, although commodity price inflation has exceeded CPI inflation for brief periods, for the 1970-94 period as a whole, commodities have lost more than half their value relative to consumer prices (Chart 6). This reduced role for commodities means that they are a less reliable inflation signal, not only because price pass-through effects are weakened, but because as increasing parts of the economy become independent of commodity markets, a rise in commodity prices is more likely to reflect an increase in a narrow part of final demand than an increase in economy-wide demand.

Chart 5

Prediction Errors in a Model That Controls for Monetary Policy



Sources: Authors' calculations, based on data from Bureau of Labor Statistics, *Journal of Commerce*, Commodity Research Bureau.

Notes: The model for the acceleration in core CPI inflation is estimated through December 1986 and then dynamically simulated forward. The forecast prediction errors are reported as a twelve-month moving sum. The average for the first twelve months includes both in-sample and out-of-sample errors.

The final—and probably most important—factor in the diminished commodity-CPI connection is the sharp decline in the commodity composition of U.S. output.

WHY HAVE COMMODITY PRICES RISEN?

If commodities are not signaling major inflation pressures, why have they risen so sharply? In large part, two factors seem to be at work. First, in many cases, prices have rebounded from unusually depressed levels. As in most cycles, the initial rebound in commodity prices may represent a catching-up process or a return to more normal input demands rather than a signal of economy-wide capacity pressures. As Chart 6 shows, even with their recent rebound, commodity prices remain well below their late 1980s peaks in real, CPI-adjusted terms.

Second, commodity prices may also have risen in response to the weak dollar. We would expect commodities—which are homogenous goods and are heavily traded in international markets—to be subject to the law of one price, that is, to have similar prices in each country's home currency. Thus, if the dollar weakens relative to other currencies, all else being equal, commodity consumers outside the United States should be willing to pay more dollars for

Chart 6

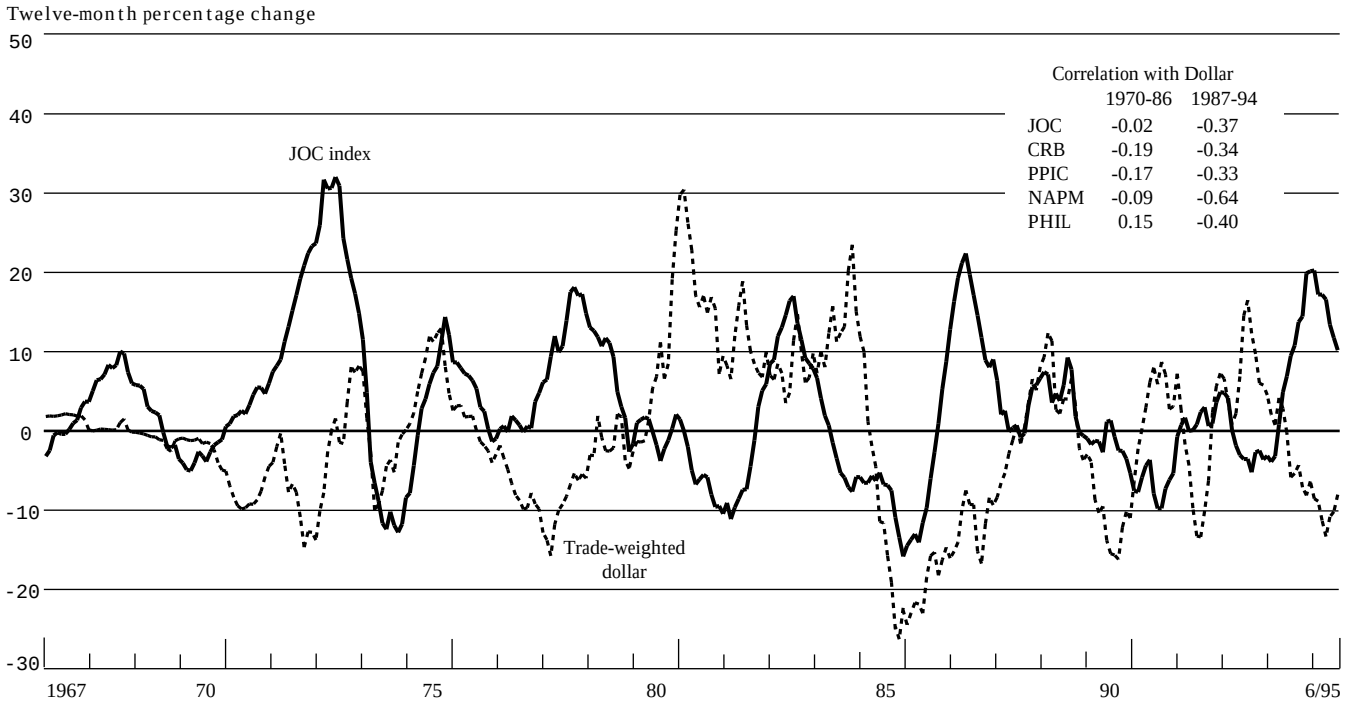
"Real" JOC Index

Sources: Bureau of Labor Statistics; *Journal of Commerce*.

Note: The values are calculated by dividing the JOC index by the CPI and then rescaling the data to equal 100 in January 1980.

Chart 7

Commodity Inflation and Dollar Appreciation



Sources: *Journal of Commerce*; Board of Governors of the Federal Reserve System.

commodity inputs, bidding up their dollar price.[13] Chart 7 shows that commodity prices have been particularly sensitive to dollar movements in recent years. For example, over the 1971-86 period, the simple correlation between twelve-month changes in the dollar and the JOC index was only -0.02, but grew to -0.34 in the 1987-94 period.

Conclusion

This article has analyzed the short- and long-run relationships between commodity prices and consumer prices. Using several VAR specifications, we find that most commodity indexes did have predictive power in explaining consumer inflation in the 1970s and early 1980s. However, we also present evidence that commodities have either lost that power or, in some cases, are sending perversely negative signals.

What accounts for this poor performance? Commodities have declined in importance, both as a share of final output and as a source of exogenous shocks to the economy. Some commodity price signals may also have been offset by countervailing changes in monetary policy. Furthermore, much of the recent commodity price run-up should be seen as both a reaction to the dollar's weakness and a normal catch-up from very depressed levels.

These findings clearly pour some cold water on the use of commodities as inflation signals in the recent period. But could commodities regain their predictive power in the future? There is little reason to expect a change in the trend away from commodity-intensive production; commodities should continue to diminish in importance as a measure of input prices and as an indicator of broad-based strength in the economy. In other respects, however, their signaling power may partially revive. Commodities should remain an indicator of global excess demand. Thus, even if they do poorly in predicting inflation in individual countries, they should retain some role as global inflation predictors. There are also signs of a partial revival in commodity investments as inflation hedges: several new commodity funds cropped up in the last year.

Nonetheless, in the absence of a major supply shock, commodity prices should remain a secondary indicator of future inflation. Inflation hawks might more profitably focus on the unemployment rate and other indicators for signs of future inflation.

APPENDIX I: COMMON FORMS OF CORRELATION PRODUCTS

The conventional VAR methods reported in this article are the most popular, but not the only, econometric methodology used in the commodity literature. This appendix briefly reviews the results for two alternatives: (1) error correction VARs, which help us regain information on the long-run relationships among the variables, and (2) time-varying parameter VARs, which provide a more flexible test for shifts in the model relationships.

ERROR CORRECTION VARS

If two or more series have a cointegrating relationship—an equilibrium relationship to which they gravitate over time—then conventional VAR specifications ignore useful information. Error correction VAR models can help us regain information on these long-run relationships. In this two-stage procedure, we first estimate a cointegrating vector and we then add the lagged errors from this cointegrating regression—the error correction term—to the conventional VAR model to explain the acceleration in CPI inflation.

The stationarity tests reported in this article limit the scope for cointegration. Two series can only be cointegrated at one degree of differencing less than the differencing needed to achieve stationarity. As a result:

- NAPM, which is stationary in levels, cannot be cointegrated with the core CPI, and
- the other four commodity indexes and the core CPI cannot be cointegrated at the same degree of differencing because the commodity indexes are stationary in first differences, while the core CPI is stationary in second differences.

Nonetheless, cointegration tests were run and revealed that the *levels* of the JOC, CRB, and crude PPI indexes were cointegrated with core CPI *inflation*, but only if the finished goods PPI was also included in the cointegrating vector.[14]

These cointegration results present a dilemma for the literature on the commodity–consumer price connection. Although the statistical results show a long-run linkage between the *level* of commodity prices and the rate of core CPI inflation, this relationship is difficult to reconcile with economic theory. For example, in a price pass-through model, why would a onetime increase in the price of a commodity input cause a permanent increase in the rate of growth in output prices? The puzzling nature of our findings prompted us to focus on the conventional VAR tests of a short-run commodity-CPI linkage in this article.

With this important caveat in mind, we present in the appendix table the error correction results for the three

DUMMY VARIABLE TESTS IN AN ERROR CORRECTION VAR MODEL

	Full Sample		Dummy Variable	
	Sign	P-Value	Sign	P-Value
CRB model				
Error correction	(-)	.01	(+)	.72
CPI	(+)	.00	(-)	.00
Finished PPI	(+)	.01	(-)	.00
CRB	(+)	.59	(-)	.00
JOC model				
Error correction	(-)	.01	(-)	.48
CPI	(-)	.00	(-)	.00
Finished PPI	(+)	.17	(-)	.10
JOC	(+)	.34	(-)	.33
Crude PPI model				
Error correction	(-)	.00	(+)	.09
CPI	(-)	.00	(-)	.00
Finished PPI	(+)	.00	(-)	.00
Crude PPI	(-)	.00	(+)	.00

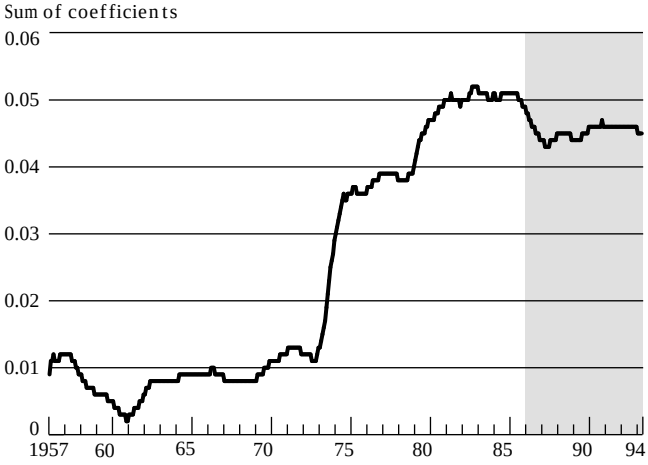
Sources: Authors' calculations, based on data from Bureau of Labor Statistics, *Journal of Commerce*, Commodity Research Bureau, National Association of Purchasing Managers, Federal Reserve Bank of Philadelphia.

Notes: Table reports the sign and joint statistical significance of the coefficients for the principal explanatory variables and the corresponding dummy variables. The dummy variables are set equal to the explanatory variables for the 1987-94 period, and are zero otherwise. The regression equation includes a constant, a linear time trend, the lagged errors from the cointegrating regression, and one to twelve lags of: the prime-age male unemployment rate, the dependent variable, the finished PPI, and a commodity index. NAPM and the unemployment rate enter as levels; the CRB, JOC, crude PPI, and finished PPI enter as log differences.

commodity models. The explanatory variables, including the error correction term, are listed at the left. The first two columns show the sign and the joint statistical significance of the sum of the lagged coefficients associated with each variable. The last two columns continue our tests for a structural shift in these relationships, showing the sign and statistical significance of dummy variables. These variables take on a value equal to the explanatory variable for the 1987-94 period and are zero otherwise. The coefficients for the dummy variables show whether the relationship has shifted in the more recent period, becoming either stronger (positive coefficient) or weaker. The formulation also allows for a formal Chow test of whether the dummy variables are jointly statistically different from zero.

The results from this more complicated model generally support the VAR findings. In particular, the coefficients for the commodity price dummy variables provide further evidence of a diminished short-run linkage between commodities and core CPI inflation in the recent period. The coefficients on both the CRB and JOC dummy variables are negative; for the CRB index, the shift is highly statistically significant. Chow tests are highly significant in all three cases, confirming a shift in the overall relationships in the model.

The Changing Link between the JOC and the CPI



Sources: Authors' calculations, based on data from Bureau of Labor Statistics, *Journal of Commerce*.

Notes: The chart is based on a regression of the second difference in the log of core CPI on a constant, a linear time trend, the prime-age male unemployment rate, and one to twelve lags of the dependent variable and the log change of the JOC index. All parameters are estimated assuming they follow a random-walk process. The sum of the coefficients on the JOC index is plotted as a twelve-month moving average to smooth out month-to-month variations. The shaded area denotes the 1987-94 period.

TIME-VARYING PARAMETER ESTIMATION

Using dummy variables or splitting the sample does not allow us to examine the evolution of the coefficient estimates. In this section of the appendix, we allow the coefficients associated with commodity prices to vary over time. This methodology is useful because it enables us to examine when the relationship between commodity prices and inflation appears strongest and when it appears weakest. The time-varying technique uses initial conditions to estimate coefficients and updates the coefficients under the assumption that the parameters are persistent, that is, follow a random-walk process. The econometrics involved closely resemble those used in Doan, Litterman, and Sims (1984) and are briefly reviewed in Blomberg and Harris (1995).

We estimate the time-varying model for all commodity indexes and obtain qualitatively similar results for all indexes. Therefore, we report only those results for the JOC because it has the longest history of our commodity series. The appendix chart plots the twelve-month moving average of the sum of coefficients associated with the JOC index. The results are generally consistent with our earlier findings: the commodity coefficients tend to increase in the 1970s but decline in the more recent period. The decline appears modest because the estimation methodology only gradually captures a structural shift; if the recent weaker linkages continue, the time-varying coefficients will continue to fall as well.

ENDNOTES

1. Indeed, these models predict that commodity prices will tend to overshoot the mark in response to a money supply increase, rising above their long-run equilibrium initially and then falling back to equilibrium.

2. Even if commodity prices rise simultaneously with final goods prices, the increase will first be *observed* in commodity indexes because they are updated almost immediately, while consumer price indexes are reported with a lag of several weeks.

3. For an excellent review of the literature, see Hilton (1990).

4. Starting in the late 1980s, several Federal Reserve Governors pointed to a role for commodity prices in the conduct of policy. See, for example, Angell (1987), Greenspan (1987), and Johnson (1988). Studies of the Federal Reserve's "reaction function" have found mixed evidence of a role for commodity prices. Hakkio and Sellon (1994), for example, find that commodity indexes are individually statistically significant in explaining movements in the federal funds rate but do not add to the model's overall ability to predict the funds rate over the 1983-93 period.

5. If the data are not stationary—that is, if the underlying process that generated the series changes over time—then classical tests are invalid. Dickey-Fuller tests showed NAPM and the prime-age unemployment rate to be stationary in levels; finished PPI, crude PPI, CRB, JOC, and PHIL to be stationary in first differences; and the core CPI to be stationary in second differences. We experimented with alternative lag lengths. Akaike information criteria suggested that nine or twelve lags were optimal for all our equations, with very little difference in the test statistics. In keeping with the literature and to ensure that seasonal effects were captured, we settled on twelve lags for all our tests. See Blomberg and Harris (1995) for details of these tests.

6. Earlier data are available for some of our commodity indexes, but we choose a uniform sample to make our tests comparable.

7. An additional disadvantage of the PHIL index as an indicator of national inflation pressures is that it covers only a relatively narrow geographic region.

8. In experimenting with alternative dates for splitting the sample, we found a progressive deterioration in the commodity variable coefficients as we moved through the 1980s. For example, although all of the commodity price variables had the correct sign for the full sample, only four of five were correct for the 1979-94 sample, only three were correct for 1983-94, only two for 1985-94, only one for 1987-94, and none for 1989-94. We settled on the 1987 split not only to make comparisons with previous research, but also to ensure an adequate number of observations in each subsample.

9. In contrast to commodity prices, the prime-age male unemployment rate remains a significant inflation predictor in all our equations, regardless of the sample period.

10. Similar results were obtained using the federal funds rate as the monetary indicator. For these equations, we also deleted the trade-weighted dollar, but this change did not materially affect the results for the monetary variables.

11. The simulation results are sensitive to how the unemployment rate enters the model. Although it is logical to assume that the unemployment rate is stationary, the Dickey-Fuller tests suggest that we may want to enter it in first differences rather than in levels. In this case, although the commodity models still tend to strongly overpredict the change in CPI inflation during periods of high commodity inflation, the forecast errors for the 1987-94 period as a whole have less of an upward bias. In addition, by including the change in the unemployment rate, we reverse our finding for M2: it no longer appears to improve the out-of-sample forecast performance.

12. These figures understate total commodity consumption somewhat because they include only purchases on spot markets.

13. A key assumption here is that the dollar movement is exogenous and is causing the commodity price change. Alternatively, both the dollar depreciation and the commodity price surge could reflect worsening inflation expectations. It is hard to believe, however, that the relatively modest inflation cycles of recent years could play much of a role in the period's dramatic exchange rate movements. It seems more plausible to argue that swings in investor sentiment are driving the dollar, which in turn is influencing commodity prices.

14. See Blomberg and Harris (1995) for formal test results.

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