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The ups and downs of commodity price indexes

The current concern about inflation began with the run-up in commodity prices at the beginning of 1993. At that time, financial markets overreacted when they interpreted a temporary surge in commodity price indexes as a sign of imminent higher inflation. As it turned out, commodity prices were responding to a variety of short-lived economic events and, contrary to expectation, inflation actually declined in 1993.

More recently, the robust growth in domestic economic activity since late 1993 has caused some pressure on the prices of some industrial materials. As a result, the spotlight is once again on commodity price indexes as leading indicators of inflation. Commodity-based indicators are calculated as an average of the prices of different commodities, and potentially translate individual price movements into a common measure of aggregate price changes.

Spot and futures prices of individual commodities are determined and quoted daily in competitive auction markets; these prices adjust quickly to changes in supply and demand. Commodities account for only a small fraction of the cost of finished goods. Yet because they have a considerable weight in Consumer Price Index (CPI) calculations, a continued increase in commodity prices may push up the inflation rate, as measured by the percent change in the CPI. Thus changes in materials prices can be real-time indicators of other price changes, current or anticipated.

A considerable amount of time may pass, however, before commodity price gains translate into higher inflation. Furthermore, price increases in industrial commodities and raw materials don't always cause inflation to rise. Sometimes they are only temporary responses to a variety of events whose effects reach no further. Also, since commodity price indexes respond to changes in supply and demand of individual commodities, they may reflect price fluctuations that are only relative and not indicative of inflationary pressures.

The November 1993 *Chicago Fed Letter* showed that inflation forecasts based on individual commodity prices and commodity price indexes can be highly misleading, since commodity prices often signal concurrent changes in price and output.[1] In this *Fed Letter* we take the analysis a step further and present evidence that commodity price indexes are not statistically useful in predicting consumer price inflation. First, we analyze the compositional characteristics of three different commodity price indexes designed specifically to help forecast inflation. Then we present the results of a number of statistical tests we performed to assess the indexes' power to do just that. The tests indicate that as forecasters of inflation, commodity price indexes contribute no additional information beyond what is contained in the past history of consumer prices.

How are the indexes composed?

We analyzed the three most widely known commodity price indexes: the Commodity Research Bureau Futures Price Index (CRB), the Journal of Commerce Industrial Price Index (JOCCI), and the Change in Sensitive Materials Prices (SMPS).[2] Their main distinguishing characteristics are the commodity price used (futures or spot prices), the number of component commodities, and the weight attached to each commodity to calculate the index. As figure 1 shows, CRB is calculated on the basis of futures prices of 21 commodities, JOCCI is calculated on spot prices of 18 industrial commodities, and SMPS is calculated on spot prices of 12 crude and intermediate materials and 13 raw industrial materials. Furthermore, CRB and SMPS assign equal weights to their components, while JOCCI assigns individual weights based on the components' estimated ability to lead consumer price inflation.

One major shortcoming of these commodity price indexes is the weighting scheme used to calculate them. When commodities are equally weighted, as they are in CRB and SMPS, for example, a 1% increase in the price of cocoa would have the same impact on the index as a 1%

1. Composition of commodity price indexes

	CRB	JOCCI	SMPS
Prices	futures	spot	spot
Components	21	18	25
Weights	equal	individual	equal
Weights by category			
Metals	19%	35%	38%
Energy	14%	12%	0%
Livestock	14%	0%	0%
Grains, food, and fiber	43%	17%	29%
Other	10%[a]	36%[b]	33%[c]

[a]Orange juice and lumber
[b]Rubber, red oak, hides, tallow, boxes, and plywood
[c]Rubber, hides, rosin, tallow, wastepaper, sand, and lumber

increase in the price of crude oil. However, not all commodity prices have the same impact on inflation, since certain goods represent only a small portion of world consumption and production. In addition, equal weighting tends to overstate the importance of groups of commodities. For example, as figure 1 shows, the CRB index is heavily weighted toward agricultural commodities, whose futures prices are constantly affected by changing weather reports. As a result, the CRB responds sharply to price swings in commodities such as coffee and cotton that have very little impact on overall inflation.

An alternative approach would be to weight each component in proportion to its relative value in world production. The Producer Price Index, for example, uses a production-based weighting scheme for its components, where weights depend on the product output value at the time of shipment to another industry. The higher the output value of the commodity, the heavier its weight in the index. Similarly, under a world production weighting scheme, crude oil, for example, would have three times the weight it now has in CRB, while cocoa would have 1/24 the weight used in CRB. This method of weighting would reflect the fact that a sustained increase in the price of crude oil has a larger impact on overall inflation than a comparable increase in the price of cocoa. This is because crude oil is an input to a vastly larger number of finished goods and has a much greater world production value than cocoa.

JOCCI uses yet another weighting scheme that gives more importance to materials whose price movements are believed to lead consumer price inflation. This is consistent with the basic idea that among commodities used intensively in cyclical industries, prices tend to increase before consumer prices do. Theoretically, this weighting scheme should eliminate some of the problems of equal weighting and increase the indicator's ability to anticipate inflation.

Compositional issues such as these make commodity price indexes susceptible to sharp fluctuations, since materials prices respond not only to economic fundamentals but also to various market forces. Pindyck and Rotemberg, for example, found that prices of unrelated commodities tend to move together as a result of "herd" behavior in financial markets.[3] That is, traders seem to exhibit a similar behavior in all commodities markets instead of responding to specific economic events. Thus, for instance, futures prices of precious metals have been responding to movements in grain futures, which are affected by constantly changing weather forecasts. Clearly, prices of precious metals should not be affected by weather conditions. But when grain prices rise, CRB also increases because it is heavily weighted toward agricultural commodities. Traders in other commodities markets fear higher inflation and react accordingly. Such behavior is reasonable if the index's increase is truly signaling higher inflation. It is not reasonable, however, if movements in the index are caused by relative price changes. Given the many compositional quirks of the various commodity price indexes, it is very difficult to determine whether an increase in an index is supply-driven or actually indicates inflation.

How well do they forecast inflation?

Do commodity price indexes help forecast inflation? That is, if such an index were included in a forecasting model containing data on past inflation, would the resulting forecast be more accurate than the one the model would have generated without the index? We attempted to answer this question by comparing historical data on actual inflation with the forecasts the commodity price indexes would have generated for the same periods.

We evaluated the commodity price indexes in three steps. First, we produced inflation forecasts from January 1970 to June 1994 based only on past inflation and calculated the average size of the forecast errors over this period, as measured by root mean squared errors (RMSEs).[4] In this first step, we used a simple autoregressive model which we called the no-indicator model, with 12 lags of inflation growth and a constraint term on the right-hand side of the equation. Next, we repeated this analysis by adding one commodity price index to the no-indicator model to produce bivariate models which we called indicator models. We tested three such models, each including one of the three commodity price indexes; in all of these models, both the index and inflation growth were lagged 12 months. Third, we compared the average forecast error from each indicator model with the average forecast error from the no-indicator model. If the average error from an indicator model was significantly smaller than the average error from the no-indicator model, then we would say that the added index improved the forecast. To quantify the statistical significance of any apparent improvement in forecast, we performed a t-test on the difference between the two models' squared forecast errors.

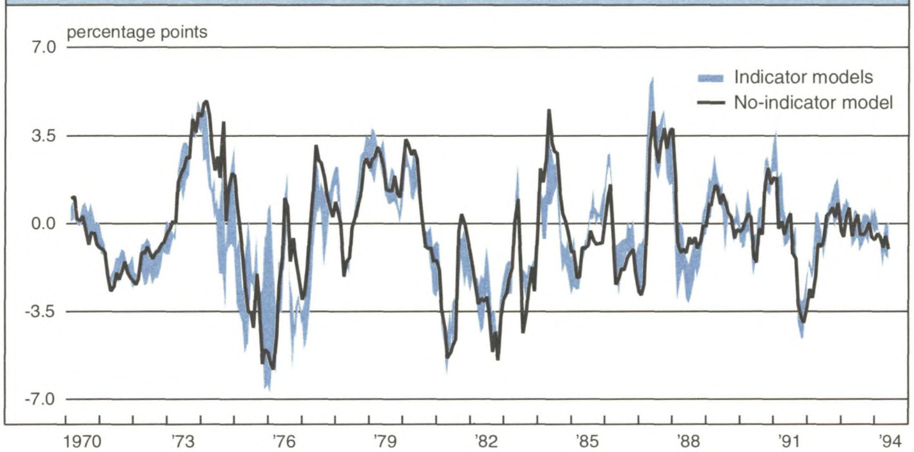
Figure 2 ranks the indicators according to their average forecast errors at 3-month, 6-month, and 12-month forecast horizons. In simple terms, the lower the average forecast error, the better the performance of the forecasting model. JOCCI and SMPS seemed to perform better than the no-indicator and CRB models at all

2. Average forecast errors

	3-month		6-month		12-month	
Indicator	RMSE	Rank	RMSE	Rank	RMSE	Rank
None	2.269	4	2.098	3	2.214	3
CRB	2.264	3	2.112	4	2.214	4
JOCCI	2.171	1	1.950	1	2.085	2
SMPS	2.203	2	1.959	2	2.038	1
Significance levels						
CRB	0.934		0.815		0.993	
JOCCI	0.165		0.069		0.110	
SMPS	0.280		0.057		0.026	

Note: RMSEs are root mean squared errors. Significance levels were for the t-test of the null hypothesis that the mean of the difference of the squared errors was equal to zero.

3. Forecast errors (12-month horizons)



forecast horizons. JOCCI ranked first at the 3-month and 6-month horizons, and SMPS took the lead at the 12-month horizon. Although CRB did better than the no-indicator model in the short run, its forecasting ability deteriorated at longer forecast horizons. The results in figure 2 seem to indicate that JOCCI and SMPS improved the performance of the forecasting model, since they succeeded in lowering the average forecast error. However, the differences between the forecast errors of the no-indicator model and the forecast errors of the indicator models were very small, averaging less than one-tenth of a percentage point. Such a small improvement in the forecast error seems insignificant when we consider that between January 1970 and June 1994 the annual inflation rate ranged from approximately 2% to over 12%. As figure 2 shows, we also calculated significance levels to measure the probability that the mean of the differences of the squared forecast errors was actually zero. Values above 0.05 indicate that the average differences between the forecast errors were so small that they are likely to be *truly* zero in the long run and hence insignificant. Conversely, values below 0.05 indicate that we can reject the hypothesis that the mean of the differences is zero. In the latter case, we would consider the improvement in the forecast significant. Only the SMPS model reduced the forecast error by any statistically significant amount, and then only at the 12-month horizon.

Figure 3 allows a visual check of how similar the forecast errors from the various models truly are over time. The chart depicts the difference between actual inflation and forecasts of inflation at 12-month horizons (forecast errors) produced by the no-indicator and indicator models from January 1970 to June 1994. It is clear that with only a few minor exceptions, the path of forecast errors from the three indicator models (depicted by the shaded band in the figure) is almost identical to the path of forecast errors from the no-indicator model. This shows that the difference between the forecast errors tends to average zero over the time period. It also shows that the size of the forecast errors from all of the models is very similar. Clearly, commodity-based indicators appear to add no valuable information to that already provided by past inflation.

Conclusion

Economic indicators have value only to the extent that they possess unique and independent information. In addition, they can be useful forecasting tools if they reliably and consistently satisfy the purpose for which they were designed. The three commodity price indexes we analyzed were all created to measure anticipated inflation. Yet our findings show that they don't do any better than the past history of prices. That is, even though CRB, JOCCI, and SMPS contain some qualitative information on price movements, they possess no unique information for measuring changes in inflation. Although these indexes fail in their role as forecasters of inflation, they still provide valuable real-time information on aggregate price movements. The task of the sophisticated analyst is to interpret these movements carefully in light of the compositional problems that characterize commodity-based indicators.

—Francesca Eugeni and Joel Krueger

[1]Francesca Eugeni, Charles Evans, and Steven Strongin, "Commodity-based indicators: Separating the wheat from the chaff," *Chicago Fed Letter*, No. 75, November 1993.

[2]The Commodity Research Bureau Futures Price Index (1967=100) is compiled by the Commodity Research Bureau, Inc., Chicago. The Journal of Commerce Industrial Price Index (1980=100) is compiled by the Center for International Business Cycle Research at Columbia University, New York. The Change in Sensitive Materials Prices (1987=100) is calculated as the moving average of the monthly changes in the Index of Sensitive Materials Prices, which is compiled by the U.S. Department of Commerce, U.S. Department of Labor, and Commodity Research Bureau, Inc.

[3]Robert S. Pindyck and Julio J. Rotemberg, "The excess co-movement of commodity prices," National Bureau of Economic Research, Washington, DC, working paper, No. 2671, July 1988.

[4]Our forecasts were out of sample and were recursively estimated using Kalman filtering techniques from January 1970 to June 1994. The full sample period was January 1963 to June 1994.

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Tracking Midwest manufacturing activity

Manufacturing output indexes (1987=100)

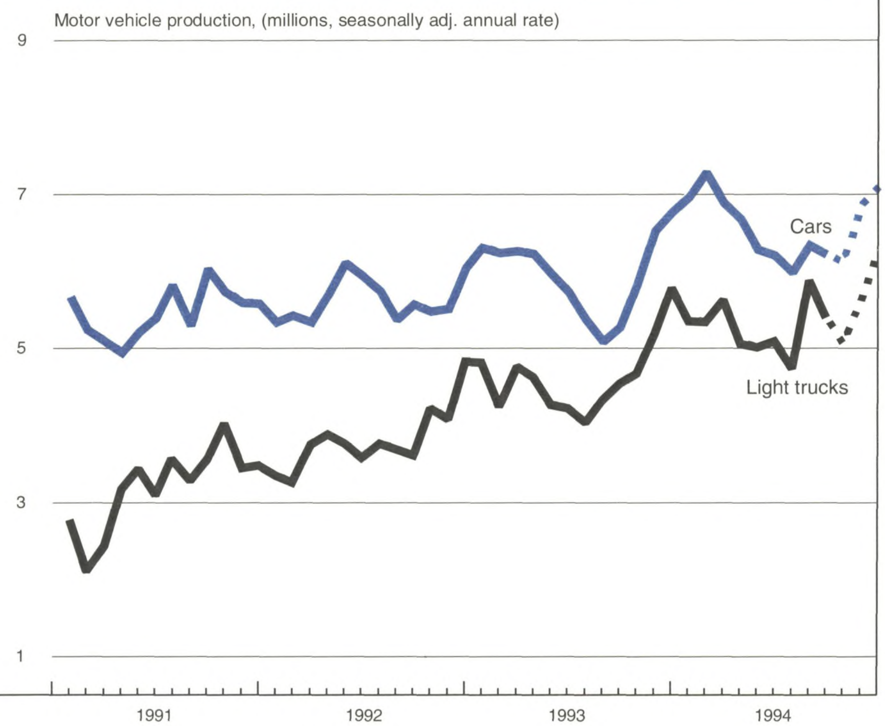
	Aug.	Month ago	Year ago
MMI	135.0	133.2	120.0
IP	120.7	119.4	111.8

Motor vehicle production (millions, seasonally adj. annual rate)

	Sept.	Month ago	Year ago
Cars	6.2	6.4	5.3
Light trucks	5.4	5.9	4.6

Purchasing managers' surveys: net % reporting production growth

	Oct.	Month ago	Year ago
MW	67.7	68.7	64.7
U.S.	64.2	61.2	56.5



Note: Dotted lines are estimated production from auto producers.

Component shortages, strikes, and special interruptions associated with new model changeovers took a toll on light vehicle assemblies in recent months. Ongoing difficulties at one large automaker may further constrain output in the fourth quarter.

Supply considerations do not explain all of the slowdown since early 1994, however. Total light vehicle production peaked in February, the same month in which short-term interest rates began to rise and the S&P 500 reached a peak. A sharp slowdown in mortgage refinancing and a flattening out in consumer confidence have also let some of the steam out of growth in vehicle demand. Even so, sales and production remain at high levels, and most industry participants remain optimistic about their prospects for 1995.

Sources: The Midwest Manufacturing Index (MMI) is a composite index of 15 industries, based on monthly hours worked and kilowatt hours. IP represents the Federal Reserve Board industrial production index for the U.S. manufacturing sector. Autos and light trucks are measured in annualized physical units, using seasonal adjustments developed by the Board. The purchasing managers' survey data for the Midwest are weighted averages of the seasonally adjusted production components from the Chicago, Detroit, and Milwaukee Purchasing Managers' Association surveys, with assistance from Bishop Associates and Comerica.

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