EXAMINING THE CRB INDEX AS AN INDICATOR FOR U.S. INFLATION

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Abstract

This paper analyzes historical movements in the commodity futures market and the relationship to inflation. Specifically, the relationship between the Commodity Research Board (CRB) Index and United States inflation is investigated. It was found that the relationship between the CRB index and the U.S. inflation rate was greater in the past than in more recent times. This is probably due to a change in the composition of the United States economy, as the service sector has grown as larger proportion of the economy. The service sector uses less commodities than the manufacturing and agricultural sectors use.

Key Words: *CRB index, Commodities Research Bureau, inflation, Vector Autoregression*

JEL Codes: E00, E30

I. Introduction

The area of economic inquiry into the interrelationship between commodity prices and inflation is a timely topic. The CRB index is intended to measure anticipated inflation. (CRB Yearbook, 2004; Rogers, 2007) Many economists and publications have somewhat accepted the CRB index as a bell weather indicator of future inflation (Angell, 1992; Bianco, 1993; Kuhn, 1994; Liscio, 1991; Nusbaum 1993; Hess, 2003; Compton, 2005; Rogers, 2007). The CRB index in October 2000 provides a good example of how the high prices of some commodities (oil and natural gas) can be offset by the prices of other commodities, such as agricultural ones and gold. All of these commodity prices are of course in the CRB index (Palavi, 2000). However in recent years, the effectiveness of the CRB index to predict future inflation rates has diminished (Bloomberg and Harris, 1995; Kudyba and Diwan, 1998).

Knowing if the inflation rate is going to change is very helpful to many economic agents. Let's use the example that there is going to be an increase in the inflation rate. This would make holders of debt lose real wealth due to being paid back in cheaper dollars. Conversely, debtors would stand to gain because their debts would be less in real terms. This assumes that the nominal interest rate on those loans is fixed. Salary and wage agreements would also be affected with the employer coming out on the winning end. Real asset values increase in times of inflation include land and precious metals. Governments, among the largest issuers of debt, are keen to note that inflation lessens the real burden of their debt. Businesses, with all the many inputs that they use and the selling of the many outputs of goods and services, must predict the accurate prices of everything. So there is no doubt that a precise as possible measure of inflation is a worthy goal.

A popular measure of inflation is the Consumer Price Index (CPI). We know this measurement is based on a basket of goods and services that are sold at the *retail level*. What about looking at the pries of some inputs at the very beginning of the production process? One such measurement is the Commodity Research Bureau Index (CRB Index) which is currently based on 17 commodities. Commodities are differently prices than retail items. Commodities are priced using an auction market, where supply and demand constantly change and constantly use those changes to determine new prices for those commodities. That means that even during the course of just one day, the price of a commodity may change many times. In considering the retail goods and services that you purchase, one does not often see the price tag changing up and down, over the course of a day or even between just two days. So clearly commodity market or retail market, has the most volatile prices.

Of importance, the commodity market is composed of items that are not finished goods. For example, gasoline is not on the commodity market; oil is. Some agricultural products are also in the commodity market before they have been processed and packaged, ready to be sold consumers. Economists place a great deal of importance on lag time because there can be an effect felt in one part of the economy that is not felt in the other part of the economy immediately, because of the lag time. For example, a price increase being seen in commodity prices, it may not be felt until the lag elapses and then it is felt in the consumer price index. But what about services? They have no commodities as raw materials. And countries like the United States now have economies based more on services then those countries did before. Still commodities are important to America. So the CRB Index is only somewhat as good a predictor of inflation as it once was, due to the

changing composition of the United States economy. The remaining sections of this paper include a literature review, a model section, a review of the results and then a summary and conclusion.

II. Literature Review

Products which tend to be heterogeneous and have longer contract periods have a slower price response to monetary changes than homogenous commodities. Because agricultural products have well-developed auction markets and tend to be more homogeneous than industrial products, there is "a faster price response by agricultural products than by industrial products" (Bordo, 1980). Bordo's study of 14 industries, including a farm product sector, showed that prices for agricultural and other crude products responded more rapidly than prices of manufactured goods, when there was a change in monetary policy. Yet it was found that there was still a lag effect before price increases occurred in the agricultural sector, after an unanticipated increase in the money supply (Bordo, 1980; Saunders, 1988). However, Tweeten (1980) states that it has long been found that the total effect of inflation on agricultural commodities take place in a year or less.

Effectiveness of the CRB Index as a Leading Inflation Indicator

The Fed has acknowledged internal research on the use of commodity prices in monitoring inflation. (Tanzy, 1987) Aside from only trading futures contracts on physical commodities, there are exchanges that also trade futures based on commodity indexes (Cantania, 1994). A respected "overall index of commodity prices" has been calculated by the Commodity Research Bureau, since September 1956 (Kaufman, 1984). The

current CRB index is an equally weighted average of the commodities (Bloomberg and Harris, 1995; Gorton and Rouwenhorst, 2006). Because the CRB index is updated continuously throughout the business day as commodity futures prices fluctuate, the CRB index is monitored widely by financial market participants (Garner, 1995). There is an advantage in having a broad index of commodity prices that might act as a leading indicator of inflation. For instance like gold, these commodities can be held as stores of value when the general inflation rate is expected to rise. Also, the prices of these commodities can adjust quickly to a change in general inflation expectations. This is because commodity futures trade in highly efficient auction markets. On the other hand, measures of consumer price inflation adjust more slowly (Garner, 1995).

In contrast to the price of gold, the diversified CRB index may be a better leading indicator for two reasons. Firstly, the commodities in the CRB index play a more important role than gold in the current productivity of the economy. Since the CRB index is more likely to represent an increase in production costs that must ultimately be passed on to consumers. Secondly, a diversified commodity price index may also be less likely to give false signals of somewhat universal inflationary pressures because of factors affecting a particular commodity market. Similar to the price of gold, other commodity prices also fluctuate because of market-specific disturbances to supply or demand having nothing to do with the overall inflation rate. These type market-specific disturbances may average out across a broad range of commodities. This however leaves movements in the commodity index that more closely reflect changes in general inflation expectations. Although the CRB futures index may be a better leading indicator of inflation than the

price of gold, many analysts believe the components of the index are not diversified enough to be an extremely reliable leading indicator (Feder, 1994).

Most points of view for a signaling role for commodities rest on the fact that commodity prices are set in auction or flexi-price markets. Because of this, these commodity prices can dash ahead quickly in response to actual or expected changes in supply or demand. By contrast, prices of most final goods services are restrained by contractual arrangements and other frictions. So they respond gradually and steadily to supply and demand pressures, only slowly gaining ground on commodity prices (Bloomberg and Harris, 1995). An interesting quote from Bloomberg and Harris (1995) states, "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. " Furthermore, Bloomberg and Harris point at the classic exchange rate model developed in Dornbusch (1976). This model is commonly referred to as the "overshooting model" (Rogoff, 2001; Romer, 2003). According to this model, prices on goods maybe "sticky" in the short run. However, in the short run the financial markets may adjust to disturbances very quickly. Now let's take the case of an increase in the money supply. Then the market will need to move to a new equilibrium between quantities and prices. This will be achieved through changes in financial market prices. Only later on will the prices of goods become less sticky. Then they will shift towards new equilibrium points. At that time, the financial market prices will shift down but not all the way down to the original level. Then a new equilibrium will be obtained for money, the supply of goods and the financial markets. This initial over reaction and then settling back down is what is meant by the overshooting model (Dornbush, 1976; Rogoff, 2001; Romer, 2003). In

addition, Bloomberg and Harris (1995) state that Boughton and Branson (1991) and Furhrer and Moore (1992) employ models that show commodity prices increasing faster, with final goods prices, only responding, with a lag, when there is an unexpected increase in the money supply. 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" (Bloomberg and Harris, 1995).

First, as illustrated by the tortoise-and-hare fable, commodity prices may give forewarning signals of an inflationary swell in aggregate demand. Higher demand for final goods increases the demand for commodity inputs and, even though the inflation momentum may start in final goods markets, the first visible increase in prices may be in the flexi-price commodity markets. Because commodities are widely traded internationally, this aggregate demand signal would most likely occur when strong domestic demand is not counterbalanced by weak foreign demand. Certainly, in empirical models commodity prices are often modeled as a function of global economic activity. These demand-induced commodity price run-ups most probably will be concentrated in industrial materials (Bloomberg and Harris, 1995). Second, commodity prices and broad inflation may be directly connected 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 sooner or later be passed through to final goods prices. Historically, large direct input price effects have tended to be concentrated in food and energy commodities (Bloomberg and Harris, 1995).

The third connection between commodity prices and future inflation stems from the first two. Because commodity prices respond quickly to wide-ranging inflation

pressures, investors may see them as a useful inflation hedge. This view 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. Usually, precious metals have been signaled out as the most convenient commodities for hedging inflation (Bloomberg and Harris, 1995). One such principle is the notion that rising commodity prices cause an acceleration in the rate of inflation. A popular application of this idea is to sell government securities to "price in" possible monetary contraction by the Federal Reserve Board because the Commodity Research Bureau (CRB) index is in an uptrend. Such methods no longer may be valid. It is correct that this commodity-inflation link thrived from 1975 to the mid-1980s. Yet, much to the disappointment of inflation hawks and market letter writers, it appears momentary (Kudyba and Diwan, 1998).

The fourth and most prevailing hypothesis that commodities are leading indicators for changes in the CPI is based on the idea that the prices of widely traded commodities reflect immediate information about expected changes in supply and demand in the economy. These forces can in the form of weakening or strengthening economic activity supply shocks or persons using precious metals to hedge against expected inflation. While commodity prices may react immediately, final consumer goods lag because producers are restricted by lengthy contractural agreements and other rigidities (Kudyba and Diwan, 1998).

Some Ineffectiveness of the CRB Index as a Leading Indicator of Inflation

There has been work that has concluded that the CRB and similar futures indices lose their ability to forecast inflation past a few months into the future.(Eugeni, Evans

and Strongin, 1993; Eugeni and Krueger, 1994). There is no long-run connection between the level of commodity prices and the level of consumer prices. Yet there is a link between the level of commodity prices and the rate of consumer price inflation (Bloomberg and Harris, 1995). During an examination of a full sample period which was 1970-94, all of the traditional commodity indexes had some ability to predict short-run changes in core CPI inflation. However, this relationship weakened greatly initially in the mid-1980s (Bloomsberg and Harris, 1995). The breakdown extends further than the commodity prices (Bloomsberg and Harris, 1995). Indeed the finished goods PPI cannot help forecast changes in core CPI inflation in the latter part of the of the sample period (Bloomberg and Harris, 1995). Adding monetary variables and the dollar exchange rate to the models aids in eliminating some contrary findings, suggesting that some inflation signals from commodities are being hidden by offsetting changes in exchange rates and monetary policy" (Bloomberg and Harris, 1995). In spite of any empirical agreement, the commodity-CPI connection may have weakened since the mid-1980s (Bloomberg and Harris, 1995). First, with commodities playing a smaller role in U.S. production, and in the lack of major food and oil price shocks, recent commodity fluctuations may not have been big enough to be passed through to consumer prices (Bloomberg and Harris, 1995). Second, the theoretical writing on commodity prices suggests that the current attention of monetary authorities to commodity prices may have established commodities' signaling role. This would occur if monetary authorities eased or tightened policy in response to the inflationary signals of commodity prices and thus mitigated the real inflation outcome (Bloomberg and Harris, 1995). Third, since commodity investments have yielded a poor return in recent years, they have lost some attraction as inflation hedges, making them

less responsive to inflation expectations. Finally, recent commodity movements may have little to do with causal inflation pressures and instead may reflect a rebound in very depressed markets and the contact of movements in dollar exchange rates (Bloomberg and Harris, 1995).

A different category of explanation for the weaker prognostic power of commodities is that this may be an example of Goodhart's law. Such a view is derived from Wojnilower (1980). This is a corollary of the Lucas critique (1976). Goodhart's law states that "any statistical regularity will tend to collapse once pressure is placed on it for control purposes." Consequently, if investors accept as true that monetary authorities are reacting to the inflation signals from commodity prices, then the commodity price movements will begin to mirror market expectations of monetary policy rather than independent information on the economy (Bloomberg and Harris, 1995). The final – and almost certainly most important – factor in the diminished commodity – CPI connection is the pointed decline in the commodity composition of U.S. output (Bloomberg and Harris, 1995). This diminished role seems to be a sign of a great downward shift in demand for commodities and the increase in quantity consumed. Final demand has moved steadily away from goods with high commodity content. These include food, furniture and textiles. Instead final demand has gone towards sectors with low commodity content such as electronics, engineering products, plastics, and services. As an example, from 1948 to 1994, the share of services in consumer spending almost doubled from 32 percent to 57 percent. Also, though commodity price inflation has exceeded CPI inflation for brief periods, for the 1970-94 period all together , commodities have lost more than half their value relative to consumer prices (Bloomberg

and Harris, 1995). This reduced role for commodities means that they are a less dependable inflation indication. That is because price pass-through effects are weakened, as more parts of the economy become independent of commodity markets, an increase in commodity prices is more likely to reflect an increase in a narrow part of final demand than an increase in economy–wide demand (Bloomberg and Harris, 1995).

Commodities should stay continue to be an indicator of global excess demand. Therefore, even if they do poorly in predicting inflation in individual countries, they should continue to retain some role as global inflation predictors (Bloomberg and Harris, 1995). With the swift progress of technology and globalization, many earlier accepted relationships have changed. Enhancements in production effectiveness, structural shifts toward the service sector and the enlargement of the multinational corporate business all have assailed traditional market theory (Kudyba and Diwan, 1998) Financial traders in the investment sector need to avoid financial damage and advance in order to survive. One such principle is the idea that rising commodity prices cause an acceleration in the rate of inflation. A popular use of this idea is to sell government securities to "price in" possible monetary tightening by the Federal Reserve Board since the Commodity Research Bureau (CRB) index is in an uptrend (Kudyba and Diwan, 1998). Such techniques no longer may be suitable. It's true this commodity-inflation link worked well from 1975 to the mid-1980s . Altough much to the disappointment of inflation hawks and market letter writers, it appears fleeting (Kudyba and Diwan, 1998).

Through the use of ordinary least squares regression analysis, Kudyba and Diwan (1998) test this theory by considering the theories of cost-push and demand-pull inflation, with references to the influence of commodity prices on the U.S. Consumer

Price Index (CPI). They try to determine if accepted beliefs regarding commodities and inflation last in today's global, computerized, service–oriented society (Kudyba and Diwan, 1998). OLS regression analysis by Kuyba and Diwan (1998) is used to look at two periods of time – 1975 – 1986 and 1986 – 1996 yielded two important different results. During the period from 1975 through 1986, the assorted independent commodity variables explain a realistic amount of change in the CPI. In order of being influential independent variables were crude oil, followed by spot gold, thirdly the grains index, fourthly the industrials index, with the CRB index of all commodities in the index being fifth. With the broader CRB index, the effect of more important subcomponents (for example crude oil) may be subdued by adverse price movements of less-influential components. Kudyba and Diwan (1998) posit that the CRB index may incorporate too many commodities to be a reliable inflation indicator. They say this because in looking at he period from 1986 to 1996, "all correlation coefficients and corresponding t-statistics of non-oil commodity groups fall to insignificant levels" (Kudyba and Diwan, 1998). Indeed with the stronger independent variable of crude petroleum, "it can be argued its influence on inflation was negligible " (Kudyba and Diwan, 1998). The reason for the loss in ability for commodities to provide a reliable inflation indicator is the fact that the U.S. economy's output has experienced a strong decline in commodity composition (Kudyba and Diwan, 1998).

While the index is diversified across several commodity groups, the majority of the index represents agricultural commodities and livestock. The CRB index, therefore, is not representative of the broad mix of goods and services purchased by U.S consumers since the index gives too much weight to agricultural products. Moreover, agricultural

products sometimes experience major supply shocks, such as a bad harvest caused by drought or crop disease. Therefore, the CRB index might give misleading signals about inflation if agricultural prices were to rise sharply because of a supply shock at a time when other consumer prices were decreasing or stable (Garner, 1995).

Since economies evolve, investors must continually evaluate various market links, whether economic or political in nature. Common examples that exemplify this idea are the weakening influence of U.S. money supply and merchandise trade figures on shorter-term trade volatility in the foreign exchange and interest rate markets. During the early 1980s, money market players paid attention to money supply figures dominating the landscape. Even though these series continue to be fundamental economic indicators, they have lost much of their market-moving clout (Kudyba and Diwan, 1998). The high technology, information and service characteristics of today's U.S. economy in reality vary from those of the 1950s and the 1960s. Larger numbers of more accessible international capital markets, increased trade and high-tech information systems have enlarged globalization and productivity, altering attributes of domestic economies(Kudyba and Diwan, 1998). "This new U.S. economy has helped alter the cause-and-effect relationship between commodity prices and the rate of inflation " (Kudyba and Diwan, 1998). Should commodities be disregarded when looking for leading indicators for changes in the CPI? Certainly not. Yet we should look at their price movements in context of the larger picture, and bear in mind more prolonged and extreme trends in select commodities or commodity indexes (Kudyba and Diwan, 1998).

Then again, to be a dependable leading indicator of a targeted variable, a logical cause and-effect relationship must exist between the commodities and the final products.

The CPI comprises an array of commodity inputs, so a cause-and-effect relationship should exist, thus rendering commodities a possible leading indicator for changes in the inflation gauge (Kudyba and Diwan, 1998). Only indirect associations can be drawn between the CPI and most commodity prices, such as grains as feed inputs to livestock, or as part of the manufacturing process of final goods, such as cereal and other foods(Kudyba and Diwan, 1998).

Furlong (1989) This paper determines if the Commodity Research Bureau Index contains information helpful to policy further than that contained in the intermediate targets such as M1 and M2 (Furlong, 1989). The data on both interest rates and exchange rates could also provide information to policymakers, and are accessible on as frequent and as timely a basis as are commodity prices (Furlong, 1989). Secondly, the features of commodity price indexes that make them potentially helpful for monetary policy purpose in reality may limit their usefulness. For instance, the flexibility and quick adjustment of commodity prices may perhaps increase the 'noise-to-information' content of a commodity price index. Certainly, commodity prices are apt to be quite volatile compared with prices in general (Furlong, 1989). This instability makes it not easy to differentiate between short-run movements in commodity prices the implications for overall inflation. Certainly, simple correlations for monthly data on CPI inflation and changes in commodity prices may be quite low. Therefore, month-to-month changes in commodity prices offer little information about overall inflation. Conversely, short-run movements in the monetary aggregates do not provide much information, either. The correlations for CPI inflation and month-to-month changes in M1 and M2 are only a little

higher than those for the commodity price indexes , and those for the commodity price indexes. Also, those for the monetary aggregate have the wrong sign (Furlong, 1989). Furlong (1989) states that the more important question is whether movements in commodity prices over longer periods precede movements in overall prices in both a reliable and predictable manner. He plots 12-month moving average growth rates between February, 1979 and April, 1988, inclusive. What Furlong (1989) found was that movements in the commodity indexes did tend to precede movements in overall inflation. This lends support of the usefulness of commodity indexes. Nevertheless, the usefulness of the commodity indexes is limited for several reasons. The price indexes preceded turning points in CPI inflation varied randomly when Furlong examined this over a 28 year period of time from 1960 to 1988. Firstly, the number of months by which changes in the commodity Ranges are wide for the CRB index.

Therefore, we have reviewed some of the literature that supports and counters the view that the CRB index is a useful leading indicator of inflation. Now we shall describe our model and estimation results.

Model and Estimation

A number of studies have examined the role of commodity prices as early indicators of inflation (Adams and Ichino, 1995; Tutterow, 1995; Furlong and Ingenito, 1996; Mahdavi and Zhou, 1997; Moosa, 1998; Bloch *et al*., 2004; Bloch *et al*., 2006; Bloch *et al*., 2007). Furlong examines the role of commodity price indices as monetary policy indicators. He observes that commodity prices should satisfy two conditions to become effective monetary policy indicator. First, it should have strong and stable relationship with the macro variables of interest such as economic growth or inflation.

Second, any movement in commodity prices should precede the movements in ultimate macro variables. Mahdavi and Zhou examined the effectiveness of gold and commodity prices as leading indicators of inflation. Among these two indicators, commodity price index outperformed gold price.

The relationship between commodity prices and the policy variables of interest such as economic growth, distribution of income, wage rate, and inflation is generally examined using vector autoregressive (VAR) models. In general, a VAR model is a system of equations, i.e.,

$$y = \nu + \beta(L)y + \varepsilon \tag{1}$$

where y is a *(k*1)* vector of endogenous variables and the ν is a *(k*1)* vector of intercepts that account for the possibility of observing nonzero means. $\beta(L)$ is a *(k*k)* matrix of polynomials in the lag operator *(L)* and ε is a *(k*1)* vector of error terms, which are often referred as white noise or innovation processes (Lütkepohl, 2005). The system has k equations, each containing p lags on all k variables. If these lag operators are identical, the system is estimated using an ordinary least square method without any loss of efficiency. However, if different lag lengths are involved, a more generalized estimation procedure is required (Hafer and Sheehan 1989; Lütkepohl 2005).

Using p^{th} order VAR system, the relationship between commodity prices and inflation can be specified as:

$$CRB_t = a_{01} + \sum_{i=1}^{P} b_{1i} CRB_{1,t-i} + \sum_{i=1}^{P} c_{1i} Inf_{t-i} + d_{1i} Trend + e_{1i} GDPg + f_1 M_2 + \varepsilon_{1,t}$$

$$Inf_t = a_{02} + \sum_{i=1}^{P} b_{2i} CRB_{t-i} + \sum_{i=1}^{P} c_{2i} Inf_{t-i} + d_{2i} Trend + e_2 GDPg + f_2 M_2 + \varepsilon_{2,t}, \tag{2}$$

where CRB_t is Reuters/Jefferies CRB Index (CCI), Inf_t is US inflation rate, *Trend* is a trend variable expected to measure production capacity/technological innovation (), GDP_g is US GDP growth rate, and M_2 is a measure of money supply (M_2) in the US economy. A number of empirical and statistical procedures are involved in deriving the final estimating equation from the p^{th} order VAR system in equation (2). First, a number of statistical tests such as final prediction error (FPE) criteria, Hannan-Quinn criterion (HQ), Akaike information criteria (AIC), and Schwarz criteria (SC) can be used to determine the order of the VAR system. Second, unit root tests are conducted to determine the stability of the selected equation system. Third, a VAR Granger Causality test is conducted to determine the direction of causality. In this study, we are interested to know whether there is one-way causality from commodity prices to inflation. Finally, variable exogeneity tests are conducted to determine whether the variables included in the model are exogenous to the system.

Results and Discussion

We adopt an empirical approach in determining the order of the VAR system, stability of the selected model, the direction of causality between commodity prices and inflation, and the exogeneity of other variables used in the VAR system. All five lag order selection tests indicate that the relationship between commodity price index and inflation rate can be closely approximated by a second order VAR system (table 1). Given these results, a second order VAR system is used in all subsequent estimations.

The unit root test results indicate that all four roots of characteristic polynomials lie inside the unit circle implying that the selected VAR system satisfies the stability condition (results not reported but available on request). Moreover, the Granger causality

test results show that movements in commodity prices indeed induce changes in inflation rate but not the other way around (table 2). This implies that changes in commodity price index precede changes in inflation. The variable exogeneity tests indicate that money supply and GDP growth rates are exogenous to the VAR system under consideration (results not reported but available on request).

As a second test to examine whether there is a two-way relationship between commodity price index and inflation, a second order VAR system with trend, GDP growth rate and money supply as exogenous variable was estimated (table 3). As expected, both of the coefficients associated with the lagged inflation variables in CRB Index equation (column 1) are not significant. On the other hand, the coefficients associated with the lagged CRB Index in Inflation equation (column 2) are highly significant implying that commodity prices affect inflation but inflation does not affect commodity prices.

Summary and Conclusion

Based on a series of empirical test, a second order empirical VAR system was estimated to examine whether the aggregate Reuters/Jeffrey CRB Index can be used an early warning indicator for inflation. Although earlier studies have shown that the impact of commodity prices on inflation has been declining as the share of service sector in overall US economy has been increasing, the results reported in this study show that the relationship between commodity price and inflation is still significant. In particular, the model results show that there is one-way relationship between commodity price index and inflation. For instance, an increase in commodity price index by one standard deviation would increase inflation nearly by one unit in the second year and its impact is likely to disappear by the end of the

fifth year (figure 1). This implies that commodity price index can still be used as an early warning indicator of inflation. One of the possible reasons for the divergence of our results from earlier studies may stem from the fact that we are using annual data rather than the monthly series, which has been the norm in most studies. Since commodity prices are prone to short term idiosyncratic movements (Furlong, 1989), use of annual data should provide a better measure of commodity price-inflation relationship than the models based on higher frequencies.

References

2004 Commodity Year Book, Hoboken, New Jersey: John Wiley and Sons, 2004.

Abbott, Susan, Inflation Watchers Mixed on Meaning of Recent Surge," Futures, Vol. 16, July, 1987. pp. 42-44.

Adams, F., and Ichino, Y. Commodity Prices and Inflation: A Forward-Looking Price Model. Journal of Policy Modeling, 17(4), 1995, 397-426.

Angell, Wayne D., "Commodity Prices and Monetary Policy: What Have We Learned?," *Cato Journal,* Vol. 12, No. 1, September, 1992, pp. 185-192.

Bianco, James A., "The Bull Market Nobody Wants," *Futures,* August, 1993, p. 30.

Bloch, H., Dockery, A., & Sapsford, D. (2004). Commodity Prices, Wages, and U.S. Inflation in the Twentieth Century. Journal of Post Keynesian Economics, 26(3), 523-545.

Bloch, H., Dockery, A., & Sapsford, D. (2006, Special Issue). Commodity Prices and the Dynamics of Inflation in Commodity-Exporting Nations: Evidence from Australia and Canada. Economic Record, 82, S97-109.

Bloch, H., Dockery, A., Morgan, C., & Sapsford, D. (2007). Growth, Commodity Prices, Inflation and the Distribution of Income. Metroeconomica, 58(1), 3-44.

Bloomberg, S. Brock and Harris, "The Commodity – Consumer Price Connection: Fact or Fable?," *Federal Reserve Bank of New York Economic Policy Review,* October, 1995, pages 21 – 38.

Bobin, Christopher A., *Agricultural Options: Trading, Risk Management, and Hedging*, (New York: John Wiley & Sons, Inc., 1990).

Bordo, Michael David, "The Effects of Monetary Change on Relative Commodity Prices and the Role of Long-Term Contracts," *Journal of Political Economy,* 88 (1980), pp. 1088-1109.

Boughton, James, and Wiliam H. Branson, "Commodity Prices as a Leading Indicator of Inflation in K. Lahiri and G. H. Moore, editors, *Leading Economic Indicators: New Approaches and Forecasting Records*, pp. 303-38. Cambridge: Cambridge University Press, 1991.

Catania, Patrick, ed., *Commodity Trading Manual,* (Chicago: Board of Trade of the City of Chicago, 1994).

Chavas, Jean-Paul and Matthew T. Holt, "On Nonlinear Dynamics: The Case of the Pork Cycle," *American Journal of Agricultural Economics,* August, 1991, pp. 819-828.

Cody, Brian J. Jr., ands Leonard O. Mills, "The Role of Commdity Prices in Formulating Monetary Policy," *Review of Economics and Statistics,* 73, 2, 1991, pages 358 – 65.

C,ompton, Jonathon, "Get Ready for a Bout of Inflation: Commodity Prices on the dollar likely to slide further, and dizzying monetary expansion in the US," *Euroweek,* April 15, 2005, p. 29.

Commodity Research Bureau, *CRB Indexes* Available from: http://www:.crbtrader.com/crbindex/ Cited on June 16, 2007.

Dickey, D. A. and W. A. Fuller, "Distribution of the Estimators for Autoregressive Time-Series with a Unit Root," *Journal of the American Statistical Association,* Vol. 74, pages 427 – 431, 1979.

Dornbusch, Rudiger, "Expectations and Exchange Rate Dynamics," *Journal of Political Economy,* Vol. 84, 1976, pp. 1161- 76.

Durand, Matine , and Sveinbjorn Blondal, "Are Commodity Prices Leading Indicators of OECD Prices?," in O. Guvenen W. Labys, and J. Batiste, editors, *International Commodity Market Models: Advances in Methodology and Applications*, pp. 305-21. London: Chapman and Hall.

Ehrhardt, Michael C. and Alan L. Tucker, "Pricing CRB Futures Contracts," *The Journal of Financial Research,* Vol. 13, Spring 1990, pp. 7-14.

Eugeni, Francesca, Charles Evans, and Steven Strongin, "Commodity-Based Indicators: Separating the Wheat from the Chaff," *Chicago Fed Letter, Number 75,* November, 1993.

Eugeni, Francesca and Joel Krueger, "The Ups and Downs of Commodity Price Indexes," *Chicago Fed Letter,* Number 88, December, 1994.

Ferder, Barnaby J., "Inflation Concerns Rise with Commodity Rises Prices, June 22, 1994, pages C1 and C5.

Fisher, Franklin M. and Karl Shell, *The Economic Theory of Price Indices,* (New York: Academic Press, 1972), p. 58.

Fisher, Irving, "Six Types of Index Numbers," *The Making of Index Numbers,* (New York: Houghton Mifflin Company, 1927).

Furlong, Frederick T., "Commodity Prices as a Guide for Monetary Policy," *Federal Reserve Bank of San Francisco Economic Review*, Winter, 1, 1989, pages 21-38.

Furlong, Frederick T., Robert Ingenito, "Commodity Prices and Inflation," *Federal Reserve Bank of San Francisco Economic Review*, 2, Spring, 1996, pages pages 27 – 47.

Gamber, Edward N. and Frederick L. Joutz, "An Application of Estimating Structural Vector Auto regression Models with Long-Run Restrictions," *Journal of Macroeconomics,* Vol. 15, Fall 1993, pp. 723-745.

Garner, Alan C., "Commodity Prices: Policy Target or Information Variable? A Note" *Journal of Money Credit and Banking,* 21,4,508-514.

Garner, C. Alan, "How Useful are Leading Indicators of Inflation?", *Federal Reserve Bank of Kansas City Economic Review,* Second Quarter, 1995, pages pages 5 – 18.

Gordon, Robert J., *Macroeconomics,* (Boston: Little, Brown & Co., 1978), page 6.

Gorton, Gary, and K. Geert Rouwenhorst, "Facts and Fantasies about Commodity Markets," *Financial Analysts Journal*, 62, 2, April, 2006, pp. 47-68.

Gujarati, Damador N.,"Autoregressive and Distributed Lag Models," *Basic Econometrics,* (New York: McGraw-Hill Publishing Company, 1988).

Hafer, R.W. and Sheehan. (1989). "The Sensitivity of VAR Forecasts to Alternative Lag Structures." *International Journal of Forecasting* 5:399-408.

Hallman, Jeffery J., Richard D. Porter, and David H. Small, "Is the Price Level Tied to the M2 Money Aggregate in the Long Run?," *American Economic Review,* Vol. 81, September 1991, pp. 841-858.

Hess, Lisa W., "Buy the Pacific Rim," *Forbes*,171,6,March 17, 2003,page 178.

Horrigan, Brian R., "Monetary Indicators, Commodity Prices, and Inflation," *Federal Reserve Bank of Philadelphia WorkingPaper no. 86-7,* 1986.

Kaufman, Perry J., *Handbook of Futures Markets,* (New York: John Wiley & Sons, 1984).

Knight-Ridder Financial Services, "Knight-Ridder Commodity Research Bureau's Futures Price Index," *1986 CommodityYearbook,*(Chicago: Knight-Ridder Financial, 1994).

Kudyba, Stephan and Romesh Diwan, "Rising Commodities and Higher Inflation (It's not that simple)," *Futures,* February, 1998, pages 48 – 50.

Kuhn, Susan e., "Commodity Prices Spell Inflation Danger," *Fortune,* June 27, 1994, pp. 104- 110.

Lien, Donald and Xiangdong Luo, "A Theoretical Comparison of Composite Index Futures Contracts," *The Journal of Futures Markets,* Vol. 13, No. 7, September, 1993, pp. 821-836.

Liscio, John, "Choose Your Inflation Barometer," *Barron's*, Vol. 71, May 13, 1991, page 41.

Lucas, R.E., Jr., "Econometric Policy Evaluation: A Critique," Ca*rnegie-Rochester Conference Series on Public Policy,* pages 7 – 33.

Lütkepohl, H. 2005. New Introduction to Multiple Time Series Analysis. Springer, New York.

Mahdavi, Saeid and Su Zhou. "Gold and Commodity Prices as Leading Indicators of Inflation: Tests of Long-Run Relationship and Predictive Performance." *Journal of Economics and Business,* 49(5), 1997, 475-489.

Moosa, Imad A. "Are Commodity Prices a Leading Indicator of Inflation?" *Journal of Policy Modeling*, 20(2), 1998, 201-212.

Nusbaum, David, "Commodity Indexes Hint Return of Inflation," *Futures,* Vol. 22, No. 6, June, 1993, pages 50-52.

Pearce, David., ed., *MacMillan Dictionary of Economics,* (London: The MacMillan Press, ltd., 1986).

Palavi, Gogoi, "Why High-Priced Oil Isn't Sparking Inflation," *Business Week,* 3704,October 23, 2000, page 52.

Pfaffenberger, Roger C, and James Patterson, *Statistical Methods, (*Homewood, Illinois: Richard D. Irwin, Inc., 1981).

Pindyck, Robert S. and Daniel L. Rubinfeld, *Econometric Models and Econometric Forecasts,* (New York: McGraw-Hill, Inc., 1991).

Pindyck, Robert S. and Julio J. Rotemberg, "The Excess Co-Movement of Commodity Prices," *Economic Journal,* Vol. 100, pages 1173-1189.

Rogers, Jim, *Hot Commodities: How Anyone Can Invest Profitably in the World's Best Market,* New York: Random House, 2007.

Rogoff, Kenneth s., "Dornbusch's Overshooting Model After Twent-Five Years," *Second Annual IMF Research Conference Mundell-Fleming Lecture,* November 30, 2001, pp. 1-54.

Romer, David, *Advanced Macroeconomics,* McGraw Hill, 3rd ed., 2005.

Saunders, Peter J., "Causality of U.S. Agricultural Prices and the Money Supply: Further Empirical Evidence," *American Journal of Agricultural Economics,* 70 (1988), pages 588-596.

Sims, C.A., "Macroeconomics and Reality," *Econometrica,* vol. 48, pages 1-48, 1980.

Smith, Stephen D., "What Do Asset Prices Tell Us about the Future?," *Federal Reserve Bank of Atlanta Economic Review, 3*rd Quarter, 1999.

Taylor, George Rogers and Lucius F. Ellsworth, *Approaches toAmerican Economic History,* (Charlottesville, Virginia: The University Press of Virginia, 1971).

Tutterow, R. "Evidence on commodity prices as a leading indicator of CPI inflation." *Atlantic Economic Journal,* 3(2), 1995, 148.

Tweeten, Luther G., "An Economic Investigation Into Inflation Pass through to the Farm Sector," *Western Journal ofAgricultural Economics,* December 1980, pages 89 – 106.

Webb, Roy H., "Which Price Index Should a Central Bank Employ," *Federal Bank of Richmond Economic Quarterly,* Vol. 90, 2, Spring, 2004, pages 63 – 76.

Webb, Roy H. and Tazewell S. Rowe, "An Index of Leading Indicators of Inflation," *Federal Reserve Bank of Richmond Economic Quarterly*, Vol. 8 ½, Spring, 1995, pages 75 – 96.

Whitt, Joseph A. Jr., "Commodity Prices and Monetary Policy," *Federal Reserve Bank of Atlanta Working Paper no. 88-8.*

Wojnilower, A.M., "The Central Role of the Credit Crunches in *Recent Financial History, Brookings Papers on Economic Activity, 2,* pages 277 - 339.

Table 1. VAR Lag Order Selection Test Results

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-284.7369	NA	5460.729	14.27985	14.61420	14.40160
1	-259.4819	43.11819	1942.050	13.24302	13.74455	13.42565
2	-243.3670	25.94114*	1081.853*	12.65205*	13.32076*	12.89555*
3	-240.2907	4.651859	1143.012	12.69711	13.53300	13.00149
4	-236.2392	5.731460	1157.596	12.69459	13.69766	13.05986

Note: The model used in testing VAR order includes CRB Index and inflation as the Endogenous variables and a constant, trend, US GDP growth rate, and money supply as exogenous variables.

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Table 2. Granger Causality/Block Exogeneity Wald Test Results

Dependent variable: CRBINDX			
Excluded	Chi-sq	Df	Prob.
INFLN	2.513082	2	0.2846
All	2.513082	2	0.2846

Dependent variable: INFLN			
Excluded	Chi-sq	Df	Prob.
CRBINDX	22.29831	2	0.0000
All	22.29831	2	0.0000

Table 3. Estimated Parameters for the Second Order VAR System

Variable	CRB Index	Inflation
CRBINDX(-1)	0.9987**	0.0421**
	(5.08)	(4.45)
CRBINDX(-2)	-0.2911	-0.0397**
	(-1.50)	(-4.25)
INFLN(-1)	0.7804	0.7681**
	(0.22)	(4.51)
INFLN(-2)	2.774	-0.1994**
	(0.97)	(-1.45)
C	14.5171	1.8490*
	(0.74)	(1.97)
@TREND	-0.0258	0.1069
	(-0.01)	(1.23)
GDPG	2.5670	-0.1284
	(0.96)	(-0.99)
M2	0.0095	-0.0010*
	(0.84)	(-1.92)

**, * Denote significance at 1 and 5 percent level.

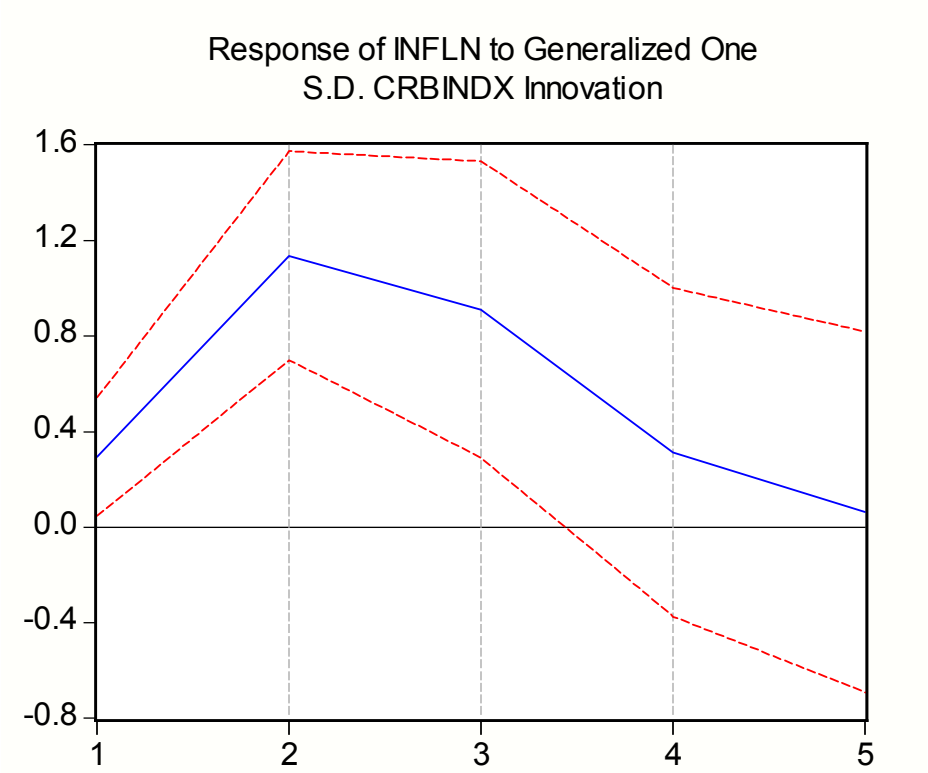

Figure 1. Impact of One Standard Deviation CRB Index Innovation on Inflation