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by

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Exchange Rate Shocks, Macroeconomic Announcements and Commodity Price Behavior

Dhaneshwar Ghura¹

This paper analyzes the immediate and delayed responses of 20 commodity prices to 7 types of macroeconomic "news". For economic variables (money stock, inflation, and real activity) which are announced periodically, survey data are used to divide macroeconomic announcements into expected and unexpected components with the latter measuring news. For other macroeconomic variables whose values are realized on financial and credit markets (exchange rates and interest rates), autoregressions are used to model their daily behavior and the residuals from these autoregressions are used as shocks to commodity markets. It was found that exchange and interest rate shocks and news from the real activity indices were important in explaining the price movement of several commodities. Also, some commodities were sluggish in their reaction to news from announcements of the real activity. Furthermore, macroeconomic news generally affected commodities within commodity groups in a uniform direction. Finally, news about the money supply and inflation indices were generally not important in significantly affecting commodity prices.

Key words: macroeconomic announcements, exchange rate shocks, commodity prices.

Introduction

There has been great interest over the past 15 years in the theoretical and empirical linkages between macroeconomic variables (including exchange rates) and commodity markets [Bond (1984); Batten and Belongia (1986); Belongia and King (1983); Chambers (1981, 1984, 1985); Chambers and Just (1979, 1981, 1982); Gardner (1981); Grennes and Lapp (1986); Orden (1986); Rauser et. al. (1986); and Schuh (1974)]. There is now an emerging literature [Barnhart (1988, 1989); Frankel (1984, 1986); Frankel and Hardouvelis (1985); Gilbert (1985, 1987)] on the impact of macroeconomic shocks on short-run commodity price behavior.

The studies by Bond (1984), Frankel (1986), Frankel and Hardouvelis (1985, henceforth, FH), and Gilbert (1985) emphasized the important role of expectations of macroeconomic variables in the short-run commodity price dynamics. Also, these studies view primary storable commodities as financial assets since they are traded continuously on futures exchanges. Hence, the short-run prices of these commodities are expected to be influenced not only by market demand and supply conditions (market fundamentals), but also by "news"² of macroeconomic variables³ (such as money stock; interest, inflation and exchange rates; and real activity), which affect the terms on which

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² News refers to unpredictable new information.

³ Of course, commodity prices and especially prices of agricultural goods are influenced not only by news of macroeconomic variables, but also by news about the weather and a host of other non-economic factors.

traders are prepared to hold title to commodity futures contracts.

FH investigated the theoretical and empirical behavior of commodity prices prior to and following money supply announcements by the Federal Reserve System of the United States (henceforth, Fed). Barnhart extended the empirical approach taken by FH to account for the prices of more commodities and more U.S. macroeconomic announcements. These studies have shown that commodity prices have responded significantly to news over the period 1977 to 1984 and that these responses have been particularly sensitive to the monetary policy regimes adopted by the Fed.

A limitation of these studies is that despite the important interlinkages between international financial and primary commodity markets (Chambers and Just; Gilbert; Schuh), they ignored any possible commodity market reactions to daily shocks from foreign exchange markets.⁴ Gilbert (1985) provided the theoretical interlinkages between exchange rate shocks and commodity price movements. In his empirical investigation, he analyzed quarterly movements of metal prices as explained by shocks in quarterly exchange rates (Gilbert, 1987). Although his analysis was an important contribution to understanding the impact of exchange rate shocks on commodity prices, it masked the important impact of daily exchange rate shocks and periodic U.S. macroeconomic announcements on daily commodity price movements.

The important role of exchange rate fluctuations in short-run commodity price dynamics cannot be ignored. The international economy has experienced several major developments in the value of the dollar over the past fifteen years. It is widely accepted that the dollar fell to a historically low level in the late 1970s, but rose sharply over the period 1982-84. The U.S. farm economy was deeply affected by the persistent overvaluation of the dollar prices of U.S. agricultural commodities became more expensive in terms of foreign currencies. By the beginning of 1985, the dollar was generally considered highly overvalued. In the mid eighties, however, there has been a persistent tendency for the dollar to depreciate.

Theoretical Considerations

In this section, a simple model is used to explain the impact of new information on commodity prices. Following the specification, the theoretical links between daily commodity price movements and new information about daily movements in exchange and interest rates, weekly announcements of the money stock, and monthly announcements of inflation and real activity indices are discussed.

The main motivations for a trader to hold commodity futures contracts in a portfolio with other liquid assets (such as stocks, bonds, foreign currencies, and money) are for diversification, risk minimization and short-run profit maximization. Any unexpected new information which affects the trader's perceptions of the future time path of his net profit flow on that portfolio will make him revise the proportion of each asset held. Such reshuffling will cause commodity prices to change accordingly, either temporarily or permanently. Hence, news results in the revision of the dynamic paths of commodity prices.

The Model

The efficient markets hypothesis attributes daily movements of financial asset prices to news about economic variables. Hence, the analysis is set in an efficient market framework where

⁴ Barnhart (1989) recognizes the importance of exchange rate shocks in commodity price dynamics. However, he chooses to ignore it in his analysis.

$$(1) DP_i(t) = a + Z^u(t)B + u(t)$$

and

- $DP_i(t)$ = percentage change in the i -th commodity price from the close of trading on day $t-1$ to the close of trading on day t ;
 $Z^u(t)$ = unexpected percentage change in economic data contained in $Z(t)$, computed as the difference between announced or realized values and expected values, $= (\ln[Z^a(t)] - \ln[Z^e(t)]) * 100$;
 $Z^a(t)$ = announced or realized values of variables in vector $Z(t)$;
 $Z^e(t)$ = expected values of variables in vector $Z(t)$;
 $Z(t)$ = vector containing the following variables: money supply; interest, unemployment and exchange rates; industrial production index, and consumer and producer price indices;
 $u(t)$ = random disturbance⁵ term with zero mean and constant variance;

and B is a vector of parameters and the scalar a is a parameter intended for estimation.

If expectations are rational,

$$(2) Z^u(t) = Z^a(t) - E[Z(t) | I(t-1)],$$

where $Z^a(t)$ is as defined before, E is the expectations operator, and $I(t-1)$ is the information set available at time $(t-1)$. If markets are efficient, only the unexpected part of any economic announcement or realized values of economic variables should cause prices to change. Events which are expected, presumably, are built into the forecast process by rational economic agents. Economic news alter agents' expectations about the future course of economic variables which in turn changes prices of commodities.

Impact of Money Surprises

The first category of economic news considered here is contained in weekly announcements of U.S. money supply. Although it is widely accepted that monetary policy is neutral with respect to commodity prices over the long-run⁶, it is not so obvious that monetary shocks are neutral over the short-run.⁷

According to the policy anticipation hypothesis about how weekly money stock announcements influence commodity prices, investors in the commodity markets believe that the unexpected money growth in period t will be offset in period $t+1$ as the Fed restricts the money supply driving up real interest rates. A rise in real rates leads to a fall in commodity prices as investors make a portfolio adjustment to hold higher yielding bonds and bills and fewer physical assets such as commodity futures contracts. By contrast, the expected inflation hypothesis assumes that the Fed will not offset increases in the money stock but will keep on increasing the money supply, resulting in higher inflation expectations. In this case, commodity futures contracts become

⁵ It is assumed that $u(t)$ is uncorrelated with information known as of the close of trading on day $t-1$.

⁶ See Grennes and Lapp (1986), for instance.

⁷ Results from Frankel and Hardouvelis (1985) and Barnhart (1988, 1989) point to the importance of monetary shocks for short-run commodity price behavior. However, the impact of monetary shocks is very sensitive to the operating procedure of the Fed.

more attractive as investors move out of bonds and decide to hold more physical assets such as stocks, foreign currencies, and commodity futures.

Since the late seventies, at least four different operating procedures have been used by the Fed. Prior to October 6, 1979, the Fed generally accommodated shifts in money demand so that interest rate fluctuations were smoothed⁸ but money supply movements were not closely controlled. After that date, the target paths for money growth were narrowed and wider interest rate swings were tolerated. The Fed concentrated on monetary aggregates, namely non-borrowed reserves. After October 1982, the Fed moved back towards its pre-October 1979 stance in which interest rate movements were given more weight and money supply movements, particularly movements in M1, were given less weight.⁹

If the earlier descriptions of the changes in the Fed's monetary policies since the late seventies is correct, commodity prices should not have reacted to unanticipated money in the pre-October 1979 and post-October 1982 periods and depreciated after a positive money shock in the October 1979 to October 1982 period. Both FH and Barnhart (1988) have found this to be the case for the period 1977-1982. Also, Barnhart found that several commodities reacted negatively to positive shocks in M1 in the post-October 1982 period when the Fed was operating under a borrowed reserve policy regime.

In the mid-eighties, the Fed has apparently stopped targeting growth rates for its monetary aggregates, although it seems that it has been more interested in setting target rates for M2 and M3 rather than for M1. The Federal Reserve Bulletin (Board of Governors, December 1985) states that "... adjustment should not be made automatically in response to the behavior of monetary aggregates alone, but should take broader economic and financial developments into account, including conditions in domestic and international financial markets." The factors that are now apparently taken into consideration in the conduct of U.S. monetary policy are: behavior of monetary aggregates; strength of the business expansion; performance of the dollar in the foreign exchange markets; progress against inflation; and conditions in domestic and international markets. Given this fact, unexpected movements in M1 alone are no longer a good guide to future monetary policy and should not have caused commodity prices to react significantly in the period 10/01/86-12/31/87.

Impact of Inflation Surprises

The second category of news considered is from monthly announcements of the Producer Price Index (PPI) and the Consumer Price Index (CPI). The linkage between unexpected inflation and daily commodity price movements depends on how investors interpret the news in regard to inflationary expectations and in regard to how they expect the Fed to react to the inflation figures. If the announcements activate a fear of renewed inflation, investors move out of bonds and into physical assets. Thus, they demand more commodity futures contracts, causing commodity prices to rise. If, however, investors believe that the Fed will resort to a restrictive monetary policy due to the unexpected increase in inflation, causing nominal interest rates to rise in excess of expected inflation, real interest rates should rise. In this case, investors will adjust their portfolio by selling commodity contracts, stocks, and foreign currencies and by holding more bonds. Hence, commodity prices would be expected to fall.

⁸ The Fed targeted the federal funds rate to do so.

⁹ The Fed moved towards a borrowed reserve target.

Impact of Real Activity Surprises

The third category of news considered is from the announcements about real economic variables -- industrial production and unemployment rate. Unexpected economic growth as manifested by an unexpected increase in industrial output and/or a decline in unemployment could be expected to have ambiguous effects on commodity price growth rates since this "good" news can be viewed by investors in two ways. First, news of a strengthening of economic activity may increase investors' confidence about future growth in the economy. In such a case, investors will increase their demand for short-run investments causing short-term nominal and hence real interest rates to rise (assuming inflation expectations do not change). Again, commodity prices are expected to fall for reasons discussed earlier. On the other hand, investors might interpret the strengthening of economic activity as a sign of an "overheating" economy. There are two possible price reactions in this case. If traders expect the Fed to react by contracting money supply, real rates should go up and hence commodity prices fall. However, if traders believe that the Fed will remain passive and hence increase their inflationary expectations, real interest rates are supposed to fall causing commodity prices to rise as investors demand more commodity contracts. Therefore, the overall impact of news of real activity is ambiguous and can affect different commodities differently.

Impact of Interest Rate Surprises

The impact of a surprise in nominal interest rates is also ambiguous with respect to commodity prices since it depends on the extent to which the surprise in the nominal rate reflects a real rate surprise. If a positive nominal rate shock is in excess of inflationary expectations, it translates into a positive real rate shock and commodity prices would be expected to fall for two important reasons. First, investors adjust their portfolio by holding more money and fewer commodity contracts. Also, for storable commodities, real interest rate surprises¹⁰ are important since interest rates are a major cost component in storage. An unexpected rise in real rates makes it more costly to hold inventories. In the short-run, traders will get rid of their inventories and cut further demand for them. All this action will in turn cause commodity prices to fall. However, if positive nominal rate shocks are not in excess of increases in expected inflation, real rates fall and commodity prices rise.

Impact of Exchange Rate Surprises

The last category of news considered is unexpected exchange rate movements. With the exception of Gilbert (1985, 1987), no other study has investigated the impact of economic news from the international economy as embodied, say, in unexpected movements of exchange rates on commodity prices. Exchange rate fluctuations are a major source of variability in commodity prices. Gilbert (1985), in the context of independence of price expectations of the country in which these expectations are formed, efficient forward exchange markets, covered interest parity, and no transportation costs, developed the theoretical linkage between commodity price movements and news from the foreign exchange markets. The implication of his derivation is that an unexpected one percent appreciation of the dollar causes commodity price to fall by less than one percentage point.

¹⁰ Barnhart provides empirical evidence on the important impact on commodity prices of unexpected changes in announced discount rates. The present study considers the impact of daily interest rate surprises on commodity markets. In this way one can capture the full effect of surprises from the credit markets on the commodity markets. Also, a higher discount rate will most likely translate into a higher market rate and hence the impact of unexpected changes in discount rates are also captured in this way.

Schuh has noted that U.S. agricultural goods loses their international competitiveness when the dollar appreciates. When the dollar gains in strength, U.S. goods become more expensive in terms of foreign currencies and foreign demand falls causing commodity prices to fall in the U.S. Chambers and Just (1981) have shown empirically that when the dollar is strong, U.S. prices of soybeans, wheat and corn fall significantly. Also, Orden provides empirical evidence that a decline in the real value of the dollar has a positive effect on relative agricultural prices.

Data and Specification of Variables

The data for commodity prices, economic announcements, and expected values of economic announcements are discussed in this section. The sample period begins on October 1, 1986, and ends on December 31, 1987. Because of the important role of expectations, the expectations data are examined in detail.

Commodity Prices

Table 1 gives a summary of the important characteristics of the commodities considered. To investigate the responses of commodity prices to new information, daily percentage changes in closing price quotations on "nearby"¹¹ futures contracts were used.

Announcement Data

The money stock data consist of announced weekly changes in the level of narrowly defined money stock (MS)¹² as reported in the Federal Reserve H.6 Statistical Release.

The data on inflation are the monthly percentage changes in the producer price index (PPI) and the consumer price index (CPI)¹³, as announced by the Bureau of Labor Statistics (BLS). These two figures on inflation are released at 8:30 a.m. once every month on various days of the week and the released figures provide inflation information during the preceding month. The announced figures for the CPI and PPI are from the BLS Press Release.

Data on industrial production (IP) and unemployment rate (UR) are used to represent information on real economic activity. Both indicators are announced monthly on various days of the week and they report figures for the previous month. The figures for the percentage change in industrial production are announced by the Fed at 9:15 a.m. They are reported in the Federal Reserve G.12.3 Statistical Release. The unemployment rate figures are announced by the BLS at

¹¹ A nearby is a continuous price series for a contract. Since a futures contract stops trading on its expiration date, nearbys were created by "splicing" individual successive futures contracts together. For example, if a commodity (e.g. cotton) had contracts that matured in the months numbered 3 (March), 5 (May), 7 (July), 10 (October), 12 (December), the futures prices of the contract maturing in month 3 were used until calendar month 3, then prices of contracts maturing in month 5 were used until calendar month 5, etc. All commodity futures price data are from Data Resources / The McGraw-Hill Financial and Economic Information Company, Lexington, Massachusetts.

¹² The Fed announces changes in the level of the money stock for the statement week ending on Wednesday of the previous calendar week minus the revised estimate of the previously reported level of the money stock. Since March 22, 1984, the money stock announcements have been made on Thursdays at 4:30 P.M. (E.S.T.).

¹³ The PPI announcement is always made earlier in the month than the CPI announcement and hence it may contain more news on inflation for the preceding month.

8:30 a.m. They are reported in the BLS Press Release.¹⁴

Expectations and Market Data, and Economic News

For those variables (MS, PPI, CPI, IP, UR) for which regular announcements are made, market expectations data were used. These expectations are from surveys conducted by MMS International, Redwood City, California. They consist of median responses from surveys of approximately 40 to 60 market participants. These market expectations are good proxies for market expectations and have been shown to be unbiased and efficient (Pearce and Roley, 1985).

The unanticipated percentage change in the money supply is defined as $MS^u(t) = ([M^a(t) - M^e(t)]/MS(t-1)) * 100$, where $M^a(t)$ is the announced weekly change in narrowly defined money, in billions of dollars, $M^e(t)$ is the survey median of the expected change in money stock from the previous announcement in week $t-1$ to the present and $MS(t-1)$ is the revised level of money stock in period $t-1$.

The unexpected percentage change in the unemployment rate is calculated as follows: $UR^u = [(UR^a - UR^e)/UR^a(t-1)] * 100$ where $UR^a(t)$ is the announced level of unemployment in period t and $UR^e(t)$ is the market median survey of the unemployment rate level for period t .

For other announced variables used in this study (PPI, CPI, IP), since both the announced and expected figures are themselves in terms of percentage changes, the unexpected percentage changes are calculated as the difference in announced and survey expectations figures.

The two remaining independent variables are: the unexpected changes in daily interest rates (IR) and exchange rates (ER). The interest rate chosen is the three-month U.S. treasury bill rate. It is a daily average as reported by the U.S. Treasury. The exchange rate is defined as London noon quotation of the number of SDR per U.S. dollar as reported by the Bank of England.¹⁵ An increase in that number corresponds to an appreciation of the dollar. Both of these rates were obtained from International Monetary Fund (IMF) data tapes. The daily values of these two rates are realized in the financial markets and are not announced. They themselves respond to economic announcements as shown by Hardouvelis (1988). However, in this study, it is assumed that unexpected changes in the daily interest rate (IR^u) and exchange rate (ER^u) are exogenous¹⁶ to the behavior of commodity prices. This is a reasonable assumption given the fact that these rates adjust very quickly to economic announcements. Hakkio and Pearce (1985) have shown that exchange rates adjust to economic announcements within twenty minutes. Barnhart and FH have shown that commodity prices are somewhat sluggish in their reaction to economic news. Exchange rate and interest rate surprises have

¹⁴ Great care was taken to match the dates of the announcements with the price changes. Since money announcements are made on Thursday afternoons after the commodity markets are closed, the unanticipated component of money announcements were matched with the difference between the Friday close and the Thursday close prices to measure the immediate impact of shocks in the money supply on commodity prices. Also, since all the other announcements are made while the markets are still open, the unanticipated components of these announcements were matched with the difference in the close of the announcement day and the close of the previous day to measure the immediate impact.

¹⁵ This exchange rate is chosen for two important reasons. First, in terms of timing, investors in the U.S. have access to it in the morning. Second, the SDR/U.S. dollar rate summarizes the interesting movements of a representative basket of important international currencies vis-a-vis the U.S. dollar.

¹⁶ Empirical analysis of the impact of unexpected announcements of money stock, consumer, producer and industrial production indices, and unemployment rates on the residuals from autoregressions of daily exchange and interest rates did not indicate any statistically significant influence. Hence, this assumption is justified.

been calculated as the residuals from second order autoregressions of the daily series of these rates.¹⁷

Empirical Framework and Results

The Empirical Model

The empirical equation estimated is

$$(2) \text{DP}_i(t) = a + Z^u(t)B + LZ^u(t)C + u(t)$$

where $LZ^u(t)$ is the one-day-lagged values of the unexpected percentage change in economic data contained in vector $Z(t)$, C (like B) is a vector of parameters intended for estimation, and all other variables are defined as in equation (1).

The results of estimation¹⁸ of equation (2) are given in Tables 2.

The coefficient for each commodity represents the percentage change in commodity prices following a one percentage unexpected change in the relevant variable. For instance, from Table 2, a one percent appreciation of the dollar causes the price of cocoa to fall by six-tenth of a percentage point. For a contract representing 10 metric tons trading at one dollar per metric ton, this corresponds to an approximate decline of six-tenth of one cent which translates in a depreciation of about 6 cents for the value of the contract. The impact of the other variables on commodity prices can be derived in a similar way by using the information given in Table 1.

Three F-statistics are given in Tables 2. The F-statistic F_1 , tests the null hypothesis that the impact of all the included variables in equation (2) --variables measuring both the immediate and the lagged responses-- is jointly equal to zero. F_2 tests the null hypothesis that the joint impact of variables (MS^u , PPI^u , CPI^u , IP^u , UR^u , IR^u and ER^u) measuring of the immediate response is equal to zero. F_3 tests the same hypothesis as F_2 but for the variables (LMS^u , $LPPI^u$, $LCPI^u$, LIP^u , LUR^u , LIR^u and LER^u) measuring the one-day-lagged impact.

Each variable generally affected each commodity within a group in a uniform direction. Also, certain commodities such as sugar, pork bellies, cotton, energy products, and gold did not react significantly to news. Also, several of the commodities reacted to news with delay, indicating the possibility of market inefficiency in commodity markets. This result concurs with those of Barnhart (1988), FH, and Gilbert (1987).

Impact of Exchange Rate Surprises

It is clear from the results that news from the foreign exchange markets is important in explaining the behavior of daily commodity prices. The majority of the significant immediate impact of unexpected exchange rate appreciations on commodity prices were negative as expected and were of particular importance in explaining the price movements of precious metals, cocoa, and live cattle. All four precious metals (gold, palladium, platinum and silver) reacted strongly to unexpected exchange rate movements, although the reaction of the silver price was the strongest.

¹⁷ This method for producing surprises implicitly assumes that agents know in period t the underlying coefficients of their forecasting model in periods $t+1$, $t+2$, However, this procedure is justified if the coefficients of the forecasting models have not changed significantly over time. This was the case.

¹⁸ There is empirical evidence [see Milanos (1986), for instance] that the first difference of commodity prices have a tendency to exhibit heteroskedasticity. The results given here are those obtained after correction for an unknown form of heteroskedasticity.

The results on the direction of the immediate impact of exchange rate shocks concur both with theory and with the empirical findings of Gilbert (1987) for quarterly London Metal Exchange metal prices. However, most of the significant one-day-lagged impacts of exchange rate news were positive. This result is puzzling and can be explained by the expectations of possible interventions by the Fed to counteract large unexpected swings in the dollar exchange rate.

In view of the fact that the U.S. is heavily dependent on the exports of soybeans and soybean products, corn and wheat, it is surprising that their prices did not respond significantly to exchange rate movements. This may have been due to the fact that U.S. grains traders engage heavily on the forward foreign exchange markets for their exports and are thus insulated from the daily movements of spot exchange rates. If this is the case, then the significant impact of exchange rate fluctuations on grain prices should show up in the medium term. Chambers and Just show this to be the case using quarterly data for wheat, corn and soybeans. Also, the exchange rate used in this study (SDR/U.S.\$) might not have adequately represented the exchange rate movement of countries which compete most closely with the U.S. as consumers or producers of these commodities.

Impact of Interest Rate Surprises

News from the credit markets as reflected by unexpected movements in three-month treasury bills rate were also important for explaining the behavior of daily commodity price movements. News from the credit markets was of particular importance in explaining the price movements of crops, soybeans and soybean products, and some metals. That crop prices respond significantly to interest rate shocks is not surprising given that the prices of these commodities depend heavily on storage costs. The immediate significant impacts for most commodity prices were positive. An implication of this finding is that nominal interest rate variation appears to have been related more to variations in inflation expectations. This positive relationship between nominal rates and commodity price changes conforms to the view advanced by Fama and Gibbons (1982) where nominal interest variation was generally related to variations in inflation expectations.¹⁹ Also, the strong positive immediate reaction of copper prices to positive shocks in the interest rate is easy to explain. A large percentage of the demand for copper is for industrial usage. In the period of analysis, the economy was growing very rapidly. This surge in the economy could have caused inflationary expectations to go up thus making the shocks in real exchange rates to be negative. The impact of a negative real interest shock is to make bonds less attractive and commodities futures contracts more attractive.

However, most of the significant one-day-lagged impacts of positive interest rate shocks were negative. Commodities such as cocoa, corn, soybeans, soymeal, and soyoil which had positive immediate reactions to unexpected increases in interest rates reacted negatively with a one-day-lag to the same shock. Again, such reversal in the delayed reactions for interest rates may have reflected the expectations of a subsequent reversal as investors might have had reasons to believe that the Fed might have counteracted large swings in interest rates.

Impact of Real Activity Surprises

The news from real activity announcements were generally more important than news from any other announcements. Eleven commodities reacted to news from the industrial production figures or from the unemployment rate figures either immediately or with lag. Most of the adjustment to

¹⁹ Over the period when the Fed was targeting M1, however, nominal interest rate variations were related more to real rate variations and commodity prices should have reacted negatively to positive shocks in the discount rate. See Barnhart (1988) for a confirmation of this result.

news about the real activity came with a lagged effect possibly indicating some uncertainty on the part of investors about the future course of real activity. The first result to note is that different commodity groups reacted to news about the real activity differently, either immediately or with a lag. However, the majority of the significant effects of news of a surge in the real activities were to raise prices. The strongest lagged impact from news about the industrial production was in the soybean complex and for wheat prices. The implication of this positive price response is that investors had a tendency to believe that the Fed would remain passive and hence causing inflation expectations to go up. The major exception to this is the behavior of silver prices to the immediate impact of industrial production and unemployment rate shocks. Its price fell with a surge of in the economy indicating that investors in the metals market possibly took the news about surges in the economy as good news and expecting the real rates to rise and inflation expectations to stay constant.

Impact of Money and Inflation Surprises

Surprises from the money and inflation announcements generally did not induce any significant reactions from commodity prices. Also, the few significant responses of commodity prices from surprises in the money stock and inflation indices were not strong and consistent both within and across commodity groups. Five commodities responded significantly to money shocks either immediately or with a lagged effect. The direction of the responses were not uniform, however. The immediate responses of palladium, heating oil and unleaded gasoline were positive following unexpected money increases whereas the immediate response of wheat and the lagged responses of live cattle and wheat were negative. An interpretation of such mixed results is not easy.

The fact that most commodity prices were not significantly affected by money supply shocks can be due to a number of reasons. Perhaps the most logical one is that since the Fed does not have a specific target for M1 anymore, investors do not pay much attention to unexpected movements in M1. This interpretation concurs with the findings of Barnhart, and FH on the behavior of commodity prices prior to October 1979 when the Fed did not emphasize target rates for M1. Also, if this interpretation is correct, commodity prices should have reacted significantly to interest rate shocks since the Fed is more apt to take measures to offset interest rate swings. As can be seen, interest rate shocks caused many commodity prices to be significantly affected. It is also possible, as shown by FH and Barnhart, that most commodity markets reacted to shocks in M1 very rapidly and that movements in daily close to close prices are not capturing that effect.

With the exception of heating oil and gasoline prices, most of the significant immediate price reactions to news about inflation was negative, possibly indicating that there was a fear from certain groups of investors of future tightening of credit by the Fed. However, the fact that the unexpected components of inflation announcements did not induce immediate and/or significant reactions from many commodities is not surprising given that inflation was not out of control in the period of analysis. Therefore, the majority of investors might not have reacted strongly to inflation news given that they did have any reason to believe the Fed to tighten credit.

Summary and Conclusions

This paper has presented further empirical evidence on the reaction of 20 commodity futures prices to announcements of money supply (M1), inflation indices (CPI and PPI), real activity indices (industrial production and unemployment rate) and to shocks from the foreign exchange and credit markets in affecting commodity prices. For economic variables (money stock, CPI, PPI, unemployment rate and industrial production index) are announced periodically, survey data were used to divide macroeconomic announcements into expected and unexpected components with the latter measuring news. For other macroeconomic variables whose values are realized on financial

and credit markets (exchange rates and interest rates), autoregressions were used to model their daily behavior and the residuals from these autoregressions were used as exogenous shocks to commodity markets.

The impact of exchange rate shocks on commodity prices and to behavior of commodity prices was analyzed. Foreign exchange shocks were found to be an important source of fluctuation for commodity prices. Most of the significant immediate impact of exchange rate surprises were negative, as expected. However, many of the one-day-lag impacts of news from the exchange rates were positive. It was also found that news from the credit market as reflected by surprises in the interest rates were an important source of fluctuation for commodities such as metals, soybeans and soybean products, corn, and cocoa. Most of the significant immediate impact of interest rate shocks were positive and most of the significant lagged impacts of such shocks were negative.

Furthermore, the real activity news were important in affecting the prices of several commodities. However, news from the money stock and from inflation indices were generally not important in explaining commodity price behavior. The fact that announcements of the money stock did not cause commodity prices to react significantly is not surprising given the fact that the Fed does not have a specific target for M1 anymore. It is possible that investors no longer use unexpected money stock announcements as a guide for future monetary policy of the Fed. Also, several of the commodities responded to news with delay indicating signs of inefficiency in the commodity markets.

Finally, the plausibility of the results presented in this paper can only be checked by extending the data set to look at a longer time period and more commodities. Also, a look at the difference between daily open and close prices would be useful in this kind of research.

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Table 1: Commodity Futures Contract Characteristics

Commodity	Code	Exchange / ^a	Delivery Months	Trading / ^b Hours (E.S.T.)	Contract / ^c Size	Minimum / ^c Price Change		Maximum / ^c Price Change	
						Per Unit	Per Contract	Per Unit	Per Contract
Foods & Livestock									
Cocoa	CO	CSCE	3,5,7,9,12	9:30-3:00	10 metric tons	\$ 1/ton	\$10.00	\$88.00/ton	\$ 880
Coffee	CF	CSCE	3,5,7,9,12	9:45-2:28	37,500 lbs.	\$.0001/lb.	\$ 3.75	\$.04/lb.	\$1,500
Live Cattle	LC	CME	2,4,6,8,10,12	10:05-2:00	40,000 lbs.	\$.00025/lb.	\$10.00	\$.015/lb.	\$ 600
Orange Juice	OJ	NYCE	1,3,5,7,9,11	10:15-2:45	15,000 lbs.	\$.0005/lb.	\$ 7.50	\$.05/lb.	\$ 750
Pork Bellies	PB	CME	2,3,3,7,8	10:10-2:00	38,000 lbs.	\$.00025/lb.	\$ 9.50	\$.02/lb.	\$ 760
Sugar (#11)	SU	CSCE	1,3,5,7,9,10	10:00-1:43	112,000 lbs.	\$.0001/lb.	\$11.20	\$.005/lb.	\$ 560
(World)									
Crops									
Corn	CN	CBT	3,5,7,9,12	10:30-2:15	5,000 bus.	\$.0025/bus.	\$12.50	\$.10 bus.	\$ 500
Cotton (#2)	CT	NYCE	3,5,7,10,12	10:30-3:00	50,000 lbs.	\$.0001/lb.	\$ 5.00	\$.02/lbs.	\$1,000
Soybeans	SB	CBT	1,3,5,7,8,9,11	10:30-2:15	5,000 bus.	\$.0025/bus.	\$12.50	\$.30/bus.	\$1,500
Soy Meal	SM	CB	1,3,5,7,8,9,10,12	10:30-2:15	100 tons	\$.10/ton	\$10.00	\$10.00/ton	\$1,000
Soy Oil	BO	CBT	1,3,5,7,8,9,12	10:30-2:15	60,000 lbs.	\$.0001/lbs.	\$ 6.00	\$.01/lb.	\$ 600
Wheat	WH	CBT	3,5,7,9,12	10:30-2:15	5,000 bus.	\$.0025/bus.	\$12.50	\$.20/bus.	\$1,000
Industrials									
Crude Oil	OX	NYHGX	All Months	9:30-3:30	1,000 barrels	\$.01/barrel	\$10.00	\$1.00/barrel	\$1,000
Heating Oil (#2)	OH	NYHGX	All Months	9:50-3:05	1,000 barrels	\$.0042/barrel	\$ 4.20	\$.84/barrel	\$ 840
Gasoline (regular unleaded)	HU	NYHGX	All Months	9:55-3:00	1,000 barrels	\$.0042/barrel	\$ 4.20	\$.84/barrel	\$ 840
Metals									
Copper	CP	COMEX	1,3,5,7,9,12	9:50-2:00	25,000 lb.	\$.0005/lb.	\$12.50	\$.05/lb.	\$1,250
Gold	GK	CBT	2,3,4,6,8,10,12	9:00-2:30	32.15 troy oz.	\$.10/oz.	\$ 3.22	\$50.00/oz.	\$1,607.50
Palladium	PA	NYHGX	3,6,9,12	9:00-2:20	100 troy oz.	\$.05/oz.	\$ 5.00	\$ 6.00/oz.	\$ 600
Platinum	PL	NYHGX	1,4,7,10	9:10-2:30	50 troy oz.	\$.10/oz.	\$ 5.00	\$25.00/oz.	\$1,250
Silver	SV	COMEX	1,3,5,7,9,12	8:05-1:25	5000 troy oz.	\$.001/oz.	\$ 5.00	\$.50/oz.	\$2,500

/a CBT - Chicago Board of Trade; CME - Chicago Mercantile Exchange; COMEX - Commodity Exchange, Inc. (New York);

CSCE - Coffee, Sugar, and Cocoa Exchange (New York);

NYCE - New York Cotton Exchange; NYHGX - New York Mercantile Exchange.

/b Times quoted are as of July 1986.

Table 2 -- Immediate and Lagged Individual Commodity Responses to Macroeconomic News, 10/01/86-12/31/87.

Commodity	UNS	UPPI	UCPI	UIP	UUR	UIR	UER	LUNS	LUPPI	LOCPI	LOIP	LUUR	LUIR	LUER	F1	F2	F3	R ²
FOODS & LIVESTOCK																		
Cocoa	-.11	1.97	.52	1.97	-.16*	-.003	-.58**	-.22	.24	1.61	.78	.008	-.02**	.06	2.31**	3.44**	1.08	.055
t	(0.33)	(0.91)	(0.21)	(1.39)	(1.69)	(0.61)	4.35	(0.67)	(0.18)	(0.67)	(0.55)	(0.08)	(2.50)	(0.42)				
Coffee	-.33	.46	-3.44	-.48	-.09	.01	-.07	.27	-.21	-1.39	1.02	.14	-.006	.55**	0.72	0.40	1.03	-.013
t	(0.60)	(0.21)	(0.84)	(0.20)	(0.58)	(1.16)	(0.32)	(0.46)	(0.09)	(0.34)	(0.42)	(0.84)	(0.53)	(2.41)				
Live Cattle	.08	1.28	-1.31	.67	-.17*	.006	-.42**	-.86**	.34	.40	.07	-.25**	.008	.02	1.88**	2.17**	1.90*	.038
t	(0.25)	(0.96)	(0.54)	(0.47)	(1.78)	(0.89)	(3.09)	(2.62)	(0.25)	(0.16)	(0.05)	(2.60)	(1.24)	(0.16)				
Orange Juice	.25	1.47	-1.03	2.12	.09	.02**	.20	.47	-.21	6.49**	.24	.01	-.002	.06	2.01**	2.44**	1.63	0.43
t	(0.84)	(1.22)	(0.46)	(1.62)	(1.04)	(2.90)	(1.59)	(1.57)	(0.17)	(2.92)	(0.18)	(0.13)	(0.29)	(0.48)				
Pork Bellies	-.47	1.33	.66	1.41	.02	.02	-.14	-.96	4.44*	7.83	-.57	-.33*	-.008	.04	0.80	0.40	1.23	-.009
t	(0.73)	(0.51)	(0.14)	(0.50)	(0.08)	(1.18)	(0.53)	(1.49)	(1.70)	(1.63)	(0.20)	(1.71)	(0.61)	(0.17)				
Sugar	1.15	4.64	1.44	-5.71	-.18	-.06	-2.18	-2.24	5.19	6.47	7.82	-.77	-.02	2.53	0.22	0.20	0.25	-.036
t	(0.21)	(0.21)	(0.04)	(0.24)	(0.12)	(0.56)	(0.98)	(0.42)	(0.24)	(0.16)	(0.33)	(0.48)	(0.17)	(1.15)				
CROPS																		
Corn	-.52	-1.64	-.72	1.27	-.02	.03**	.0002	.58	-2.02	4.41	1.89	-.11	-.01*	.21	1.96**	1.92*	1.94*	0.41
t	(1.29)	(1.01)	(0.24)	(0.72)	(0.18)	(3.14)	(0.001)	(1.45)	(1.24)	(1.48)	(1.07)	(0.93)	(1.77)	(1.24)				
Cotton	.14	-3.73*	2.77	-1.84	.10	.02**	.29	.23	.66	4.58	-.44	.15	.006	.22	1.11	1.63	0.69	.005
t	(0.29)	(1.91)	(0.78)	(0.87)	(0.68)	(2.13)	(1.44)	(0.47)	(0.34)	(1.28)	(0.21)	(1.04)	(0.67)	(1.11)				
Soybeans	-.22	-.98	-.54	.88	.007	.02**	.15	.12	-.95	-.07	3.65**	-.11	-.02**	.06	2.56**	2.03**	2.68**	.065
t	(0.74)	(0.81)	(0.24)	(0.67)	(0.09)	(3.34)	(1.18)	(0.40)	(0.79)	(0.03)	(2.79)	(1.19)	(2.74)	(0.48)				
Soy Meal	-.03	-2.06	2.21	-.35	.05	.01	.27*	.27	-1.00	-5.82**	3.67**	-.13	-.02**	.11	2.00**	1.05	2.69**	.043
t	(0.07)	(1.31)	(0.77)	(0.21)	(0.43)	(1.46)	(1.68)	(0.69)	(0.64)	(2.01)	(2.16)	(1.08)	(2.48)	(0.69)				
Soy Oil	-.34	.29	.74	2.12	.03	.02**	.07	-.3	-2.23	4.26	5.80**	-.11	-.01*	-.15	2.37**	1.28	3.09**	.058
t	(0.86)	(0.18)	(0.25)	(1.23)	(0.23)	(2.54)	(0.43)	(0.09)	(1.40)	(1.45)	(3.36)	(0.97)	(1.85)	(0.94)				
Wheat	-.65*	1.88	.34	.52	-.14	.001	-.02	-.69*	-1.70	3.32	3.71**	-.33**	-.02**	.18	2.36**	.71	4.09**	.058
t	(1.82)	(1.30)	(0.13)	(0.33)	(1.31)	(0.20)	(0.14)	(1.95)	(1.12)	(1.25)	(2.38)	(3.12)	(2.58)	(1.26)				
ENERGIES																		
Crude Oil	.73	-.72	2.83	-1.91	.05	-.003	.23	.43	2.01	2.02	-3.77*	.04	-.007	-.20	0.54	0.72	1.02	-.004
t	(1.52)	(0.37)	(0.80)	(0.91)	(0.39)	(0.28)	(1.17)	(0.91)	(1.04)	(0.57)	(1.80)	(0.26)	(0.75)	(1.01)				
Heating Oil	1.13**	-1.59	1.48	-1.41	.02	-.005	.09	.52	.006	2.65	-3.42*	-.003	-.009	-.21	0.98	1.01	0.87	-.001
t	(2.37)	(0.83)	(0.42)	(0.69)	(0.14)	(0.53)	(0.47)	(1.10)	(.003)	(0.75)	(1.65)	(0.02)	(0.93)	(1.09)				
Gasoline	1.01**	-1.05	1.23	-2.70	-.02	-.01	.22	.49	2.00	3.98	-1.79	.02	-.01	-.12	1.36	1.57	1.01	.016
t	(2.43)	(0.61)	(0.39)	(1.45)	(0.15)	(0.96)	(1.25)	(1.15)	(1.17)	(1.26)	(0.96)	(0.14)	(1.08)	(0.68)				
METALS																		
Copper	.35	-1.83	.59	-.40	.13	.04**	-.23	.24	1.60	1.60	2.50	-.29**	.02*	.31*	3.03**	3.67**	2.06**	.083
t	(0.77)	(0.99)	(0.18)	(0.20)	(0.98)	(4.80)	(1.24)	(0.53)	(0.86)	(0.86)	(1.25)	(2.11)	(1.67)	(1.65)				
Gold	.17	.31	.57	-1.94	.12	.005	-.31**	.06	.06	-.43	-.32	-.04	.00001	.32**	1.20	1.50	1.00	.009
t	(0.54)	(0.24)	(0.25)	(1.41)	(1.40)	(0.79)	(2.41)	(0.19)	(0.19)	(0.34)	(0.23)	(0.42)	(0.01)	(2.52)				
Palladium	.88*	-1.16	-1.68	-2.38	.20	.01	-.50**	.21	.21	-1.14	.97	-.10	.03**	.61**	2.68**	2.05**	3.23**	.070
t	(1.88)	(0.61)	(0.48)	(1.16)	(1.45)	(1.49)	(2.59)	(0.44)	(0.44)	(0.61)	(0.47)	(0.68)	(2.69)	(3.17)				
Platinum	.70	.25	0	-2.37	-.01	.02*	-.49**	.18	.18	-1.99	-1.90	-.15	.01	.69**	1.87**	1.68	2.21**	.038
t	(1.40)	(0.12)	0	(1.01)	(0.04)	(1.73)	(2.36)	(0.37)	(0.37)	(0.99)	(0.88)	(1.04)	(0.55)	(3.36)				
Silver	.99	1.92	.73	-6.92**	.31	.02	-.74**	-.14	-.14	-1.18	1.70	-.22	.01	.91**	2.57**	2.91**	2.41**	.061
t	(1.51)	(0.73)	(0.15)	(2.43)	(1.61)	(1.54)	(2.74)	(0.22)	(0.22)	(0.45)	(0.60)	(1.14)	(0.70)	(3.40)				

Footnotes on next page

Footnotes for Table 2.

For each commodity the numbers given on the same line represent the slope coefficients of the relevant variables. The numbers in parentheses under the estimated coefficients are the estimated t-statistics.

UMS, UPPI, UCPI, UIP and UUR are the unexpected percentage changes in money stock, producer price index, consumer price index, industrial production, and unemployment rate respectively. UIR and UER are the unexpected percentage changes in the daily interest and exchange rates respectively; their values are obtained from residuals of second-order autoregressions.

LUMS, LUPPI, LUCPI, LUIP, LUUR, LUIR and LUER are the one-day-lagged values of the variables UMS, UPPI, UCPI, UIP, UUR, UIR and UER respectively.

The F-statistic F1 tests the null hypothesis that all slope coefficients in equation (2) are jointly equal to zero.

The F-statistic F2 tests the null hypothesis that the coefficients of the variables (UMS, UPPI, UCPI, UIP, UUR, UIR and UER) representing the immediate responses are jointly equal to zero.

The F-statistic F3 tests the null hypothesis that the coefficients of the variables (LUMS, LUPPI, LUCPI, LUIP, LUUR, LUIR and LUER) representing the lagged responses are jointly equal to zero.

The dependent variable is calculated as the percentage change in the i-th commodity futures prices from the close of trading on day t-1 to the close of trading on day t. Great care is taken to match the date of the surprises with the appropriate price changes. For UMS which measures the immediate impact of money surprises, the match of the innovation in money announcement is done with the difference of prices from Thursday close to Friday close. For the variables UPPI, UCPI, UIP, and UUR which measure the immediate impact of innovations in other announcements, the match of the innovation in the relevant announcement is made with the difference in the close of the prices on the announcement day and the close of prices the previous business day. Also, to measure the immediate impact of interest and exchange rate, the shocks occurring in the period between days t-1 and t are matched with the difference in the close prices between days t-1 and t.

To measure the lagged impact of surprises in announcements, the innovations in the announcements are matched with the difference in the close price after the announcement to the following close price. Also, for exchange and interest rates, the shocks occurring in the period between days t-2 and t-1 are matched with the difference in the close prices between days t-1 and t.

Each equation has 354 observations.

F1 and F2 each has 7 and 339 degrees of freedom.

F2 and F3 each has 14 and 339 degrees of freedom.