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Dieter Hess, He Huang, and Alexandra Niessen

Abstract

This paper investigates the impact of seventeen US macroeconomic announcements on two broad and representative commodity futures indices. Based on a large sample from 1989 to 2005, we show that the daily price response of the CRB and GSCI commodity futures indices to macroeconomic news is state-dependent. During recessions, news about higher (lower) inflation and real activity lead to positive (negative) adjustments of commodity futures prices. In contrast, we find no significant reactions during economic expansions. We attribute this asymmetric response to the state-dependent interpretation of macroeconomic news. Our findings are robust to several alternative business cycle definitions.

Keywords: Commodities; Macroeconomic Announcements; Business Cycle
JEL classification: E44, G14

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1 Introduction

Macroeconomic news is known to be an important driver of asset prices. Several studies have documented the impact of macroeconomic announcements on bond markets (see, e.g., Fleming and Remolona (1999), and Balduzzi, Elton, and Green (2001)), stock markets (see, e.g, McQueen and Roley (1993), and Boyd, Hu, and Jagannathan (2005)), and foreign exchange markets (see, e.g., Andersen, Bollerslev, Diebold, and Vega (2003)). In contrast to this large body of evidence, the literature on the reaction of commodity prices to macroeconomic announcements is scarce. Previous studies only investigate the impact of macroeconomic news on individual commodity types (see, e.g., Barnhart (1989), Christie, Chaudhry, and Koch (2000), and Cai, Cheung, and Wong (2001)). This is surprising because investors are increasingly looking for alternative investments such as commodities (see, e.g., Gorton and Rouwenhorst (2006), and Kat and Oomen (2007)). Our paper is the first to investigate the price reaction of two broad commodity futures indices to several US macroeconomic announcements. Additionally, we allow for an asymmetric commodity price response depending on the state of the economy.

Although commodity futures are widely accepted as a distinct asset class, it is well known that the correlation between different groups of commodity futures is very low, much lower than for example the correlation between different stock sectors (see Erb and Harvey (2006)). Therefore, existing results regarding the price impact of macroeconomic announcements on individual commodity types are of minor importance for a commodity investor holding a diversified portfolio of commodity futures. Our paper sheds light on this issue by investigating the price response of two broad commodity futures indices to seventeen US macroeconomic releases. Commodity indices represent commodity portfolio strategies that are replicated by many investors. However, since there is no universally accepted commodity futures index, we choose two very distinct indices in order to account for two representative commodity investment strategies. First, we consider the Reuters

CRB Commodity Index which assigns equal weights to its index constituents. Second, we consider the S&P GSCI Commodity Index which is weighted by world production quantities.

Macroeconomic releases convey two important pieces of information about future economic conditions: real activity and inflation. Gorton and Rouwenhorst (2006) show that both factors affect commodity futures returns. However, the sign of the overall relation between macroeconomic news and commodity prices is not evident because there are two opposing effects that influence commodity prices.

On the one hand, higher than expected real activity has a positive effect on commodity prices due to an increase in demand for commodities as input goods for rising production levels.[1] In the context of rather fixed supply in the short run, rising demand will lead to higher prices. This assertion could become even more important in the future, as rising worldwide demand for commodities might push the equilibrium point to the unelastic part of the supply curve, as pointed out by Brevik and Kind (2004). The announcement of higher than expected inflation figures also has a positive effect on commodity prices. Commodities are positively correlated with inflation and better suited to hedge against inflation than stocks or bonds (see Gorton and Rouwenhorst (2006) for a detailed discussion). Thus, positive inflation news might cause investors to assign a larger portfolio weight to commodities, which creates additional demand and leads to higher commodity prices.

On the other hand, higher than expected real activity or inflation has a negative effect on commodity prices due to increasing interest rates. According to the Taylor (1993) rule, the FED is committed to contain an overheating economy and rising inflation by increasing interest rates and to promote growth by lowering interest rates. Interest rates, however, are negatively related to commodity prices through various channels (see, e.g., Frankel

[1] Our examples are based on the announcement of higher than expected real activity/inflation figures. Of course, the opposite relation also applies to the announcement of lower than expected figures.

(2006)). First, high interest rates increase storage costs. As a consequence, commodities are rather brought to the market instead of being held in storage. Second, high interest rates make financial assets such as bonds more attractive relative to commodity contracts and thus encourage investors to shift their portfolios out of commodities into bonds. The negative relation between interest rates and commodity prices is supported theoretically by Bond (1984) and Chambers (1985) and empirically by Frankel (2006).

To sum up, macroeconomic news may have a positive as well as a negative impact on commodity prices. We propose that the relative strength of these effects is state dependent, i.e., the overall price reaction depends on whether positive or negative effects prevail. We expect that during expansions positive and negative effects cancel out each other. In contrast, during recessions, when interest rate concerns are lower, we expect to find a positive relation between the commodity price response and surprises in macroeconomic announcements. These hypotheses are based on findings from the literature on the stock market response to macroeconomic news. McQueen and Roley (1993) show that a positive surprise in real activity news primarily signals cash flow growth during recessions, while it primarily signals an increase in discount rates during expansions. Similarly, Andersen, Bollerslev, Diebold, and Vega (2007) find that stronger anti-inflationary monetary policies during expansion periods strengthen the influence of the interest rate component. If the interpretation of macroeconomic news by commodity investors is state-dependent, it is reasonable to assume a state-dependent price response of commodity futures as well.

Based on a large sample of daily observations over the period from 1989 to 2005, we find that the impact of macroeconomic news on commodity prices is indeed dependent on the state of the economy. As long as the business cycle is not considered, we find only moderate and mostly insignificant reactions of the CRB index and the GSCI to macroeconomic announcements. However, in a state-dependent model, surprises in several macroeconomic news are significantly positively related to both indices during recessions, but not during economic expansions. Moreover, we document that many price response

coefficients are significantly larger during recessions than during expansions. Our findings are robust to several alternative business cycle definitions.

Our paper offers two major contributions. First, we contribute to the literature on the link between macroeconomic conditions and commodity prices (see, e.g., Erb and Harvey (2006), Gorton and Rouwenhorst (2006), Kat and Oomen (2007)) by studying the price response of two representative commodity future indices to macroeconomic news. By analyzing two diverse indices, we document that during recessions macroeconomic announcements are relevant to the typical commodity investor holding a diversified portfolio of commodity futures. Second, we contribute to the broader literature on the state-dependent impact of macroeconomic news on asset prices (see, e.g, McQueen and Roley (1993), and Boyd, Hu, and Jagannathan (2005)) by showing that the price impact of macroeconomic news on commodity futures is dependent on the state of the economy. Overall, our findings indicate that macroeconomic releases are interpreted differently in different states of the economy.

Our results provide important implications for hedging and diversification from an investor's point of view. During recessions the direction of the price response to macroeconomic announcements of commodities is mostly opposite to that of stocks and bonds. Thus, a negative price reaction of bond and stock prices to macroeconomic news could be offset by a positive price reaction of commodity futures within a portfolio consisting of these three asset classes. The fact that the hedging value of commodities with regard to macroeconomic risks is predominantly found during recessions emphasizes that it is important to consider the business cycle for asset allocation decisions.

The paper proceeds as follows. In section 2 we describe the data used in our empirical analysis. Section 3 provides the results of our empirical investigation regarding the impact of macroeconomic announcements on commodity futures. Section 4 concludes.

2 Data

We investigate the impact of macroeconomic news on two distinct commodity futures indices: the Reuters-CRB Futures Price Index (now: Reuters/Jefferies-CRB), which is traded on the New York Board of Trade, and the S&P GSCI, which is traded on the Chicago Mercantile Exchange.[2] Both indices measure the return from investing in nearby commodity futures and rolling them forward each month, always keeping an investment in close to maturity futures. A detailed list of the individual components of both indices is given in the appendix. The CRB index consists of 17 equally-weighted constituents, while the GSCI includes 24 commodity futures weighted by world production output. For both indices, we calculate daily log returns from the respective excess return index. Studying excess return indices abstracts from the price response of the T-Bill collateral and is better suited to investigate the commodity-specific price response.[3]

It is unclear which index best represents commodity futures as an asset class. Many prominent studies (see, e.g., Bodie and Rosanksy (1980), and Gorton and Rouwenhorst (2006)) have focused on equally-weighted commodity futures portfolios. They argue that their performance reveals the average commodity futures performance and thus is a good measure for the aggregate market. Other studies, e.g., Arnott, Hsu, and Moore (2005), point out that equally-weighted indices have return characteristics that are not representative for the aggregate market as they overweight small and illiquid index constituents. Erb and Harvey (2006) conclude that due to the lack of an objective, market-capitalization based weighting scheme for commodity futures each index represents an alternative commodity portfolio strategy. Thus, to ensure that our results hold for different commodity portfolio

[2]The data is obtained through Thomson Financial Datastream.

[3]A commodity total return index assumes that for each Dollar invested in a certain commodity futures contract one Dollar is also invested into a risk free asset until that futures contract matures. This risk free investment, usually T-Bills, is referred to as the collateral. By contrast, an excess return index does not assume a collateral position. Note that the excess return index does not exactly equal the total return index performance minus the risk free rate. See `http://www2.goldmansachs.com/gsci/#tres` for a detailed discussion about the differences.

strategies, we investigate the CRB index as well as the GSCI, which represent two distinct portfolio strategies. The CRB index is the world's oldest commodity index. We choose this index in accordance with Gorton and Rouwenhorst (2006) to investigate the average commodity futures response to macroeconomic news. The GSCI is the most traded commodity index, accounting for USD 70bn of the total USD 120bn invested worldwide into commodity indices.[4] This index, while heavily skewed towards energy commodities, presumably best represents most commodity investors' portfolios.

To compare the price response of commodity futures to macroeconomic news with the price response of other asset classes, we additionally investigate the reaction of stock and bond returns to the same news releases. We use daily log returns for the S&P 500 and the Datastream 10-year constant maturity US Government Bond Benchmark (T-Bond) index in our analysis. Summary statistics for both commodity indices' daily log returns as well as their correlation with the S&P 500 and the T-Bond are presented in Table 1. We report results for the whole sample from 1989 to 2005 (Column 1), as well as for the sample divided into announcement days (i.e., days on which a macroeconomic announcement occurs) vs. non-announcement days (Column 2, 3), and expansion vs. recession periods according to the NBER classification (Column 4, 5).

— Please insert TABLE 1 approximately here —

The first two rows in Panel A and B contain the annualized means and standard deviations of both indices.[5] To test for significant differences between the subsamples, we conduct two-sided mean, variance, and correlation tests. Mean CRB index daily log returns (Panel A) are significantly higher on announcement days, while mean GSCI daily log returns (Panel B) are significantly higher on non-announcement days. Furthermore, mean returns of both

[4]Figures according to Bloomberg News "Commodity investments up 50%, AIG reports", published August 13, 2007.

[5]We obtain annualized means by multiplying the daily value with 252, the approximate number of trading days in a year. Likewise, we obtain annualized standard deviations by multiplying with $\sqrt{252}$.

indices are significantly lower in recessions than in expansions, which is consistent with Gorton and Rouwenhorst (2006). While the CRB index standard deviation is essentially constant throughout all subsamples, the GSCI standard deviation is significantly higher during the recession sample. Overall, the GSCI is more volatile and yields higher returns than the CRB index. These differences can be attributed to the fact that the GSCI mainly consists of energy and oil contracts, which are known to be more volatile and yield high returns (see Kat and Oomen (2007)).[6] In line with Gorton and Rouwenhorst (2006), we find that the correlation with stocks and bonds is consistently negative across all subsamples and significantly lower in the recession sample.

To investigate the impact of macroeconomic news on commodity futures, stock returns, and bond returns, we use data on seventeen US macroeconomic announcements. Although commodities are demanded by investors worldwide, we restrict our analysis to US announcements for two reasons. First, both commodity indices are listed in the US and are presumably predominantly traded by US investors. Second, it is known that US macroeconomic releases are of great importance for financial markets worldwide (see, e.g., Andersen, Bollerslev, Diebold, and Vega (2007)), for some markets it is even more important than domestic news (see, e.g., Andersson, Hansen, and Sebestyén (2006), and Funke and Matsuda (2006)). All macroeconomic announcement data used in this study are provided by Money Market Services (MMS). Assuming efficient markets, only unexpected news will impact commodity prices. Therefore, we have to isolate the surprise component of the announcements. As a proxy for market expectations regarding upcoming announcements, we use median analyst forecasts provided by MMS.[7] The surprise component is then computed

[6]For example, on January 17, 1991 the GSCI loses 18.5% on one day due to a 30% drop in crude oil prices on that day. The oil price shock was caused by the end of the first Gulf War. Our results (not reported) hold when we exclude this day from our analysis. This price shock does not affect our results, as there was only one announcement on that day, the insignificant housing starts announcement.

[7]Each Friday, MMS polls analysts' forecasts of several economic indicators to be released in the following week. Survey responses are received over a 3 to 4-hour period every Friday morning via fax or phone.

as follows:

$$S_{i,m} = \frac{A_{i,m} - F_{i,m}}{STD(A_i - F_i)}. \tag{1}$$

For each announcement i (with $i = 1, ..., 17$ indicating the announcement type investigated), the surprise component $S_{i,m}$ is defined as the difference between the actually released value, $A_{i,m}$, and the median analyst forecast, $F_{i,m}$. In line with Balduzzi, Elton, and Green (2001), we standardize the surprise value of each announcement observation by the standard deviation across the time series of all observations of this announcement type. This procedure facilitates a comparison of the estimated coefficients. The standardized surprise, $S_{i,m}$, is then used in our empirical analysis. Summary statistics for all seventeen macroeconomic announcements are given in Table 2.

— Please insert TABLE 2 approximately here —

All announcements are released each month on a prescheduled day at a fixed time.[8] We divide them into three broad categories: real activity news, inflation news, and other news. Although some announcement types are not available from the very beginning of our investigation period, the data on all seventeen announcement types cover both recession periods. We report minimum, maximum and mean values for the standardized surprise in the rightmost part of Table 2. Positive (negative) mean surprises indicate whether an announcement was more often above or below analysts' expectations. For instance, a negative mean surprise of the US trade balance indicates that in our sample period this announcement was on average lower than expected by analysts. However, mean values are mostly very close to zero, indicating that median analyst forecasts are not biased, i.e., analysts do not systematically forecast too high or too low. The unbiasedness of forecasts collected by MMS has also been repeatedly confirmed by Pearce and Roley

[8] GDP is a quaterly figure, but there is an announcement each month. In the first month of each quarter, the Bureau of Economic Analysis releases an advance estimate for the last quarter. In the second month it releases a preliminary figure. The final figure is released in the third month. We do not differentiate between advance, preliminary and final figure to allow for more observations.

(1985), McQueen and Roley (1993), and Balduzzi, Elton, and Green (2001). In unreported results, we also validate that there are no systematic differences between mean surprises in expansions and recessions.

To investigate the effect of macroeconomic news dependent on the state of the economy, it is necessary to find an appropriate definition of expansion and recession periods. The most widely used (see, e.g., Boyd, Hu, and Jagannathan (2005), or Gorton and Rouwenhorst (2006)) business cycle definition is released by the National Bureau of Economic Research (NBER). Business cycle turning points are observed and announced by the NBER Business Cycle Dating Committee. Its decisions are based on overall economic activity, usually visible in real GDP, real income, employment, industrial production, and wholesale-retail sales. In line with the literature, we define expansion and recession periods according to the NBER.[9] In addition, we test the robustness of our results on three alternative business cycle definitions. We also divide our sample according to the Chicago FED National Activity Index (CFNAI), consecutive changes in non-farm payroll figures (NFP), and the capacity utilization (CAPAC).[10] Figure 1 reports the recession periods according to all four business cycle definitions.

— Please insert FIGURE 1 approximately here —

In our sample period from 1989 to 2005, all four definitions yield two recession periods, one in the early 1990's and the second one in the early 2000's. However, the two recession periods according to CFNAI and capacity utilization are longer than the recession periods as defined by NBER and non-farm payroll figures.

[9]The business cycle definition of the NBER is obtained from `http://www.nber.org/cycles.html`.

[10]The CAPAC classification distinguishes strong and weak states of the economy based on the median capacity utilization. In addition to recession months, "weak months" according to CAPAC also include those months that occur right before and after a recession. We use this alternative classification to test the robustness of our results.

3 Empirical Results

3.1 Unconditional price impact of macroeconomic announcements on commodity futures

We first examine the impact of macroeconomic news on the CRB index and the GSCI without conditioning on the state of the economy. We also investigate the price response of the 10-year T-Bond and the S&P 500 to compare our results for commodity futures with those for other asset classes. Our initial estimation approach for each of the three asset classes follows the literature on the stock market impact of macroeconomic announcements (see, e.g., McQueen and Roley (1993), and Adams, McQueen, and Wood (2004)). We regress the daily log return on the surprise component in macroeconomic announcements on that day according to the following equation:

$$R_t = c + \beta \cdot R_{t-1} + \sum_{i=1}^{17} \delta_i \cdot S_{i,t} + \epsilon_t, \tag{2}$$

where R_t represents the daily log return of either the CRB index, the GSCI, the T-Bond, and the S&P 500, respectively. Following Flannery and Protopapadakis (2002), we include the lagged return, R_{t-1}, to control for autocorrelation, because most commodity futures exhibit significant degrees of serial correlation in daily returns (see Kat and Oomen (2007)). $S_{i,t}$ is the standardized surprise of announcement i. If i is not released on day t, then $S_{i,t}$ is zero. For example, if announcement $i = 4$ is released on January 7 for the month $m = Jan$, and the standardized surprise for January, $S_{i,m}$, is 0.5, then $S_{i,t}$ equals 0.5 for January 7 and zero for all other trading days in that month. δ_i represents the price response coefficient to the surprise component of announcement i. All regressions are estimated with Newey-West heteroskedasticity and autocorrelation consistent error terms. Empirical results are given in Table 3.

— Please insert TABLE 3 approximately here —

The first and second columns contain the CRB index and GSCI price response coefficients to each of the seventeen macroeconomic news in our sample.[11] Without conditioning on the business cycle, both commodity futures indices do not significantly react to the release of macroeconomic announcements. The only exception is a positive reaction of both indices to a surprise in the consumer price index (CPI) and a positive response of the GSCI to the GDP announcement. For example, a one standard deviation positive surprise in the CPI announcement on average leads to a 0.07% price increase in the CRB index and a 0.18% increase in the GSCI. The autocorrelation coefficient for the CRB index is positive and highly significant while it is not significant for the GSCI. This might be caused by the higher weighting of smaller, illiquid futures in the CRB index which are more likely to be subject to autocorrelation due to non-synchronous trading (see Scholes and Williams (1977)).

Column 3 reports the price response of daily 10-year T-Bond returns to the release of macroeconomic announcements. In line with previous studies (see, e.g., Fleming and Remolona (1999), and Balduzzi, Elton, and Green (2001)), we find that T-Bond returns are significantly negatively related to several macroeconomic announcements. The sign of the price response coefficient is in line with standard economic theory: higher than expected inflation or real activity leads to expectations of increasing interest rates, and thus a decrease of bond prices. Column 4 contains results for the price reaction of daily S&P 500 returns. The sign of the price response coefficient depends on the released announcement. We observe a significantly negative relation between stock returns and surprises in the two price indices (CPI and PPI), and we find a significantly positive relation between stock returns and surprises in industrial production and gross domestic product.

Looking at the unconditional results, one could conclude that macroeconomic announcements do not have a significant impact on commodity futures markets. The explanatory

[11] The sign of business inventory announcements and the unemployment rate has been reversed to make the coefficient signs comparable to the other real activity announcements, i.e., positive values equal higher economic activity.

power of the model in terms of the R^2 (0.77% for the CRB index and 0.37% for the GSCI) is much lower than the R^2 values for stocks (1.2%) and bonds (6.2%). The latter values are comparable to previous studies on the response of daily stock and bond returns to macroeconomic news. However, it might also be the case that macroeconomic releases about real activity and inflation contain positive as well as negative information for commodities that cancel out each other in expansions, while positive effects prevail in recessions. In expansions, positive news about real activity or inflation might lead to higher price levels, but also to higher interest rates. Thus, the positive effect on commodity prices due to increasing demand and the negative effect on commodity prices due to increasing interest rates could cancel out each other. In recessions, when interest rates are not likely to rise, the positive effect of increasing demand on commodity prices may be more likely to prevail. A state-dependent impact of macroeconomic news is well known from stock markets (see, e.g., McQueen and Roley (1993), Adams, McQueen, and Wood (2004), Boyd, Hu and Jagannathan (2005)). We investigate the price response conditional on the state of the economy in the next section.

3.2 Asymmetric price impact conditional on the business cycle

In this section, we now split our sample according to the NBER business cycle definition into two subsamples: expansion and recession. We use the following specification for our empirical analysis:

$$R_t = c + \beta \cdot R_{t-1} + \sum_{i=1}^{17} \delta_i^{exp} \cdot D_t^{exp} \cdot S_{i,t} + \sum_{i=1}^{17} \delta_i^{rec} \cdot D_t^{rec} \cdot S_{i,t} + \epsilon_t, \tag{3}$$

where D_t^{exp} (D_t^{rec}) is a dummy variable that takes the value of one if the economy is in an expansion (a recession) according to the NBER classification, and zero otherwise. All other variables are defined as in Equation (2). We report the results in Table 4.

— Please insert TABLE 4 approximately here —

In contrast to the results in the unconditional model, Table 4 shows that the CRB index (Column 1) and the GSCI (Column 2) are significantly positively related to several macroeconomic announcements during recessions, while there is no significant price response during expansions. During recessions, both commodity futures indices are positively related to surprises in CPI and GDP announcements. In addition, we find a positive relation between the returns of the CRB index and surprises in durable good orders (DGO), non-farm payrolls (NFP) and retail sales (RS), while the GSCI is positively related to consumer confidence (CC) announcements. Although the CRB index is based on equal weights and the GSCI constituents are weighted by worldwide production output, results are qualitatively similar for both indices. Therefore, we conclude that during recessions most commodity investors' portfolios will be affected by macroeconomic announcements.

An explanation for these findings might be that the commodity price response to macroeconomic announcements is driven by two opposing factors that are interpreted differently, depending on the state of the economy. During expansions, unexpectedly high real activity announcements signal higher demand for commodities as input goods, and unexpectedly high inflation news signal higher demand for commodities as an inflation hedge. But at the same time, both types of news are connected with substantial fears of rising interest rates, which are negatively related to commodity prices due to rising storage costs and portfolio adjustments from commodities into bonds. As a consequence, both effects cancel out each other during expansions. In contrast, interest rates are much less of a concern during recessions and therefore the positive effects prevail.

In order to provide further evidence about the asymmetric price effect, we check whether the price response coefficients are larger during recessions than during expansions. Therefore, we conduct a one-sided Wald coefficient test for every price response coefficient. For example, we test the following hypothesis for the price response coefficients of durable goods orders (DGO): $\delta_{DGO}^{rec} > \delta_{DGO}^{exp}$. For the sake of brevity, we do not include the results of each coefficient test in our table. However, bold numbers in Table 4 indicate whether a

coefficient is significantly larger during economic recessions than during economic expansions on at least the 10% level. Our findings suggest that six out of eight significant price response coefficients are significantly larger in recessions than in expansions.[12]

With respect to the price response of stocks and bonds, we find that the reaction of the 10-year T-Bond (Column 3) is still consistently negative for both subsamples and for the majority of announcements. It is important to note that in comparison to high-frequency event studies on the impact of macroeconomic news on bond prices (see, e.g., Balduzzi, Elton, and Green (2001)), daily returns are noisier, which makes it more difficult to obtain statistically significant results. Thus, our findings regarding the significance of price response coefficients can be regarded as conservative. The stock price reaction (Column 4) is consistently negative for inflation news, while it mostly depends on the business cycle for real activity news. In line with Boyd, Hu, and Jagannathan (2005), we find a significantly negative impact of employment news on stock prices during expansions, while we find the opposite reaction to this news in recessions.[13] Comparing the overall results provide an interesting implication. Bonds and stocks seem to be mostly negatively related to the majority of announcements, while commodity futures are positively related to some of these announcements during recessions. Hence, commodity futures might be especially valuable to hedge against macroeconomic risks during recessions.

3.3 Robustness to alternative business cycle definitions

Since our main results hinge on the distinction between expansion and recession periods, it is critical to test the robustness of our findings by applying alternative business cycle definitions. Apart from the NBER classification, there is a large number of alternative definitions that has been used in previous studies to define the state of the economy.

[12] In unreported results, we also test the opposite hypothesis that price response coefficients are larger during expansions, e.g., $\delta^{exp}_{DGO} > \delta^{rec}_{DGO}$. As expected, none of these tests yields any significant results.

[13] In contrast to Boyd, Hu, and Jagannathan (2005), we include two employment figures in our analysis, nonfarm-payrolls and unemployment rate. Given the significant reaction of nonfarm-payrolls, it is not surprising that we do not find a significant reaction of the unemployment rate.

Therefore, we reexamine the state-dependent price impact using three alternative definitions of the business cycle states: the Chicago FED National Activity Index (CFNAI), consecutive changes in the same direction of the nonfarm payroll employment (NFP), and the US capacity utilization compared to its long-term median value (CAPAC). For each alternative definition, we estimate the price response based on Equation (3) but include dummy variables indicating high or low economic activity based on the respective business cycle definition. The three alternative indices have very distinct features, which allows us to draw a more comprehensive conclusion with respect to the state-dependent effects we have presented in section 3.2.

Following Kurov and Basistha (2006), we use the CFNAI index as an alternative business cycle measure because it is commonly regarded as a "next generation" indicator.[14] Similar to the NBER business cycle definition, the CFNAI defines expansion and recession periods based on a broad assessment of the overall economic situation: it is the weighted average of 85 monthly indicators of economic activity.[15] However, both NBER and CFNAI have the disadvantage that they are not suitable to define business cycles in real time. That is, the information about the state of the economy is not available at the time of an announcement's release, but it is only available ex-post.[16] In order to apply an ex-ante available indicator, we follow Andersen, Bollerslev, Diebold, and Vega (2007) and define the start of a recession as a three month consecutive decline in nonfarm payroll employment, and the end of a recession as a three months consecutive rise in nonfarm payroll employment.[17] Our final indicator follows McQueen and Roley (1993), who use capacity utilization data to divide their sample into periods of high and low economic activity.[18] We use the 25-year median capacity utilization during the period from 1980 to 2005 as our break point. This

[14] For a further discussion, see `http://ksghome.harvard.edu/JStock/xri/`.

[15] We obtain historical values of the CFNAI from the website of the Federal Reserve Bank of Chicago.

[16] As of 2007, the CFNAI is released with a one month delay, while the November 2001 NBER trough was announced as late as July 17, 2003.

[17] We obtain monthly data on seasonally adjusted total nonfarm employment from the Bureau of Labor Statistics.

[18] We obtain monthly data on US capacity utilization from the Federal Reserve Bank of St. Louis.

alternative definition yields two almost equally large subsamples. This specification allows us to test if commoditiy futures respond to macroeconomic news only during recessions, or if they also respond during weaker states of the economy that are typically not considered recession periods. Results for the three alternative definitions are presented in Table 5.

— Please insert TABLE 5 approximately here —

Despite the differences in defining the state of the economy, the results are qualitatively similar and robust across all three alternative business cycle definitions and for both commodity futures indices. The CRB index and the GSCI hardly respond to macroeconomic news in expansions, while both indices are significantly positively related to several macroeconomic announcements in recessions. The only exception is a significantly negative GSCI response during expansion periods to surprises in the ISM purchasing manager index and in the retail sales announcement. However, this finding is consistent with the view that the interpretation of macroeconomic news depends on the state of the economy. It seems that during expansions positive ISM and retail sales news primarily signal rising interest rates, which leads to a decrease in GSCI prices. In contrast, during recessions positive ISM and retail sales news primarily signal rising economic activity and more demand for commodities, thus leading to an increase in the GSCI. The notion of a state-dependent effect is again supported by comparing the price response coefficients for recessions and expansions. Several price response coefficients are larger during recessions (again marked in bold), and no coefficient is larger during expansions.

4 Conclusion

Previous studies documented a link between macroeconomic news and individual commodity goods. This paper is the first to investigate the impact of macroeconomic announcements on two broad and representative commodity futures indices. Specifically, we analyze

how the equally-weighted CRB index and the production output-weighted GSCI respond to the release of seventeen US macroeconomic announcements. Our analysis is relevant to typical commodity investors holding a diversified portfolio of commodity futures. In order to account for a state-dependent response, we differentiate between expansion and recession periods based on several alternative business cycle definitions.

We document that both commodity futures indices significantly react to several macroeconomic announcements during recession periods. The reaction is most pronounced for the announcement of consumer prices, durable goods orders, the Institute for Supply Management (ISM) survey, and unemployment figures. All these announcements are positively related to commodity prices. In contrast, we find almost no significant price response of either commodity index during economic expansions. We attribute this asymmetric response to the state-dependent interpretation of real activity and inflation news. We support this view by showing that price response coefficients are larger during recessions than during expansions. Our results are robust to several alternative business cycle definitions.

Our findings provide important implications for asset management. In line with Dahlquist and Harvey (2001), our results suggest that it is important to consider the business cycle for asset allocation decisions. During recessions, the typical diversified commodity portfolio is positively related to several macroeconomic announcements, while there is no significant response during expansions. Stocks and bonds, on the other hand, are mostly negatively related to macroeconomic announcements during both, expansions and recessions. Thus, commodity futures might be especially valuable to hedge against macroeconomic risks during weak states of the economy. Although an investor cannot anticipate the sign of the announcement surprise, and therefore does not know the direction of the commodity price movement in advance, adding commodities to a stock/bond portfolio might reduce its sensitivity to macroeconomic announcements during weak states of the economy. Accordingly, a successful risk diversification strategy based on commodities requires active portfolio management depending on the business cycle.

Appendix

Composition of the CRB index and the GSCI

Commodity Future	CRB index	GSCI
Aluminium	-	0.029
Cocoa	0.059	0.003
Coffee	0.059	0.006
Copper	0.059	0.023
Corn	0.059	0.031
Cotton	0.059	0.011
Crude Oil	0.059	0.284
Brent Crude Oil	-	0.131
Feeder Cattle	-	0.008
Gas Oil	-	0.045
Gold	0.059	0.019
Heating Oil	0.059	0.081
Lead	-	0.003
Hogs	0.059	0.021
Live Cattle	0.059	0.036
Natural Gas	0.059	0.095
Nickel	-	0.008
Orange Juice	0.059	-
Platinum	0.059	0.000
Silver	0.059	0.002
Soybeans	0.059	0.019
Soybean Oil	-	0.000
Sugar	0.059	0.014
Unleaded Gas	-	0.085
Wheat	0.059	0.029
Read Wheat	-	0.013
Zinc	-	0.005
Total	1.000	1.000
No. of Futures Contracts	17	24

This table contains the portfolio weights of the CRB index and the GSCI as of May 2004. Source: Erb and Harvey (2006).

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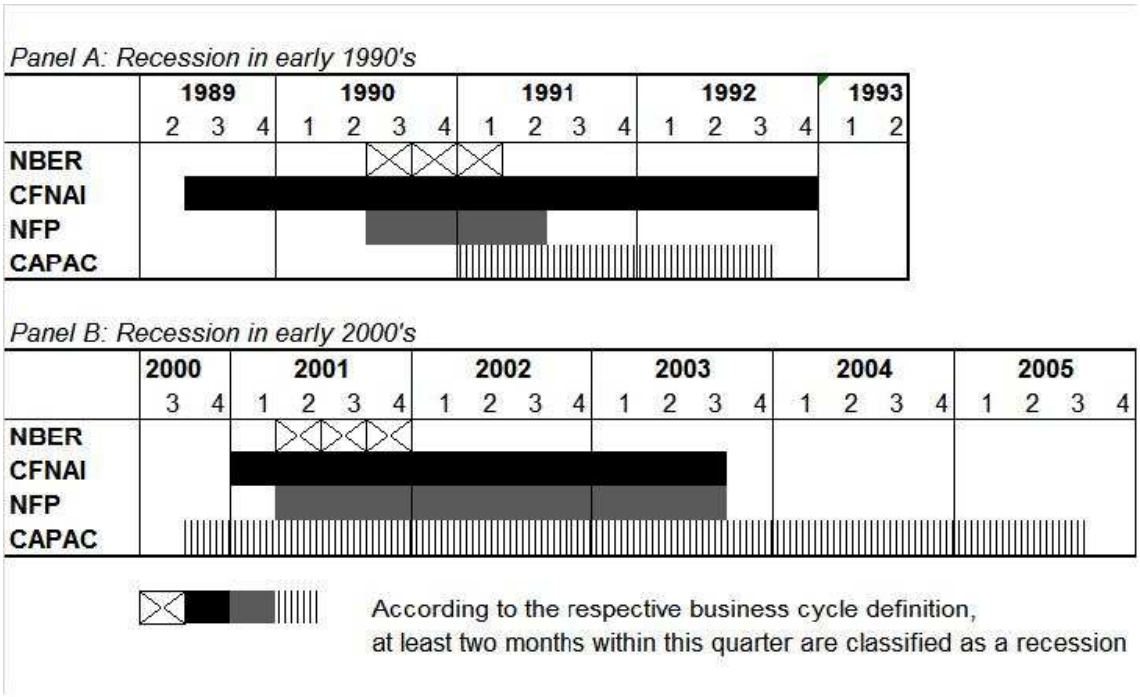
Figure 1: Alternative Business Cycle Definitions



This figure shows recession periods in our sample according to the alternative business cycle definitions used in this study. Business cycles are defined according to the NBER classification, the CFNAI definition, the nonfarm payroll (NFP) definition and the capacity utilization definition (CAPAC).

Table 1
Summary Statistics of Daily CRB/GSCI Log Returns

Panel A: CRB index	1989-2005	AD	NAD	Expansion	Recession
Ann. Mean (in %)	1.9001	5.7708**	−1.3608**	3.5028**	−14.868**
Ann. Std. Dev. (in %)	9.1390	9.3152	8.9834	9.0501	9.9644
Median (in %)	0.0140	0.0231	0.0001	0.0183	-0.0252
Min (in %)	-2.2831	-2.2831	-2.2363	-2.2363	-2.2831
Max (in %)	2.4645	2.3798	2.4645	2.4645	1.7594
Correlation with S&P 500	-0.0142	-0.0102	-0.0206	0.0000**	−0.1216**
Correlation with T-Bond	-0.0761	-0.0980	-0.0549	-0.0749	-0.0865
Panel B: GSCI	**1989-2005**	**AD**	**NAD**	**Expansion**	**Recession**
Ann. Mean (in %)	4.8636	2.0513**	7.2576**	6.2496**	−9.3240**
Ann. Std. Dev. (in %)	19.435	19.808	19.119	17.622**	32.844**
Median (in %)	0.0170	0.0001	0.0240	0.0118	0.0620
Min (in %)	-18.4549	-18.4549	-5.6908	-5.1451	-18.4549
Max (in %)	7.5349	4.7481	7.5349	6.5389	7.5349
Correlation with S&P 500	-0.0747	-0.0684	-0.0797	−0.0267**	−0.2861**
Correlation with T-Bond	-0.0513	-0.0667	-0.0348	−0.0244**	−0.2112**
Observations	4288	1959	2329	3912	376

This table contains summary statistics for CRB index daily log returns (Panel A) and GSCI daily log returns (Panel B). Annualized means and standard deviations, medians, minimum and maximum values as well as correlations with the S&P 500 and the 10-year T-Bond are given for the whole sample period from 1989 to 2005 (Column 1), the sample split into announcement days (AD, Column 2) and non-announcement days (NAD, Column 3) as well as expansions (Column 4) and recessions (Column 5). Recessions and expansions are defined according to the NBER business cycle classification. ** denotes significance at the 5% level for a two-sided test of significant differences between values in the respective subsamples.

Table 2
US Macroeconomic Announcements

Abbr.	Announcement	Obs.	Source	Availability		Release	Standardized Surprise		
				from	until	Time	min	mean	max
Real Activity									
DGO	Durable Good Order	203	BC	01/89	12/05	8:30	-2.62	0.02	3.78
NFP	Nonfarm Payrolls	204	BLS	01/89	12/05	8:30	-2.94	-0.17	3.67
HS	Housing Starts	199	BC	01/89	12/05	8:30	-3.17	0.13	2.96
IP	Industrial Production	204	FRB	01/89	12/05	9:15	-2.77	0.08	4.31
ISM	ISM Index	191	ISM	01/90	12/05	10:00	-2.37	-0.03	3.65
RS	Retail Sales	197	BC	07/89	12/05	8:30	-3.05	-0.09	2.54
CC	Consumer Confidence	174	CB	07/91	12/05	10:00	-2.59	0.06	2.65
CS	Construction Spending	204	BC	01/89	12/05	10:00	-2.45	0.09	2.50
UER	Unemployment Rate	204	BLS	01/89	12/05	8:30	-2.79	-0.25	2.79
GDP	Real GDP	161	BEA	01/90	06/03	8:30	-2.20	0.24	3.11
PI	Personal Income	203	BEA	01/89	12/05	8:30	-3.71	0.18	5.77
BI	Business Inventories	204	BC	01/89	12/05	8:30	-3.95	0.16	2.64
Inflation									
CPI	Consumer Price Index	197	BLS	07/89	12/05	8:30	-1.69	0.06	3.37
PPI	Producer Price Index	197	BLS	07/89	12/05	8:30	-4.83	-0.15	3.22
EAR	Average Hourly Earnings	192	BLS	10/89	12/05	8:30	-2.38	0.05	2.85
Other									
TRD	Trade Balance	204	BEA	01/89	12/05	10:00	-4.27	-0.13	3.55
LI	Index of Leading Indicators	204	CB	01/89	12/05	10:00	-3.74	0.09	4.81

This table reports the availability of US macroeconomic announcement and corresponding survey data that we use in our study. We partition news announcements into three broad categories: real activity news, inflation news, and other news. The following abbreviations indicate the respective sources of each announcement: Bureau of Labor Statistics (BLS), Bureau of the Census (BC), Bureau of Economic Analysis (BEA), Institute for Supply Chain Management (ISM), Conference Board (CB). All release times are given in Eastern Standard Time (EST). The last three columns report summary statistics for the standardized surprise in the announcements, i.e., announced figure minus market expectation according to MMS surveys, standardized by the sample standard deviation.

Table 3
Unconditional Price Impact

	CRB index	GSCI	TBOND	S&P 500
Intercept	0.0001	0.0002	0.0002 ***	0.0004 **
AR(1)	0.0652 ***	0.0041	0.0476 ***	-0.0081
DGO	0.0004	0.0003	-0.0008 *	-0.0006
NFP	0.0005	-0.0001	-0.0030 ***	-0.0014
HS	0.0001	0.0008	0.0001	-0.0007
IP	0.0002	0.0011	-0.0008 ***	0.0014 **
ISM	0.0005	0.0001	-0.0024 ***	0.0001
RS	-0.0002	0.0000	-0.0009 **	-0.0006
CC	-0.0001	0.0014	-0.0013 ***	0.0005
CS	0.0005	0.0007	0.0000	-0.0006
$-UER$	0.0003	0.0000	-0.0003	0.0002
GDP	0.0004	0.0014 *	0.0001	0.0016 ***
PI	-0.0003	0.0003	0.0000	0.0004
$-BI$	0.0003	0.0007	-0.0001	0.0004
CPI	0.0007 *	0.0018 **	-0.0012 ***	-0.0036 ***
PPI	-0.0004	-0.0013	-0.0006 **	-0.0012 **
EAR	-0.0002	-0.0004	-0.0015 ***	-0.0019
TRD	-0.0005	-0.0007	-0.0005 *	0.0011
LI	-0.0003	0.0001	-0.0002	0.0007
R^2	0.77%	0.37%	6.12%	1.18%
D.-W. Stat.	1.99	1.99	1.99	2.00
Observations	4,288	4,288	4,288	4,288

This table contains regression results of the following equation: $R_t = c + \beta \cdot R_{t-1} + \sum_i \delta_i \cdot S_{i,t} + \epsilon_t$. R_t denotes the daily log return of the CRB index (Column 1), the GSCI (Column 2), the 10-year T-Bond (Column 3), or the S&P 500 (Column 4), respectively. The daily returns are related to an autoregressive parameter, $AR(1)$, and the standardized surprise component of several macroeconomic announcements, $S_{i,t}$. The signs for Business Inventories (BI) and Unemployment Rate (UER) have been reversed to make their interpretation comparable to the other announcements: higher than expected inflation or real activity equals a positive sign. Robust standard errors are estimated with Newey West heteroskedasiticy and autocorrelation consistent covariance. Significance levels are indicated as follows: *** 1% significance, ** 5% significance and * 10% significance.

Table 4
State Dependent Price Impact I

	CRB index	GSCI	TBOND	S&P 500
Intercept	0.0001	0.0002	0.0003 ***	0.0004 ***
AR(1)	0.0639 ***	-0.0043	0.0473 ***	-0.0083
DGO^{exp}	0.0002	0.0004	-0.0011 ***	-0.0007
NFP^{exp}	0.0003	0.0000	-0.0033 ***	-0.0018 *
HS^{exp}	-0.0001	-0.0001	0.0001	-0.0007
IP^{exp}	0.0001	0.0012	-0.0010 ***	0.0013 *
ISM^{exp}	0.0006	-0.0001	-0.0024 ***	0.0005
RS^{exp}	-0.0005	-0.0002	-0.0008 **	-0.0007
CC^{exp}	-0.0002	0.0012	-0.0012 ***	-0.0001
CS^{exp}	0.0005	0.0010	-0.0001	-0.0007
$-UER^{exp}$	0.0003	0.0003	-0.0005	0.0000
GDP^{exp}	0.0002	0.0003	0.0002	0.0018 ***
PI^{exp}	0.0000	0.0003	-0.0003	0.0008
$-BI^{exp}$	0.0002	0.0007	0.0000	0.0003
CPI^{exp}	0.0006	0.0006	-0.0011 ***	-0.0032 ***
PPI^{exp}	-0.0002	-0.0008	-0.0006 **	-0.0016 **
EAR^{exp}	-0.0002	-0.0007	-0.0016 ***	-0.0017 **
TRD^{exp}	-0.0005	-0.0008	-0.0004	0.0009
LI^{exp}	-0.0003	0.0002	-0.0002	0.0011
DGO^{rec}	**0.0013** **	0.0001	0.0006	0.0001
NFP^{rec}	**0.0015** **	-0.0014	-0.0014	0.0024
HS^{rec}	0.0030	0.0131	0.0002	0.0003
IP^{rec}	0.0014	-0.0009	0.0006	0.0019
ISM^{rec}	-0.0004	0.0011	-0.0034 ***	-0.0036
RS^{rec}	**0.0021** **	0.0007	-0.0013	0.0005
CC^{rec}	0.0010	0.0035 **	-0.0030 ***	0.0062 **
CS^{rec}	-0.0004	-0.0018	0.0002	-0.0011
$-UER^{rec}$	-0.0002	-0.0022	0.0011	0.0017
GDP^{rec}	**0.0025** ***	**0.0104** ***	-0.0006	0.0000
PI^{rec}	-0.0017	0.0004	0.0017 ***	-0.0006
$-BI^{rec}$	0.0028	0.0000	-0.0020	0.0006
CPI^{rec}	0.0014 **	**0.0073** **	-0.0017 ***	-0.0053 ***
PPI^{rec}	-0.0022	-0.0067	-0.0007	0.0028
EAR^{rec}	0.0002	0.0042	-0.0005	-0.0059 **
TRD^{rec}	-0.0002	0.0008	-0.0008	0.0026
LI^{rec}	-0.0004	-0.0011	-0.0003	-0.0020
R^2	1.28%	1.33%	6.75%	1.72%
D.-W. Stat.	1.99	1.99	2.00	2.00
Observations	4,288	4,288	4,288	4,288

This table contains regression results of the following equation: $R_t = c + \beta \cdot R_{t-1} + \sum_i \delta_i^{exp} \cdot D^{exp} \cdot S_{i,t} + \sum_i \delta_i^{rec} \cdot D^{rec} \cdot S_{i,t} + \epsilon_t$. R_t denotes the daily log return of the CRB index (Column 1), the GSCI (Column 2),

the 10-year T-Bond (Column 3), or the S&P 500 (Column 4), respectively. The daily returns are related to an autoregressive parameter, $AR(1)$, and the standardized surprise component of several macroeconomic announcements, $S_{i,t}$. The response is conditional on the business cycle according to the NBER definition. The signs for Business Inventories (BI) and Unemployment Rate (UER) have been reversed to make their interpretation comparable to the other announcements: higher than expected inflation or real activity equals a positive sign. Robust standard errors are estimated with Newey West heteroskedasiticy and autocorrelation consistent covariance. Significance levels are indicated as follows: *** 1% significance, ** 5% significance and * 10% significance. Bold numbers indicate whether a coefficient is significantly larger (one-sided test) during economic recessions than during economic expansions on at least the 10% level or higher.

Table 5
State Dependent Price Impact II

	CFNAI		NFP		CAPAC	
	CRB index	GSCI	CRB index	GSCI	CRB index	GSCI
Intercept	0.0001	0.0002	0.0001	0.0002	0.0001	0.0002
$AR(1)$	0.0640 ***	0.0023	0.0651 ***	0.0001	0.0656 ***	0.0037
DGO^{exp}	0.0000	-0.0002	0.0001	0.0001	-0.0002	0.0000
NFP^{exp}	0.0005	0.0000	0.0005	0.0004	0.0005	-0.0005
HS^{exp}	-0.0003	-0.0008	-0.0001	-0.0003	0.0001	0.0003
IP^{exp}	0.0000	0.0013	0.0001	0.0010	0.0003	0.0012
ISM^{exp}	-0.0002	-0.0018 *	-0.0001	-0.0019 **	-0.0005	-0.0018 **
RS^{exp}	-0.0010	-0.0020 *	-0.0007	-0.0011	0.0005	-0.0002
CC^{exp}	-0.0008	-0.0003	-0.0006	0.0003	-0.0006	-0.0004
CS^{exp}	0.0005	0.0013	0.0006	0.0013	0.0002	0.0012
$-UER^{exp}$	-0.0002	-0.0002	0.0000	-0.0008	0.0000	-0.0006
GDP^{exp}	-0.0006	0.0008	0.0004	0.0004	0.0005	0.0014
PI^{exp}	0.0000	-0.0009	-0.0001	-0.0006	0.0003	0.0003
$-BI^{exp}$	-0.0001	0.0009	-0.0001	0.0007	-0.0004	0.0006
CPI^{exp}	0.0004	0.0009	0.0003	0.0004	0.0001	-0.0003
PPI^{exp}	-0.0002	-0.0011	-0.0002	-0.0010	-0.0004	-0.0010
EAR^{exp}	-0.0006	-0.0005	-0.0003	-0.0010	-0.0005	-0.0007
TRD^{exp}	-0.0005	-0.0013	-0.0005	-0.0009	-0.0002	0.0007
LI^{exp}	0.0000	0.0005	-0.0001	0.0005	-0.0002	-0.0001
DGO^{rec}	**0.0008** **	0.0008	**0.0012** **	0.0010	**0.0011** **	0.0008
NFP^{rec}	0.0004	-0.0003	0.0002	-0.0024	0.0007	0.0011
HS^{rec}	0.0007	**0.0030**	0.0007	0.0046	0.0000	0.0011
IP^{rec}	0.0003	0.0009	0.0005	0.0005	-0.0001	0.0009
ISM^{rec}	**0.0015** *	**0.0031** *	**0.0025** **	**0.0068** ***	**0.0015** *	**0.0021**
RS^{rec}	**0.0006**	**0.0018**	0.0007	0.0018	-0.0007	0.0002
CC^{rec}	**0.0007**	**0.0035** ***	0.0013	**0.0041** **	0.0004	**0.0032** ***
CS^{rec}	0.0005	-0.0006	-0.0001	-0.0015	0.0012	-0.0001
$-UER^{rec}$	**0.0010** **	0.0004	0.0012	**0.0025** *	0.0009	**0.0014**
GDP^{rec}	-0.0008	**0.0026** *	0.0007	**0.0045** **	0.0001	0.0017
PI^{rec}	-0.0005	0.0013	-0.0011	0.0010	-0.0010	0.0002
$-BI^{rec}$	0.0009	0.0002	0.0011	-0.0002	**0.0010**	0.0006
CPI^{rec}	0.0008 **	0.0024 **	**0.0015** **	**0.0051** ***	**0.0015** **	**0.0047** ***
PPI^{rec}	-0.0007	-0.0017	-0.0009	-0.0021	-0.0005	-0.0018
EAR^{rec}	**0.0005**	-0.0001	0.0005	0.0029	**0.0005**	0.0006
TRD^{rec}	-0.0004	0.0003	-0.0005	-0.0005	-0.0007	-0.0017
LI^{rec}	-0.0005	0.0000	-0.0006	-0.0005	-0.0004	0.0003
R^2	1.25%	0.99%	1.32%	1.47%	1.32%	0.88%
D.-W. Stat.	2.00	1.99	1.99	1.99	2.00	1.99
Observations	4,288	4,288	4,288	4,288	4,288	4,288

This table contains regression results of the following equation: $R_t = c + \beta \cdot R_{t-1} + \sum_i \delta_i^{exp} \cdot D^{exp} \cdot S_{i,t} + \sum_i \delta_i^{rec} \cdot D^{rec} \cdot S_{i,t} + \epsilon_t$. R_t denotes the daily log return of the CRB index, or the GSCI, respectively.

Business Cycles are defined according to the nonfarm payroll classification (Column 1), the CFNAI definition (Column 2) and the capacity utilization definition (Column 3). The daily returns are related to an autoregressive parameter, $AR(1)$, and the standardized surprise component of several macroeconomic announcements, $S_{i,t}$. The signs for Business Inventories (BI) and Unemployment Rate (UER) have been reversed to make their interpretation comparable to the other announcements: higher than expected inflation or real activity equals a positive sign. Bold numbers indicate whether a coefficient is significantly larger during economic recessions than during economic expansions on at least the 10% level or higher. Robust standard errors are estimated with Newey West heteroskedasiticy and autocorrelation consistent covariance. Significance levels are indicated as follows: *** 1% significance, ** 5% significance and * 10% significance. Bold numbers indicate whether a coefficient is significantly larger (one-sided test) during economic recessions than during economic expansions on at least the 10% level or higher.

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