The Economic Drivers of Commodity Market Volatility*

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Abstract

We analyze the relationship between economic uncertainty and commodity market volatility. We find that commodity market volatility comoves strongly with economic and financial uncertainty, especially during recessions. Variables associated with credit risk, financial market stress, and fluctuations in business conditions bear significant predictive ability for commodity market volatility. The documented predictability is mainly observed in the period after the financialization of commodity markets (i.e. post–2004) and it peaks around the 2008–2009 global financial crisis.

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1 Introduction

Commodity price volatility is a direct input in hedging decisions, risk management, and commodity contingent claim valuation. Furthermore, it affects production decisions through its impact on the value of the option embedded in inventory. Therefore, understanding the sources of its variations is an issue of paramount importance for investors, producers and policy makers. In this paper, we are seeking to fill a substantial gap in the literature by empirically investigating whether countercyclical variations in commodity market volatility can be explained by variables related to economic uncertainty.

Following the seminal paper of Schwert (1989), a large number of studies have attempted to answer the above question by using different variables and econometric methodologies in the context of equity and bond markets (Hamilton and Lin, 1998; Ludvigson and Ng, 2009; Paye, 2012; Engle et al., 2013). Despite their economic importance, commodities have attracted much less attention in the existing literature. We argue that investigating the links between economic uncertainty and commodity market volatility has profound implications in light of recent developments in commodity markets. These include, the “financialization” of commodity markets (Tang and Xiong, 2012), and the increased trading activity of liquid commodity volatility instruments, such as commodity variance swaps.

We use an extensive dataset of daily futures prices on 25 major commodities and construct an equally-weighted excess return commodity market index as well as sectoral sub-indices. We also analyze the S&P GSCI index since it is considered to be the most popular benchmark of commodity investment performance. Our investigation leads to a number of novel findings. First, we document a countercyclical variation in commodity futures volatility. Extending the evidence of Gorton and Rouwenhorst (2006) and Gargano and Timmermann (2014) from commodity returns, we find that commodity market volatility comoves with economic and financial uncertainty. This temporal dependence is much stronger during recessions than during expansions.

Second, we explore whether commodity market volatility can be predicted using a set of theoretically motivated variables associated with time-varying risk and changing investment opportunities. In particular, we investigate whether these variables contain information beyond that embedded in lagged volatility. We place our emphasis on two sub-samples of the January 1990–December 2015 period that are of particular importance, namely the pre- and post-financialization of commodity markets (Tang and Xiong, 2012). We show that variables associated with credit risk (e.g. default return), funding liquidity (e.g. TED spread), equity and bond market stress (e.g. VIX and implied volatility of treasury bonds), and fluctuations in real business conditions bear significant predictive power over commodity market volatility. Furthermore, a combination of significant variables delivers a forecast improvement of about 5% relative to a simple autoregressive benchmark. Most importantly, we identify a structural change in the predictive ability of the above risk factors after the financialization of commodity markets (i.e. after 2004). Consistent with the extensive evidence on the heterogeneity of commodities (Erb and Harvey, 2006), we observe some differences in the exposure of the various commodity sectors to the risk factors considered.

Third, we investigate the time-variation in the predictive power of the different variables by analyzing the dynamics of predictability in a rolling regression context. Our results show that the documented predictability is to a great extent concentrated in the 2008–2009 global financial crisis period. Most notably, a simple combination of predictors offers substantial gains in predictive performance. This is evidenced by an increase in the adjusted R^2 of up to 12% in the period following the outburst of the global financial crisis. Our result is consistent with recent research on equity markets which shows that predictability is time-varying and is concentrated in bad times (Henkel et al., 2011).

Our work primarily adds to the strand of the asset pricing literature that uses economic variables to predict volatility (Schwert, 1989; Beltratti and Morana, 2006; Engle et al., 2013). Two studies are closely related to ours. Paye (2012) finds that several variables have predictive power over aggregate stock market volatility, especially at the quarterly horizon. However, the forecasting ability of these variables is relatively limited out-of-sample. Gargano and Timmermann (2014) employ economic variables to predict commodity returns. We complement their evidence by performing a comprehensive analysis of commodity futures volatility prediction, reaching additional new results. In doing so, we also identify novel risk factors that appear to drive commodity market volatility, such as the default return spread, the TED spread, the VIX, and the option-implied volatility of US Treasury bonds.

We also add to the commodity pricing literature. Most existing studies on the determinants of commodity price volatility deal with factors that are specific to commodities, such as the convenience yield (Geman and Nguyen, 2005; Gorton et al., 2013) or hedging pressure (Bessembinder, 1992; De Roon et al., 2000). Furthermore, studies that explore the role of economic variables mainly focus on commodity returns (Bailey and Chan, 1992; Hong and Yogo, 2012; Issler et al., 2014; Ornelas and Mauad, 2017) rather than volatility. There are very few studies to date which seek to explore the link between economic uncertainty and commodity market volatility (Christiansen et al., 2012). Therefore, our results provide an important input for risk management in commodity markets as its effectiveness heavily depends on the accurate measurement of risk.

The remainder of this paper is organized as follows. Section 2 describes the data and variables employed for our empirical analysis. Section 3 presents and discusses our results and main findings. Finally, Section 4 concludes.

2 Data and Variables

In this section, we discuss the data and variables used in our analysis. We start by describing the equally-weighted excess return commodity futures index and its sectoral sub-indices. We then introduce the macroeconomic and financial risk factors we consider.

2.1 Commodity Futures Returns

Our dataset consists of daily prices on 25 commodity futures traded in the US. The data are obtained from the Commodity Research Bureau (CRB) and cover the period from January 5, 1970 to December 31, 2015.[1,2] We employ futures rather than physical spot prices because the former correspond to real transaction prices. The commodities in our sample can be classified into four broad categories, namely: (i) Agricultural, (ii) Livestock, (iii) Energy, and (iv) Metals. Table 1 contains the details on the commodity futures dataset.

We start by computing daily excess returns for each commodity futures following Singleton (2014). We employ the prices of the nearest and second nearest to maturity futures contracts, since these are considered to be the most liquid ones. We assume

[1]The earliest recorded futures prices in the CRB database are reported in July 1959. However, those include only some agricultural commodities and one metal commodity. Therefore, we have decided to start our sample in January 1970 when the data for the S&P GSCI index also becomes available.

[2]The empirical results presented in Section 3 are based on the period from January 1990 to December 2015. This period is chosen based on the greater availability and better quality of the commodity futures price data. For instance, the sample of most energy futures begins between the late 1980s to the early 1990s (e.g. natural gas). Moreover, some of the variables used in our analysis are only available from the 1990s onwards (e.g. the VIX).

a rollover strategy which takes a long position to the nearest to maturity futures contract that is closed out on the last trading day prior to the delivery month. Subsequently, a new long position to the next nearest to maturity contract is opened. The procedure is described in more detail in Section A.1 of the online appendix. We then construct an excess return index of commodity futures as an equally-weighted average of the daily excess returns across all the 25 commodities.[3] We apply the same logic to create equally-weighted sub-indices for each of the four broad commodity sectors, namely: agricultural, livestock, energy, and metals.

In order to ensure that our empirical findings are not specifically driven by our equally-weighted commodity index, we also analyze the S&P GSCI Excess Return Index which is viewed as the most popular commodity price benchmark. To address concerns relating to the over–weighting of the energy sector in the GSCI index, we examine the average across excess returns of the four GSCI sub-indices (i.e. agricultural, livestock, energy, and metals). We denote this index GSCI(Eq) to distinguish it from the standard S&P GSCI index.

2.2 Economic Predictors

To construct economic risk proxies, we first consider variables that reflect changes in the state of the broader economy. In particular, we gather data on: the growth rate of the Consumer Price Index (*Inflation*), the growth rate in industrial production (*IP*), the growth rate in the M2 money supply (*M2*), the Chicago Fed National Activity Index (*CFNAI*), the return on the trade-weighted US dollar index against major currencies (*USD index*), and the Aruoba-Diebold-Scott Business Conditions Index (*ADS*) of Aruoba et al. (2009). All series, with the exception of the ADS index,

[3]Note that the number of commodities included in the index changes over time depending on the availability of futures price data. Therefore, the index starts with 14 commodities in 1970 and ends up with 25 in 2015. Note that the index includes the full set of 25 commodities after the early 1990s.

are obtained from the Federal Reserve Bank of St. Louis (FRED). The first four series are available at a monthly frequency, whereas the USD index is sampled daily. Monthly data on the ADS index is collected from the website of the Federal Reserve Bank of Philadelphia.

We also consider a set of variables that are associated with changing financial market conditions. These variables covary with the business cycle and, from a theoretical standpoint, these variables represent shifts to the investment opportunity set in the context of asset pricing theories, such as the intertemporal capital asset pricing model of Merton (1973). Specifically, we employ: the *default yield spread* (difference between Moody's Baa and Aaa corporate bond yields), the *term spread* (long-term government bond yield minus the 3-month T-bill yield), the *default return spread* (difference between the long-term corporate and the long-term government bond returns), and the *TED spread* (difference between the 3-month LIBOR rate and the 3-month T-bill yield). These series are obtained from FRED with the exception of the long-term corporate and government bond returns which are collected from the webpage of Amit Goyal.[4]

Finally, we consider three risk measures that relate to equity and bond market stress. The first one is the Merrill Lynch 1-month Bond Volatility Index (*MOVE1M*), which is the month-ahead expectation of volatility extracted from at-the-money US Treasury bond options. The second one is the level of the *VIX* index, which corresponds to the risk-neutral expectation of the next 30-day volatility extracted from out-of-the-money call and put options on the S&P 500 index. The last variable is the variance risk premium (*VRP*) of the S&P 500 index, which is defined as the spread between risk-neutral and physical expectations of variance (Carr and Wu, 2009), i.e. $VRP_t = VIX_t^2 - E_t(RVar_{t+1})$, where: VIX_t is the option-implied volatility of the S&P 500 index at the end of month t and $E_t(RVar_{t+1})$ is the expectation of next

[4]http://www.hec.unil.ch/agoyal/

month's realized variance. Similar to Zhou (2018), we use the realized variance of month t, $RVar_t$, as the expectation of month's $t+1$ variance.[5] The daily realized variance series (constructed from 5-minute returns) is directly obtained from the Oxford-Man Institute Realised Volatility Library.[6] Section A.2 of the online appendix describes the motivation for considering the above variables and provides a more detailed definition for each of them.

3 Empirical Analysis

In this section, we first describe the methods used to obtain volatility estimates for variables observed at different frequencies. We then investigate the contemporaneous links and predictive relationships between economic uncertainty and commodity market volatility.

3.1 Measuring Volatility

Following the standard approach in the volatility literature, we compute monthly commodity futures volatility as the square root of the sum of squared daily intra-month demeaned futures returns:

$$RV_t = \sqrt{\sum_{j=1}^{N_t} (r_{j,t} - \bar{r_t})^2} \tag{1}$$

where: $r_{j,t}$ is the excess commodity futures return on day j of month t, $\bar{r_t}$ is the average futures excess return of month t, and N_t is the number of daily return observations in month t. We apply this estimator for the two aggregate commodity market indices (i.e. equally-weighted and GSCI(Eq), respectively) and for the four

[5]We have also considered the variance forecasts produced from an Heterogeneous Autoregressive (HAR) model (Corsi, 2009). This choice does not change any of our findings.
[6]https://realized.oxford-man.ox.ac.uk/

sectoral sub-indices. The documented non-Gaussian behavior of realized volatility estimates (Andersen et al., 2001; Areal and Taylor, 2002) may lead to violations in the core assumptions of the least squares estimation.[7] To this end, we follow Paye (2012) and work with the logarithm of the annualized commodity return volatility: $LRV_t = \log\left(\sqrt{12}RV_t\right)$.

Despite its empirical appeal, the estimator of Equation (1) can only be applied to daily (or intradaily) data. Nonetheless, most macroeconomic series are only available at the monthly frequency. Therefore, alternative procedures to obtain volatility estimates need to be employed. We apply a simple two-step non-parametric method similar to Schwert (1989) and Bansal et al. (2005). We start with the estimation of a twelfth-order autoregressive process on the logarithmic difference of each economic series, which includes dummy variables to allow for time-variation in the intercept:

$$Y_t = \sum_{i=1}^{12} a_i M_{i,t} + \sum_{j=1}^{12} b_j Y_{t-j} + e_t \tag{2}$$

where: Y_t is the growth rate (i.e. logarithmic difference) of a particular economic aggregate and $M_{i,t}$ are monthly dummy variables. We then obtain the logarithm of conditional volatility (V_t) through a 12-month rolling average of the absolute values of the residuals (e_t) from Equation (2):[8]

$$V_t = log\left(\sqrt{6\pi}\sum_{p=1}^{12}|e_{t-p+1}|\right) \tag{3}$$

[7] This non-Gaussian feature of the empirical distribution of realized volatility can be seen from kernel density plots of the level vs. the log of commodity market volatility. As pointed out by Andersen et al. (2003), although the distribution of raw volatility estimates is positively skewed, the distribution of logarithmic volatility is approximately normal. Our plots reported in Figure B3 of the online appendix strongly support this conjecture.

[8] As mentioned in Schwert (1989), the absolute residuals from Equation (2) are scaled by $\sqrt{\pi/2}$. This is because the expectation of the absolute value of the normally distributed error (equal to $\sigma\sqrt{2/\pi}$) is smaller than the standard deviation of the error by a factor of $\sqrt{2/\pi}$. Multiplying $\sqrt{\pi/2}$ by $\sqrt{12}$ in order to annualize the volatility series, yields the term $\sqrt{6\pi}$.

The above two-step procedure is applied to the series of inflation, IP, and M2 money supply, respectively. For macroeconomic uncertainty variables which are sampled daily (i.e. the USD index), uncertainty measures are obtained using the realized volatility estimator of Equation (1).[9]

Finally, we work with the levels (rather than the volatilities) of the remaining variables, namely: default yield spread, term spread, default return spread, TED spread, CFNAI, MOVE1M, and ADS since they already reflect risk or variation in real economic conditions. We compute monthly averages from daily values for the series that are available at a daily frequency.[10] Similarly, we employ the level of the VIX and variance risk premium series defined in the previous section.

Figure 1 plots the logarithm of the realized volatility of the equally-weighted excess return index and of the GSCI(Eq) index, respectively, for the period between January 1970 and December 2015. The shaded areas on the plot correspond to recession periods as classified by the National Bureau of Economic Research (NBER). The plot provides a first indication of the countercyclical behavior of commodity market volatility.

In order to provide more formal evidence, we perform a series of regressions of commodity market volatility on a recession indicator and lags of volatility. These results are presented in Section A.3 of the online appendix and suggest that commodity market volatility is significantly higher during recessions. This finding raises the question of whether variables that comove with the business cycle can help predict the volatility of commodity futures returns.

[9]As a robustness check, we obtain monthly volatility estimates through a GARCH(1,1) model fitted on the monthly series of economic variables and commodity returns. Section C.1 of the online appendix reports the results from this alternative specification that are very similar to our baseline estimates.

[10]Using end-of-month values instead of monthly averages does not change any of our findings.

3.2 Comovement Analysis

Table 2 reports summary statistics for the variables used in our empirical analysis. In line with previous studies (Schwert, 1989; Beltratti and Morana, 2006), we observe that financial variables, such as the VIX or the MOVE1M, are much more volatile than the macroeconomic variables. The first and twelfth order autocorrelation coefficients (columns labeled ρ_1 and ρ_{12}, respectively) indicate that most predictors are highly persistent. This slow decay is potentially related to the long memory in volatility that is documented by several studies (Areal and Taylor, 2002). Thus, to avoid spurious results due to highly persistent dependent variables and regressors, we follow Paye (2006) and consider a large number of lags of the dependent variable in our subsequent estimations.[11]

Table 3 presents the correlations between commodity return volatility and macroeconomic and financial risk measures. We focus our comovement analysis on the period between January 1990 and December 2015 in order to (i) obtain a balanced sample across most variables, and to (ii) ensure that our commodity index includes the full range of 25 commodities.[12] Panel I shows that commodity market volatility comoves with economic uncertainty.

In Panels II and III, we present pairwise correlations during NBER expansion and recession periods, respectively, over the same sample period. Comparing the coefficients in Panels II and III, we clearly see that the documented comovement is much stronger during recessions as compared to expansions. For example, the correlation between the volatility of the equally-weighted commodity index and the volatility of inflation (MOVE1M) is equal to 0.62 (0.83) during recessions, compared

[11]The last column of Table 2 shows that the Phillips–Perron unit-root test (Phillips and Perron, 1988) rejects the null hypothesis of a unit-root at the 1% significance level for all series (p-values are reported in parentheses). Therefore, even though most series are highly persistent, there in no need to take first differences or to consider alternative econometric procedures for modeling volatility.

[12]The same comovement analysis performed over the 1970–2015 period gives similar results.

to 0.26 (0.03) during expansions. With very few exceptions, similar conclusions can be drawn for the sectoral commodity sub-indices. These results are in line with the evidence of Gargano and Timmermann (2014) for commodity returns.

3.3 Predictive Regressions

We move a step further and explore the predictive ability of the various macroeconomic and financial risk measures by estimating the following regressions for commodity futures volatility:

$$LRV_t = \alpha + \gamma X_{t-1} + \sum_{j=1}^{6} \beta_j LRV_{t-j} + \epsilon_t \tag{4}$$

where: LRV_t is the logarithm of commodity futures volatility of month t and X_{t-1} is either a single predictor or a vector of several predictors.[13] To avoid spurious results due to the high persistence in volatility (Paye, 2006), we include six lags of the dependent variable in the right side of Equation (4). The above set of regressions is estimated using as the dependent variable the logarithmic volatility of the equally-weighted excess return commodity futures index, its four sectoral sub-indices, and the GSCI(Eq) index.[14] We standardize both the dependent as well as the explanatory variables prior to the estimation by subtracting the sample mean and dividing by the sample standard deviation. We do this in order to facilitate comparability across the coefficients of different explanatory variables.

[13] Sections C.2 and C.3 of the online appendix present the results from two additional robustness checks. In the first one, we employ the level as opposed to the logarithm of volatility. In the second one, we repeat all estimations using the logarithm of the variance instead of the logarithm of volatility. Both these tests provide similar, and in some cases stronger, results.

[14] One may argue that the volatility of sectoral commodity sub-indices is subject to seasonal variations and thus seasonal dummies or a periodic function should be included in Equation (4). Nevertheless, only some of the individual commodities contained in a given index are seasonal while others are not. As a consequence, the resulting volatility is not expected to exhibit any seasonal patterns. Indeed, when we include seasonal dummies in the predictive regressions for the four sectoral commodity sub-indices, we find these dummies to be insignificant in all cases.

The estimation results are reported in Tables 4 to 9. Newey and West (1987) corrected standard errors with twelve lags are employed. The column labeled $\Delta\bar{R}^2$ shows the change in the adjusted R^2 coefficient ($\bar{R}^2$) by adding a specific variable to a sixth-order autoregressive specification which serves as the benchmark. Our main results are summarized as follows. Variables related to credit risk (default return spread), funding illiquidity (TED spread), and equity and bond market stress (VIX and MOVE1M) are significant predictors of commodity market volatility.[15] Furthermore, the ADS index has a negative and significant loading in the post-2004 sub-period, indicating that shocks in the real economy affect commodity market volatility. Interestingly, the predictive power of many of the predictors is concentrated in the post-financialization period, which also includes the 2008–2009 global financial crisis. This finding is evidenced by the substantial increase in explanatory power relative to the autoregressive benchmark model during this period.

The signs of the considered predictors are as expected. For example, the TED spread is positive and highly significant at the 5% level in the post-financialization period. This positive sign can be understood in the context of Brunnermeier et al. (2008), where a higher TED spread is associated with greater funding illiquidity (and greater market stress) which subsequently pushes the volatility of risky assets to higher levels.[16] The negative sign of the ADS index of real business conditions is also intuitive, as it suggests that commodity futures volatility tends to increase during bad economic times. In a similar fashion, the positive and significant coefficients of equity and bond market option-implied volatilities (i.e. VIX and MOVE1M) in the post-2004 period suggest stronger cross-market linkages (Büyükşahin and Robe,

[15] Among the macroeconomic risk factors, only inflation volatility has some moderate predictive ability for commodity market volatility. This effect is mainly present in the early part of our sample. The results in Tables D.1 and D.2 from the online appendix show that inflation risk is a stronger predictor of commodity market volatility before the 1990s. However, its predictive ability diminishes thereafter.

[16] Consistent with this view, Büyükşahin and Robe (2014) also identify the TED spread as a fundamental driver of stock-commodity return comovement.

2014) and also indicate that commodity market volatility is strongly dependent on general financial market uncertainty.

Interesting results also emerge from the multiple regression estimations (reported at the bottom of each table) based on a combination of significant predictors. These results suggest some time-variation in the impact of the various risk factors. In particular, the overall predictability at the aggregate market level is stronger in the post–2004 period, which includes several important events, such as the financialization of commodity markets (Tang and Xiong, 2012; Silvennoinen and Thorp, 2013) and the global financial crisis. For the aggregate commodity market index (GSCI(Eq) index) in Table 4 (Table 5), a combination of factors adds a 4.96% (4.55%) to the explanatory power of the benchmark AR(6) model in the post–2004 period compared to 2.39% (2.67%) in the earlier part of the sample. Moreover, the *F-stat.* reported in the same tables clearly rejects the null hypothesis that the coefficients of all variables are jointly zero in almost every case. This finding is stronger during the post–2004 period. Looking at the results across sectoral commodity sub-indices (Tables 6 to 9), we observe that the predictability is stronger for the agricultural and energy commodities and weaker for livestock and metals. These differences are not entirely unexpected due to the heterogeneity of commodities (Erb and Harvey, 2006). Furthermore, our results suggest a change in the impact of significant predictors over time for all commodity sectors.

To formally investigate whether the relationship between commodity market volatility and the various economic uncertainty factors changes after the financialization of commodity markets (Tang and Xiong, 2012), we perform a Chow (1960) breakpoint test using December 2003 as our pre-specified breakpoint. A significant statistic would indicate a non-linear impact of specific risk factors on commodity market volatility. We reject the null hypothesis of no break at the 10% significance level for several variables (these are marked with the superscript ^{a} in the third column of Tables 4 to 9). In addition, sequential Bai and Perron (1998) tests for unknown breaks support the presence of structural breaks in a narrow time window around December 2003. This gives further credence to our choice of the above breakpoint.

3.4 The Dynamics of Predictability

The evidence above indicates the presence of time-variation in the impact of the various risk factors on commodity market volatility. To pin down the dynamics of this predictability, we rerun our analysis in a rolling regression context. Specifically, we initially estimate Equation (4) using the first 8 years of monthly observations. We then move one month forward until the end of our sample and repeat the estimation at each point.[17] We assess the in-sample predictive performance by comparing the adjusted R^2 of each model with that of the benchmark autoregressive model:

$$\Delta\bar{R}^2_{IS,t} = \bar{R}^2_{U,t} - \bar{R}^2_{R,t} \tag{5}$$

where: $\Delta\bar{R}^2_{IS,t}$ is the month t difference between the adjusted R^2 of the model augmented with a specific predictor ($\bar{R}^2_{U,t}$) and the adjusted R^2 of the sixth-order autoregressive benchmark ($\bar{R}^2_{R,t}$). Positive values indicate an improvement relative to the benchmark. Differences are expressed as a percentage (i.e. multiplied by 100).

Figure 2 presents the predictive performance for a selected set of variables used to predict the volatility of the equally-weighted commodity market index. A notable feature of the plots is that the predictive ability of many risk factors substantially increases in the post-financialization period (i.e. after 2004) and reaches its peak around the time of the 2008–2009 global financial crisis. For example, the default

[17] To make sure that the 8 years window length is not the primary driver of our results, we repeat the analysis using rolling samples of 10 and 12 years of data, respectively, and draw very similar conclusions.

return spread, the TED spread, and the MOVE1M exhibit significant predictive gains following the outbreak of the financial crisis. In some cases, this forecast improvement persists for prolonged periods (e.g. for the default return spread and the MOVE1M). Focusing on the macroeconomic volatility series (Inflation and IP), we observe that their predictive power is generally low in the post–2000 sub-sample with the exception of a period shortly before the onset of the global financial crisis. Finally, the model involving a combination of variables (bottom right graph) shows a persistent improvement in predictive power following the outburst of the crisis, which ranges between 6% and 12%.

In sum, our analysis shows that a great deal of the documented predictability is concentrated around the 2008–2009 crisis. Even though this is a new result in commodities, earlier studies from the equity literature find that a fair amount of the predictability of returns and volatility is concentrated around recessions (Henkel et al., 2011; Paye, 2012). This evidence suggests that variables related to variations in credit risk, financial market risk, or illiquidity become increasingly important during bad times.

4 Conclusion

In this paper, we investigate the links between economic uncertainty and commodity market volatility. We show that commodity market volatility comoves with economic and financial uncertainty and that this comovement is much stronger during recessions. We also explore the predictive ability of a set of theoretically motivated economic variables on commodity market volatility. We identify new predictors that are associated with credit risk, funding liquidity risk, equity and bond market uncertainty, and variation in real business conditions. We find evidence of a structural change in the predictive ability of the risk factors after 2004, a period that coincides with the financialization of commodity markets.

Our analysis also reveals important time-variations in the impact of the various predictors. Specifically, we find that the reported predictive gains increase substantially during the 2008–2009 global financial crisis and in some cases persist for long time periods. This finding is in line with the evidence from the equity markets that predictability is concentrated in bad times (Henkel et al., 2011; Cujean and Hasler, 2017). Nevertheless, the observed pattern is not consistent across all variables, implying a potentially more complex relationship between economic uncertainty and commodity futures volatility. Finally, we find that a simple combination of significant predictors leads to a substantial forecast improvement relative to a simple autoregressive benchmark, especially in the period following the onset of the global financial crisis.

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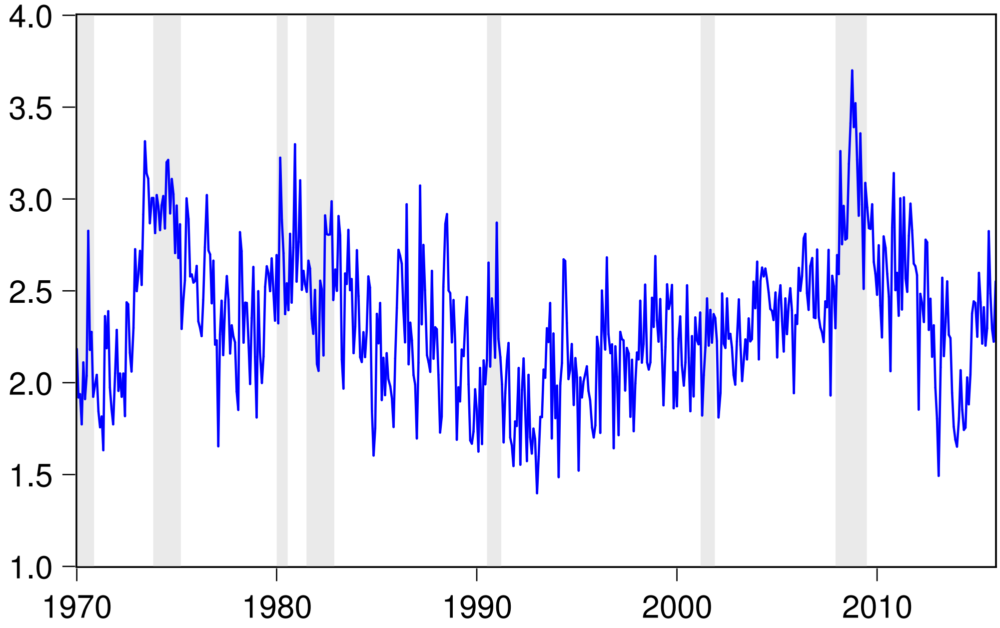
Panel A: Logarithmic Volatility of the Equally-Weighted Index



Panel B: Logarithmic Volatility of the GSCI(Eq) Index

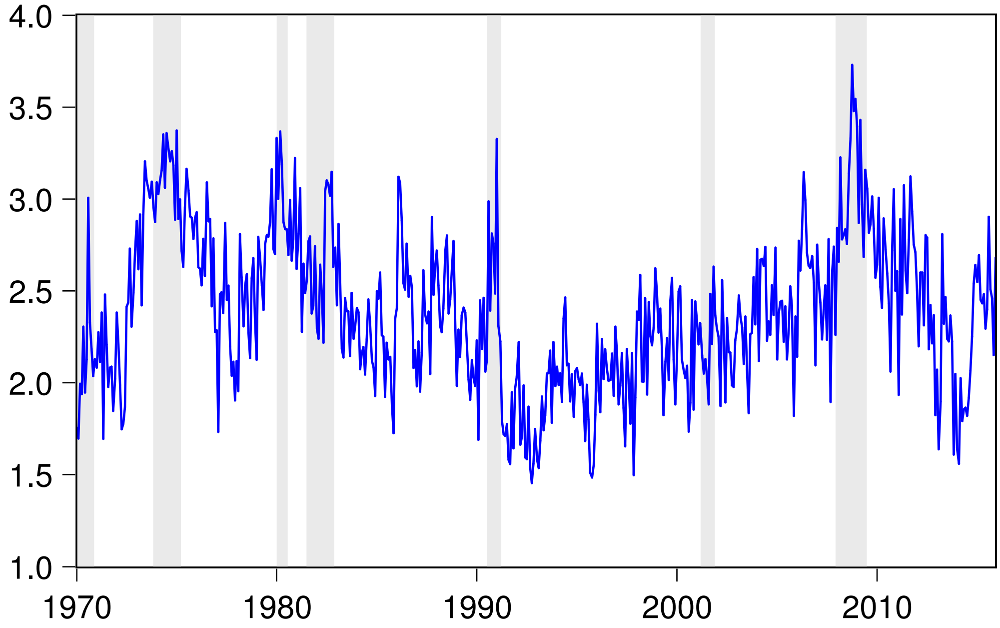


Figure 1: **Commodity Market Volatility over the Business Cycle**

This figure displays time series plots of the logarithm of realized volatility for the equally-weighted excess return commodity market index (Panel A) and the GSCI(Eq) excess return index (Panel B) over a period from January 1970 to December 2015. Gray shaded bars on the plot correspond to NBER recession periods.

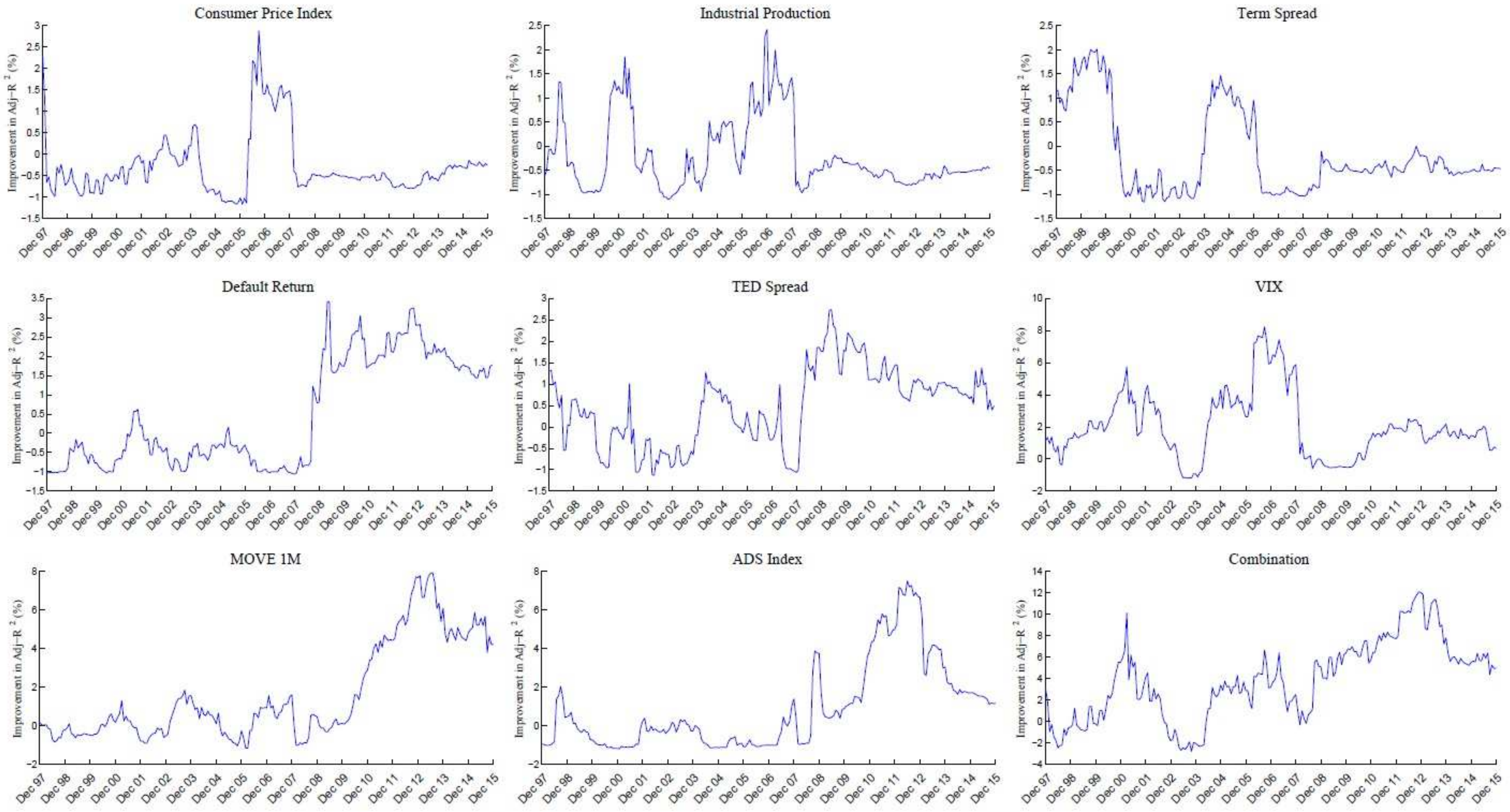


Figure 2: **The Dynamics of Predictability**

This figure shows time series plots of the differences in the adjusted R^2 coefficient of models augmented with a particular variable (or a combination of variables in the bottom right graph) and the sixth order autoregressive benchmark used for predicting the volatility of the equally-weighted commodity market index. We employ the most recent 8 years of monthly data for each rolling regression. Differences are expressed as a percentage (i.e. multiplied by 100).

Table 1: **Details on Commodity Futures**

This table contains details on the commodity futures used to construct the equally-weighted excess return commodity futures index and its corresponding sectoral sub-indices. All futures data are obtained from the Commodity Research Bureau (CRB). The end date is December 31, 2015 for all commodities. CBOT: Chicago Board of Trade, CME: Chicago Mercantile Exchange, COMEX: Commodity Exchange, ICE: Intercontinental Exchange, NYMEX: New York Mercantile Exchange.

Group	**Commodity**	**Start date**	**Exchange**
Agricultural			
	Cocoa	05/01/1970	ICE
	Coffee	17/08/1972	ICE
	Corn	05/01/1970	CBOT
	Cotton	05/01/1970	ICE
	Lumber	05/01/1970	CME
	Oats	05/01/1970	CBOT
	Orange juice	05/01/1970	ICE
	Rough rice	06/07/1987	CBOT
	Soybean meal	05/01/1970	CBOT
	Soybean oil	05/01/1970	CBOT
	Soybeans	05/01/1970	CBOT
	Sugar	05/01/1970	ICE
	Wheat	05/01/1970	CBOT
Livestock			
	Feeder cattle	01/12/1971	CME
	Lean hogs	05/01/1970	CME
	Live cattle	05/01/1970	CME
Energy			
	Crude oil (WTI)	31/03/1983	NYMEX
	Heating oil	05/09/1979	NYMEX
	Gasoline	02/01/1985	NYMEX
	Natural gas	05/04/1990	NYMEX
Metals			
	Copper	05/01/1970	COMEX
	Gold	02/01/1975	COMEX
	Palladium	04/01/1977	COMEX
	Platinum	05/01/1970	COMEX
	Silver	05/01/1970	COMEX

Table 2: **Summary Statistics of Explanatory Variables**

This table presents summary statistics for the explanatory variables considered in our analysis. We employ monthly observations over the period from January 1990 to December 2015. The mean, median, standard deviation, skewness, and kurtosis are reported for each series along with the autocorrelation coefficients of orders 1 and 12 (labeled ρ_1 and ρ_{12}, respectively). The table also displays Phillips-Perron (1988) unit-root test statistics (PP column) with their associated p-values in parentheses. All volatility series are annualized and expressed as a percentage.

Variable	**Mean**	**Median**	**Std. Dev.**	**Skew.**	**Kurt.**	ρ_1	ρ_{12}	**PP**
Inflation vol.	0.687	0.637	0.367	1.787	6.940	0.974	0.323	−4.091(0.00)
IP vol.	1.813	1.661	0.666	2.665	12.120	0.953	0.037	−4.362(0.00)
M2 vol.	0.967	0.880	0.440	0.924	3.155	0.964	0.353	−4.187(0.00)
USD index vol.	6.354	5.898	2.395	1.428	7.142	0.629	0.129	−14.092(0.00)
Default yield spread	0.960	0.880	0.407	3.107	15.943	0.964	0.267	−3.893(0.00)
Term spread	2.452	2.523	1.281	−0.265	1.989	0.975	0.489	−4.253(0.00)
Default return spread	−0.018	0.020	1.601	−0.490	11.512	0.022	0.060	−25.148(0.00)
TED spread	0.502	0.426	0.370	2.855	16.988	0.874	0.394	−4.548(0.00)
CFNAI	−0.152	−0.030	0.827	−1.940	9.633	0.675	0.153	−12.014(0.00)
VIX	19.876	18.235	7.555	1.682	7.374	0.841	0.384	−5.007(0.00)
MOVE1M	97.614	96.368	24.772	1.056	6.056	0.879	0.323	−4.650(0.00)
ADS	−0.167	−0.076	0.726	−1.990	9.810	0.895	0.173	−6.170(0.00)
VRP	16.969	14.017	20.916	−3.791	55.319	0.264	0.061	−14.392(0.00)

Table 3: **Comovement Analysis**

This table presents pairwise correlation coefficients between commodity market volatility and economic and financial uncertainty measures. Columns 2–3 report correlations for the equally weighted commodity market index (EqCI), and the GSCI(Eq) index, whereas the remaining four columns (4–7) contain results for sectoral sub-indices. Correlation coefficients that are not significant at the 5% level are marked with a dagger (†). The sample period is from January 1990 to December 2015. Panel I shows results for the full period, while Panels II and III present correlations during NBER expansions and recessions, respectively.

	EqCI	**GSCI(Eq)**	**Agricultural**	**Livestock**	**Energy**	**Metals**
I. Full sample						
Inflation vol.	0.505	0.527	0.358	0.160	0.448	0.434
IP vol.	0.536	0.515	0.437	0.213	0.398	0.382
M2 vol.	0.263	0.274	0.217	0.105†	0.174	0.253
USD index vol.	0.594	0.588	0.496	0.219	0.378	0.537
Default yield spread	0.665	0.677	0.515	0.301	0.461	0.497
Term spread	0.135	0.088†	0.175	0.103†	−0.077†	0.072†
Default return spread	−0.078†	−0.060†	−0.047†	0.081†	−0.018†	−0.127
TED spread	0.425	0.414	0.343	0.084†	0.328	0.313
CFNAI	−0.537	−0.559	−0.413	−0.157	−0.451	−0.405
VIX	0.507	0.520	0.393	0.274	0.466	0.376
MOVE1M	0.437	0.374	0.420	0.261	0.393	0.193
ADS	−0.564	−0.581	−0.438	−0.194	−0.467	−0.427
VRP	−0.245	−0.191	−0.257	0.001†	0.024†	−0.222
II. Expansions						
Inflation vol.	0.263	0.309	0.110†	0.025†	0.282	0.245
IP vol.	0.090†	0.063†	0.065†	0.110†	0.144	−0.012†
M2 vol.	0.196	0.210	0.129	0.004†	0.014†	0.233
USD index vol.	0.335	0.330	0.270	0.124	0.155	0.334
Default yield spread	0.378	0.408	0.237	0.237	0.208	0.225
Term spread	0.035†	−0.018†	0.105†	0.056†	−0.184	−0.020†
Default return spread	0.023†	0.002†	0.053†	0.007†	0.063†	−0.058†
TED spread	−0.112†	−0.120	−0.096†	−0.045†	0.041†	−0.114†
CFNAI	−0.140	−0.171	−0.097†	−0.042†	−0.119	−0.061†
VIX	0.226	0.243	0.149	0.203	0.273	0.101†
MOVE1M	0.029†	−0.079†	0.128	0.160	0.169	−0.211
ADS	−0.161	−0.192	−0.105†	−0.096†	−0.135	−0.077†
VRP	−0.033†	−0.003†	−0.052†	0.058†	0.123	−0.073†
III. Recessions						
Inflation vol.	0.615	0.609	0.522	0.473	0.459	0.582
IP vol.	0.748	0.756	0.650	0.414	0.505	0.697
M2 vol.	0.084†	0.068†	0.136†	0.336†	0.157†	0.022†
USD index vol.	0.864	0.870	0.748	0.456	0.554	0.830
Default yield spread	0.737	0.746	0.630	0.488	0.451	0.677
Term spread	0.590	0.505	0.575	0.567	0.215†	0.567
Default return spread	−0.215†	−0.153†	−0.193†	0.340	−0.156†	−0.270†
TED spread	0.791	0.793	0.717	0.249†	0.393	0.778
CFNAI	−0.666	−0.670	−0.550	−0.261†	−0.480	−0.673
VIX	0.695	0.702	0.591	0.427	0.514	0.717
MOVE1M	0.833	0.823	0.763	0.549	0.460	0.788
ADS	−0.714	−0.698	−0.620	−0.312†	−0.483	−0.716
VRP	−0.556	−0.500	−0.564	−0.154†	−0.145†	−0.528

Table 4: **Predictive Regressions for the Volatility of the Equally-Weighted Commodity Market Index**

*This table presents results from predictive regressions of the logarithmic volatility of the equally-weighted excess return index on lagged macroeconomic and financial uncertainty variables. Panel I presents regressions against each variable, whereas Panel II shows results from multivariate estimations against a combination of variables. We report the results for the full period from January 1990 to December 2015 as well as for two sub-periods: January 1990–December 2003 (pre-financialization period) and January 2004–December 2015 (post-financialization period). The intercept is not reported to save space. All variables are standardized prior to the estimation using the sample mean and standard deviation. For the single variable estimations we report the slope coefficient (γ) along with the change in the adjusted R^2 (labeled $\Delta\bar{R}^2$) with respect to a simple AR(6) benchmark specification that omits the specific variable. $\Delta\bar{R}^2$ is expressed in percentage terms (multiplied by 100). For the multivariate estimations, we show the F-statistic from testing the null hypothesis that all coefficients are jointly zero along with the increase in the $\bar{R}^2$ relative to the benchmark specification. The superscript ^{a} in column 3 indicates rejection of the null hypothesis of no structural break in December 2003 using a Chow (1960) test and a 10% significance level. Newey-West corrected standard errors with 12 lags are employed for the estimations. *, **, and *** indicate significance at the 10%, 5% and 1% level, respectively.*

	Full period 1990–2015		*Sub-period 1 1990–2003*		*Sub-period 2 2004–2015*	
	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$
I. Single Predictors						
Inflation vol.	0.099**	0.370	0.108	0.487	0.071	−0.085
IP vol.	0.013	−0.144	−0.024	−0.474	0.025	−0.341
M2 vol.	0.025	−0.105	0.016	−0.505	0.005	−0.369
USD index vol.	0.047	0.019	0.008	−0.527	0.056	−0.236
Default yield spread	0.050	−0.024	0.045	−0.344	0.057	−0.237
Term spread	−0.006	−0.155	−0.082	0.122	0.001	−0.372
Default return spread	−0.082**	0.524^a	0.032	−0.424	−0.137***	1.448
TED spread	0.060	0.181^a	0.028	−0.453	0.155***	1.368
CFNAI	−0.078	0.328	−0.032	−0.430	−0.173*	1.350
VIX	0.053	0.078^a	0.202***	2.551	0.132**	0.549
MOVE1M	0.065	0.233^a	0.108*	0.617	0.286***	2.961
ADS	−0.095**	0.533^a	−0.036	−0.402	−0.190**	1.786
VRP	−0.005	−0.156	0.150**	1.593	−0.017	−0.346
II. Multiple predictors						
	F-stat	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$
Combined variables	2.671**	1.279	1.928*	2.390	3.995***	4.958

Table 5: **Predictive Regressions for the Volatility of the GSCI(Eq) Index**

*This table presents results from predictive regressions of the logarithmic volatility of the GSCI(Eq) index on lagged macroeconomic and financial uncertainty factors. Panel I presents regressions against each variable, whereas Panel II shows results from multivariate estimations against a combination of variables. We report the results for the full period from January 1990 to December 2015 as well as for two sub-periods: January 1990–December 2003 (pre-financialization period) and January 2004–December 2015 (post-financialization period). The intercept is not reported to save space. All variables are standardized prior to the estimation using the sample mean and standard deviation. For the single variable estimations we report the slope coefficient (γ) along with the change in the adjusted R^2 (labeled $\Delta\bar{R}^2$) with respect to a simple AR(6) benchmark specification that omits the specific variable. $\Delta\bar{R}^2$ is expressed in percentage terms (multiplied by 100). For the multivariate estimations, we show the F-statistic from testing the null hypothesis that all coefficients are jointly zero along with the increase in the $\bar{R}^2$ relative to the benchmark specification. The superscript [a] in column 3 indicates rejection of the null hypothesis of no structural break in December 2003 using a Chow (1960) test and a 10% significance level. Newey-West corrected standard errors with 12 lags are employed for the estimations. *, **, and *** indicate significance at the 10%, 5% and 1% level, respectively.*

	Full period 1990–2015		*Sub-period 1* 1990–2003		*Sub-period 2* 2004–2015	
	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$
I. Single Predictors						
Inflation vol.	0.109**	0.420	0.107	0.455	0.101	0.128
IP vol.	0.013	−0.132	−0.049	−0.190	0.084	−0.044
M2 vol.	0.011	−0.136	0.010	−0.415	−0.035	−0.312
USD index vol.	−0.007	−0.141	−0.045	−0.216	0.069	−0.206
Default yield spread	0.056	0.007	0.044	−0.270	0.149**	0.392
Term spread	−0.022	−0.095	−0.101	0.572	−0.009	−0.403
Default return spread	−0.084**	0.536[a]	−0.007	−0.421	−0.133***	1.342
TED spread	0.018	−0.114[a]	0.007	−0.421	0.142**	1.093
CFNAI	−0.076	0.290[a]	−0.045	−0.232	−0.199**	1.965
VIX	0.056	0.113[a]	0.221***	3.099	0.131*	0.511
MOVE1M	0.027	−0.075[a]	0.021	−0.383	0.244**	2.466
ADS	−0.097**	0.549[a]	−0.084*	0.239	−0.191**	1.866
VRP	−0.005	−0.143[a]	0.190**	2.838	−0.065*	−0.021
II. Multiple predictors						
	F-stat	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$
Combined variables	2.671**	1.175	2.314**	2.665	3.439***	4.549

Table 6: **Predictive Regressions for the Volatility of the Agricultural Futures Portfolio**

*This table presents results from predictive regressions of the logarithmic volatility of the equally-weighted portfolio of agricultural futures on lagged macroeconomic and financial uncertainty factors. Panel I presents regressions against each variable, whereas Panel II shows results from multivariate estimations against a combination of variables. We report the results for the full period from January 1990 to December 2015 as well as for two sub-periods: January 1990–December 2003 (pre-financialization period) and January 2004–December 2015 (post-financialization period). The intercept is not reported to save space. All variables are standardized prior to the estimation using the sample mean and standard deviation. For the single variable estimations we report the slope coefficient (γ) along with the change in the adjusted R^2 (labeled $\Delta\bar{R}^2$) with respect to a simple AR(6) benchmark specification that omits the specific variable. $\Delta\bar{R}^2$ is expressed in percentage terms (multiplied by 100). For the multivariate estimations, we show the F-statistic from testing the null hypothesis that all coefficients are jointly zero along with the increase in the $\bar{R}^2$ relative to the benchmark specification. The superscript ^{a} in column 3 indicates rejection of the null hypothesis of no structural break in December 2003 using a Chow (1960) test and a 10% significance level. Newey-West corrected standard errors with 12 lags are employed for the estimations. *, **, and *** indicate significance at the 10%, 5% and 1% level, respectively.*

	Full period 1990–2015		*Sub-period 1* 1990–2003		*Sub-period 2* 2004–2015	
	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$
I. Single Predictors						
Inflation vol.	0.127***	0.912^a	0.165***	1.996	0.033	−0.330
IP vol.	0.070	0.186	−0.010	−0.559	0.045	−0.290
M2 vol.	0.102***	0.718^a	0.024	−0.505	0.106**	0.531
USD index vol.	0.050	0.001	−0.099	0.424	0.044	−0.304
Default yield spread	0.118***	0.677	0.008	−0.561	0.068	−0.183
Term spread	0.033	−0.100	−0.076	0.000	0.025	−0.360
Default return spread	−0.073*	0.334^a	−0.010	−0.558	−0.127**	1.215
TED spread	0.063	0.177^a	0.011	−0.556	0.138***	1.126
CFNAI	−0.072	0.231^a	0.083*	0.173	−0.158*	1.151
VIX	0.082**	0.377^a	0.136***	1.230	0.174***	1.288
MOVE1M	0.088*	0.509^a	0.043	−0.373	0.331***	4.243
ADS	−0.073	0.237^a	0.107**	0.673	−0.185**	1.776
VRP	0.023	−0.159^a	0.103*	0.503	0.033	−0.310
II. Multiple predictors						
	F-stat	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$
Combined variables	2.863**	1.886	3.354***	6.182	3.768***	5.123

Table 7: **Predictive Regressions for the Volatility of the Livestock Futures Portfolio**

*This table presents results from predictive regressions of the logarithmic volatility of the equally-weighted portfolio of livestock futures on lagged macroeconomic and financial uncertainty factors. Panel I presents regressions against each variable, whereas Panel II shows results from multivariate estimations against a combination of variables. We report the results for the full period from January 1990 to December 2015 as well as for two sub-periods: January 1990–December 2003 (pre-financialization period) and January 2004–December 2015 (post-financialization period). The intercept is not reported to save space. All variables are standardized prior to the estimation using the sample mean and standard deviation. For the single variable estimations we report the slope coefficient (γ) along with the change in the adjusted R^2 (labeled $\Delta\bar{R}^2$) with respect to a simple AR(6) benchmark specification that omits the specific variable. $\Delta\bar{R}^2$ is expressed in percentage terms (multiplied by 100). For the multivariate estimations, we show the F-statistic from testing the null hypothesis that all coefficients are jointly zero along with the increase in the $\bar{R}^2$ relative to the benchmark specification. Superscript ^{a} indicates rejection of the null hypothesis of no structural break in December 2003 using a Chow (1960) test and a 10% significance level. Newey-West corrected standard errors with 12 lags are employed for the estimations. *, **, and *** indicate significance at the 10%, 5% and 1% level, respectively.*

	Full period 1990–2015		*Sub-period 1 1990–2003*		*Sub-period 2 2004–2015*	
	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$
I. Single Predictors						
Inflation vol.	0.029	−0.179	0.032	−0.416	−0.011	−0.566
IP vol.	0.056	0.014	0.049	−0.287	0.068	−0.239
M2 vol.	0.017	−0.226	0.072	0.015	−0.073	−0.027
USD index vol.	0.076	0.268	0.125	1.058	0.040	−0.467
Default yield spread	0.091**	0.462	0.039	−0.381	0.126***	0.707
Term spread	0.023	−0.203	0.043	−0.330	0.001	−0.575
Default return spread	−0.102***	0.811	−0.061	−0.138	−0.132***	1.169
TED spread	0.047	−0.025	−0.057	−0.183	0.124***	0.876
CFNAI	−0.114***	1.037^a	−0.057	−0.191	−0.192***	2.648
VIX	0.070	0.193	0.095	0.287	0.043	−0.421
MOVE1M	0.047	−0.052	0.087	0.117	0.093	0.020
ADS	−0.103**	0.804^a	−0.030	−0.421	−0.194***	2.656
VRP	0.009	−0.247	0.071	−0.053	−0.008	−0.568
II. Multiple predictors						
	F-stat	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$
Combined variables	1.393	0.592	0.747	−0.788	2.090*	3.554

Table 8: **Predictive Regressions for the Volatility of the Energy Futures Portfolio**

*This table presents results from predictive regressions of the logarithmic volatility of the equally-weighted portfolio of energy futures on lagged macroeconomic and financial uncertainty factors. Panel I presents regressions against each variable, whereas Panel II shows results from multivariate estimations against a combination of variables. We report the results for the full period from January 1990 to December 2015 as well as for two sub-periods: January 1990–December 2003 (pre-financialization period) and January 2004–December 2015 (post-financialization period). The intercept is not reported to save space. All variables are standardized prior to the estimation using the sample mean and standard deviation. For the single variable estimations we report the slope coefficient (γ) along with the change in the adjusted R^2 (labeled $\Delta\bar{R}^2$) with respect to a simple AR(6) benchmark specification that omits the specific variable. $\Delta\bar{R}^2$ is expressed in percentage terms (multiplied by 100). For the multivariate estimations, we show the F-statistic from testing the null hypothesis that all coefficients are jointly zero along with the increase in the $\bar{R}^2$ relative to the benchmark specification. The superscript [a] in column 3 indicates rejection of the null hypothesis of no structural break in December 2003 using a Chow (1960) test and a 10% significance level. Newey-West corrected standard errors with 12 lags are employed for the estimations. *, **, and *** indicate significance at the 10%, 5% and 1% level, respectively.*

	Full period		*Sub-period 1*		*Sub-period 2*	
	1990–2015		*1990–2003*		*2004–2015*	
	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$
I. Single Predictors						
Inflation vol.	0.081	0.248	0.127	0.731	0.103	0.121
IP vol.	0.032	−0.095	−0.006	−0.399	0.054	−0.209
M2 vol.	−0.017	−0.146	0.017	−0.372	−0.032	−0.236
USD index vol.	0.027	−0.112	−0.030	−0.312	0.081	0.045
Default yield spread	0.056	0.064	0.088	0.181	0.049	−0.169
Term spread	−0.063*	0.225	−0.118*	0.993	−0.019	−0.300
Default return spread	−0.116***	1.137[a]	−0.067	0.048	−0.134***	1.383
TED spread	0.084**	0.487[a]	0.012	−0.387	0.133***	1.137
CFNAI	−0.080**	0.379	−0.067	0.009	−0.092**	0.349
VIX	0.090*	0.465	0.249**	3.302	0.026	−0.276
MOVE1M	0.072	0.272[a]	−0.038	−0.255	0.142***	1.114
ADS	−0.110***	0.850	−0.100*	0.548	−0.118***	0.738
VRP	0.012	−0.160	0.172**	2.333	−0.071***	0.173
II. Multiple predictors						
	F-stat	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$
Combined variables	3.528***	2.529	2.741**	3.916	3.795***	4.986

Table 9: **Predictive Regressions for the Volatility of the Metals Portfolio**

*This table presents results from predictive regressions of the logarithmic volatility of the equally-weighted portfolio of metal futures on lagged macroeconomic and financial uncertainty factors. Panel I presents regressions against each variable, whereas Panel II shows results from multivariate estimations against a combination of variables. We report the results for the full period from January 1990 to December 2015 as well as for two sub-periods: January 1990–December 2003 (pre-financialization period) and January 2004–December 2015 (post-financialization period). The intercept is not reported to save space. All variables are standardized prior to the estimation using the sample mean and standard deviation. For the single variable estimations we report the slope coefficient (γ) along with the change in the adjusted R^2 (labeled $\Delta\bar{R}^2$) with respect to a simple AR(6) benchmark specification that omits the specific variable. $\Delta\bar{R}^2$ is expressed in percentage terms (multiplied by 100). For the multivariate estimations, we show the F-statistic from testing the null hypothesis that all coefficients are jointly zero along with the increase in the $\bar{R}^2$ relative to the benchmark specification. The superscript ^{a} in column 3 indicates rejection of the null hypothesis of no structural break in December 2003 using a Chow (1960) test and a 10% significance level. Newey-West corrected standard errors with 12 lags are employed for the estimations. *, **, and *** indicate significance at the 10%, 5% and 1% level, respectively.*

	Full period 1990–2015		*Sub-period 1* 1990–2003		*Sub-period 2* 2004–2015	
	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$
I. Single Predictors						
Inflation vol.	0.078	0.249^a	−0.093	0.347	0.171^{**}	1.509
IP vol.	−0.004	-0.177^a	-0.168^{**}	1.905	0.078	−0.090
M2 vol.	−0.011	−0.168	−0.075	0.045	−0.019	−0.470
USD index vol.	0.067	0.174^a	−0.013	−0.511	0.148	0.906
Default yield spread	0.036	-0.091^a	−0.087	0.250	0.131^{*}	0.490
Term spread	0.006	−0.176	−0.064	−0.148	−0.004	−0.494
Default return spread	-0.088^{***}	0.592^a	-0.096^{*}	0.407	-0.101^{**}	0.486
TED spread	0.039	-0.037^a	0.042	−0.366	0.123^{**}	0.793
CFNAI	−0.072	0.282^a	−0.062	−0.140	-0.157^{*}	1.250
VIX	0.041	-0.023^a	0.069	−0.055	0.168^{*}	1.445
MOVE1M	0.008	-0.172^a	−0.101	0.501	0.168^{**}	1.586
ADS	-0.078^{*}	0.355^a	−0.062	−0.129	-0.150^{*}	1.172
VRP	−0.031	−0.083	0.102	0.479	−0.016	−0.471
II. Multiple Predictors						
	F-stat	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$
Combined variables	1.939	0.661	1.459	0.951	2.667^{**}	3.122

Online Appendix to:

"The Economic Drivers of Commodity Market Volatility"

Appendix A

A.1 Construction of Commodity Futures Index

We construct an equally-weighted excess return index of commodity futures as follows. We first create daily excess returns for each commodity futures similar to Singleton (2014). We employ the prices of the nearest and second nearest to maturity futures contracts (these are typically the most liquid ones). Continuous price series are then constructed by assuming a rollover strategy which involves a long position being opened on the nearest to maturity futures contract, which is closed out (by selling it) on the last trading day of the month prior to the delivery month when a new long position is opened to the next nearest to maturity futures contract.

The daily excess return on each commodity futures is computed as follows. Let $F_t^{T_i}$ be the price at time t of the futures contract maturing at T_i (where: $i = 1$ corresponds to the nearest and $i = 2$ to the second nearest futures contracts). Moreover, let t_0 be the initiation date of the contract, and $s^{(j)}$ be the j^{th} rollover day after t_0.

Then, the *excess return* between t_0 and t (where $t > t_0$) is defined as follows:

$$\frac{F_t^{T_i}}{F_{t_0}^{T_i}} - 1 \quad \text{if} \quad t < s^{(1)} \tag{A1}$$

$$\frac{F_{s^{(1)}-1}^{T_i}}{F_{t_0}^{T_i}} \cdot \frac{F_t^{T_i}}{F_{s^{(1)}-1}^{T_{i+1}}} - 1 \quad \text{if} \quad s^{(1)} \leq t < s^{(2)} \tag{A2}$$

$$\frac{F_{s^{(1)}-1}^{T_i}}{F_{t_0}^{T_i}} \cdot \frac{F_{s^{(2)}-1}^{T_i}}{F_{s^{(1)}-1}^{T_{i+1}}} \cdot \frac{F_t^{T_i}}{F_{s^{(2)}-1}^{T_{i+1}}} - 1 \quad \text{if} \quad s^{(2)} \leq t < s^{(3)} \tag{A3}$$

and so on. The first of the above equations corresponds to the excess return before the first rollover point, the second one gives the excess return between the first and second rollover points (i.e. once the generic futures curve has switched contracts at $s^{(1)}$), and so forth until the current time t. This return includes both the spot return that comes from the day-to-day change in the futures price as well as the roll yield by switching contracts at each rollover point.[18]

We construct the excess return commodity futures index as an equally-weighted average of the daily excess returns across all the 25 commodities.[19] We follow the same procedure to create equally-weighted sub-indices for each of the four broad commodity sectors, namely: agricultural, livestock, energy, and metals.[20]

A.2 Detailed Definitions of Economic Predictors

A.2.1 Macroeconomic Risk Factors

To construct empirical proxies of macroeconomic risk, we collect data on the following macroeconomic variables:

- *Inflation* which corresponds to the growth rate of the Consumer Price Index (CPI),
- Growth rate of industrial production (*IP*),
- Growth rate of the M2 money supply measure (*M2*),
- the Chicago Fed National Activity Index (*CFNAI*) which is constructed on a monthly basis using 85 economic indicators based on the methodology proposed by Stock and Watson (1999). Positive (negative) values of the index correspond to above (below) average economic growth.
- Return on the trade-weighted US dollar index (*USD index*) against major currencies,

[18]Given that the futures price converges to the spot price close to maturity, the roll yield is positive for curves in backwardation and negative for curves in contango.

[19]Note that the number of commodities included in the index changes over time, depending on the availability of futures' price data. Therefore, the index starts with 14 commodities in 1970 and ends up with 25 in 2015. The index includes the full set of 25 commodities after the early 1990s.

[20]As an additional check, we consider a spot return index that ignores the rollover return. This alternative definition of returns did not alter our main findings. Plots of both the spot and excess return indices are presented in Section B below.

- Aruoba-Diebold-Scott Business Conditions index (*ADS*) of Aruoba et al. (2009) which is constructed in such a way to track real economic activity at a high-frequency level (daily).

All series except the ADS index are obtained from the Federal Reserve Bank of St. Louis (FRED). The first four series are available at a monthly frequency whereas the USD index is available at a daily frequency. Monthly values of the ADS index were retrieved from the website of the Federal Reserve Bank of Philadelphia.

We include the above variables in our analysis in order to investigate how commodity market volatility responds to uncertainty about macroeconomic conditions (Engle and Rangel, 2008; Paye, 2012). For example, higher industrial production volatility (or low and negative values of the ADS index) may signal worsened economic prospects that are usually associated with higher volatility of risky assets. Inflation volatility may also affect the volatility of commodity futures since commodities are linked to inflation measurement. Evidence also suggests that commodities are employed by investors as inflation-hedging tools (Gorton and Rouwenhorst, 2006). Moreover, since commodities are traded internationally, fluctuations in exchange rates are a potential determinant of commodity market volatility. The CFNAI and ADS indices are used to capture variations in economic activity. The ADS index has the attractive property that it tracks economic activity by mixing economic indicators available at different frequencies.

A.2.2 Financial Risk Factors

We also consider a set of financial risk factors, commonly used as predictors of stock and bond returns (Goyal and Welch, 2008; Rapach et al., 2010; Ludvigson and Ng, 2009).[21] First, we consider the following variables related to credit risk:

- the *default yield spread*, defined as the difference between Moody's Baa and Aaa corporate bond yields,

[21]We would like to point out that the distinction between economic and financial risk factors is purely a matter of convention to facilitate exposition.

- the *term spread*, defined as the long-term government bond yield minus the 3-month T-bill yield,
- the *default return spread*, estimated as the difference between the long-term corporate and the long-term government bond returns, and
- the *TED spread*, computed as the difference between the 3-month LIBOR rate and the 3-month T-bill yield.

The data used for the construction of the above four variables are obtained from FRED. We collect the long-term corporate and government bond returns from the webpage of Amit Goyal.[22]

Furthermore, we consider the *Merrill Lynch 1-month Bond Volatility Index* (*MOVE1M*) which corresponds to the expectation of the next 30-day volatility extracted from at-the-money US Treasury bond options with a constant maturity of 1-month. Data on this index are obtained from Datastream.

Finally, we consider two uncertainty measures related to the equity market. The first one is the end-of-month level of the *VIX* index, which represents the risk-neutral expectation of the next 30-day volatility extracted from out-of-the-money call and put options on the S&P 500 index. The second variable is the variance risk premium (*VRP*) of the S&P 500 index. Similar to Carr and Wu (2009) we compute the VRP for month t as follows:

$$VRP_t = VIX_t^2 - E_t(RVar_{t+1}) \tag{A4}$$

where: VIX_t is the option implied volatility of the S&P500 index at the end of month t and $E_t(RVar_{t+1})$ is the expectation of month's $t+1$ realized variance formed at time t. We use the realized variance of month t, $RVar_t$, as the expectation of month's $t+1$ variance, similar to Zhou (2018).[23] The daily realized variance series

[22] http://www.hec.unil.ch/agoyal/

[23] As an additional robustness check, we consider variance forecasts produced from an Heterogeneous Autoregressive (HAR) model (Corsi, 2009). This choice does not change our results.

(from 5-minute returns) is directly obtained from the Oxford-Man Institute Realised Volatility Library and monthly *RVar* is computed by the sum of daily realized variance values over the entire month.[24]

The above measures convey information about real economic activity, credit risk and funding liquidity. For instance, Estrella and Hardouvelis (1991) show that the term spread has strong predictive ability for real output. Tobias and Brunnermeier (2016) employ the TED spread as a funding liquidity risk measure. Default yield and default return spreads are standard credit risk measures at the aggregate market level. For example, Bailey and Chan (1992) use the default spread to provide a risk-based explanation to the common variation in the basis across commodity markets. The MOVE1M index is a measure of uncertainty in the fixed income market and indirectly reflects option–implied expectations about monetary policy. VIX is employed in the literature as an indicator of equity market stress, investor sentiment (e.g. Baker and Wurgler, 2007), or risk appetite (Brunnermeier et al., 2008). The VRP is generally perceived as a measure of economic uncertainty (Zhou, 2018). In addition, it has been shown to be a reliable predictor of stock returns (Bekaert and Hoerova, 2014).

Moreover, the above variables are motivated by financial theories, such as, for example, the intertemporal capital asset pricing model (ICAPM) of Merton (1973). According to the ICAPM, the expected returns of equities are determined by their covariance with the market and with economic factors that represent changes in the investment opportunity set. There is ample evidence that the uncertainty about economic fundamentals is a major driver of future investment decisions (e.g., Bloom, 2009; Chen, 2010).[25] Therefore, under the view that commodities are highly integrated to traditional financial markets, variables associated with economic uncertainty, such as those considered for our analysis, are expected to

[24]The difference between the implied and the realized variance corresponds to the return of a long position on a synthetic variance swap contract. Thus, the spread of Equation (A4) is essentially the negative of the variance risk premium. Given that the variance risk premium is generally negative (i.e. the implied variance is higher than the realized variance), the above definition leads to a series which is most of the time positive, except for highly volatile periods that are associated with negative VRP values.

[25]We refer the reader to Bali and Engle (2010) for an excellent treatment of this topic.

affect commodity returns and their volatility. This should be particularly true in the post-financialization period (i.e. after 2004) which is believed to have led to a higher integration between commodity and traditional financial markets.[26]

A.3 Commodity Market Volatility during Recessions

Fama and French (1988) document business cycle variations in the spot-futures price relationship for metals. Gorton and Rouwenhorst (2006) show that commodity returns behave differently during the various stages of a business cycle in comparison to the returns of stocks and bonds. Motivated by these findings, we explore the behavior of commodity market volatility over the business cycle.

To formally investigate the behavior of commodity and macroeconomic volatility over the business cycle, we estimate the following regression:

$$Vol_{i,t} = \mu_i + \phi_i I_{NBER,t} + \sum_{j=1}^{6} \psi_{i,j} Vol_{i,t-j} + u_{i,t} \tag{A5}$$

where: $Vol_{i,t}$ is the month t log volatility of either commodity or macroeconomic variable i (i.e. the volatility series obtained from Equation (1) in the main text for the commodity market indices and sub-indices, and the USD index and from Equations (2) and (3) in the main text for inflation, IP, and M2). $I_{NBER,t}$ is a dummy variable that takes the value of 1 for NBER recession months and 0 otherwise. We include six lags of realized volatility on the right side of the above equation to account for the persistence in volatility. A positive and significant coefficient for the recession dummy (ϕ_i) means that the volatility of series i is on average higher during recessions. We estimate the above regression using as dependent variable the volatility of each commodity index, commodity sub-index, and macroeconomic risk factor.[27] The column headed "$\Delta\sigma(\%)$" reports the percentage difference between the

[26] The results of our empirical investigation seem to support this conjecture as many of the risk factors strongly predict commodity market volatility in the post–2004 period. Furthermore, this predictability peaks around the 2008–2009 financial crisis period.

[27] The energy sub-index is excluded from this analysis because of its shorter price history that includes very few recessions.

average volatility during recessions versus expansions.

Looking at the results reported in Table A.1, we observe that the recession dummy coefficient is positive and highly significant for both the equally-weighted commodity market index and for the GSCI(Eq) index. This indicates that commodity market volatility tends to be higher during recession periods. Switching our attention to the commodity sectors, we see that the increase in volatility during recessions is observed for all sectors and is stronger for metals (i.e. the volatility of metals is about 69.96% higher during recessions relative to expansions). Not surprisingly, the majority of macroeconomic volatility series also exhibit counter-cyclical patterns. Overall, with an average value of 38.41% across all series, it becomes clear that the percentage increase in volatility during recessions compared with expansions is quite substantial.

The counter-cyclical variation in commodity market volatility provides a clear indication that the volatility of commodity returns is strongly correlated with uncertainty about economic fundamentals. Furthermore, this effect tends to peak during economic downturns. One likely interpretation is that time-varying commodity premiums caused by shocks in convenience yield (inventories) during recessions may generate variations in the level of commodity return volatility.

Table A.1 **Commodity and Macroeconomic Volatility over the Business Cycle**

This table reports results from the following regression:

$$Vol_{i,t} = \mu_i + \phi_i I_{NBER,t} + \sum_{j=1}^{6} \psi_{i,j} Vol_{i,t-j} + u_{i,t}$$

where: $Vol_{i,t}$ *is the month* t *log volatility of either commodity or macroeconomic variables (i.e. the series obtained from Equation (1) for the commodity market indices and sub-indices, and USD index and from Equations (2) and (3) for inflation, IP, and M2).* $I_{NBER,t}$ *is a dummy variable that takes the value of 1 for NBER recession months and 0 otherwise. Six lags of the dependent variable are included in the right side of the above equation to account for the persistence in volatility. The second last column, headed* $\Delta\sigma(\%)$*, contains the percentage difference in volatility between recessions and expansions. *, **, and *** indicate significance at the 10%, 5% and 1% level, respectively. The sample period considered is January 1970–December 2015. The energy sub-index is omitted because of its shorter sample period which covers very few recessions. Newey and West (1987) corrected standard errors with 12 lags were employed for the estimations.*

Variable	ϕ_i	t_{ϕ_i}	$\Delta\sigma(\%)$	*Obs.*
EqCI vol.	0.112***	3.391	46.394	546
GSCI(Eq) vol.	0.120***	3.267	58.759	546
Agricultural vol.	0.081**	2.341	27.152	546
Livestock vol.	0.097***	2.850	26.175	546
Metals vol.	0.165***	3.658	69.960	546
Inflation vol.	0.034***	2.584	52.272	546
IP vol.	0.034**	2.167	25.364	546
M2 vol.	0.027**	2.352	18.482	546
USD index vol.	0.055	1.346	21.091	510

Appendix B. Plots

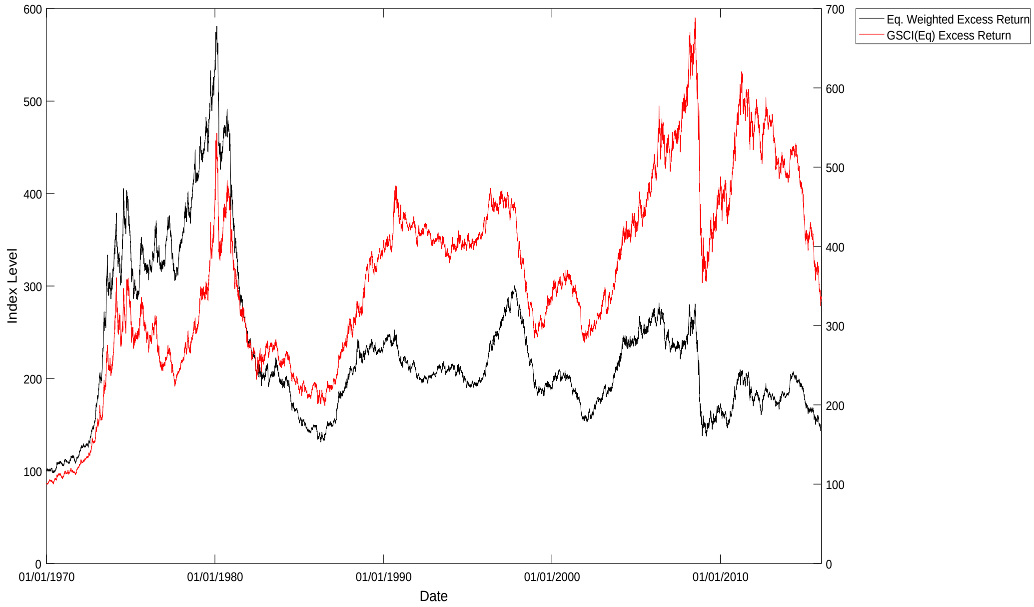


Figure B1: **Excess Return Commodity Market Indices**

This figure plots the daily levels of the equally–weighted excess return commodity market index (left vertical axis) and the GSCI(Eq) excess return index (right vertical axis). The period is from January 5, 1970 to December 31, 2015.

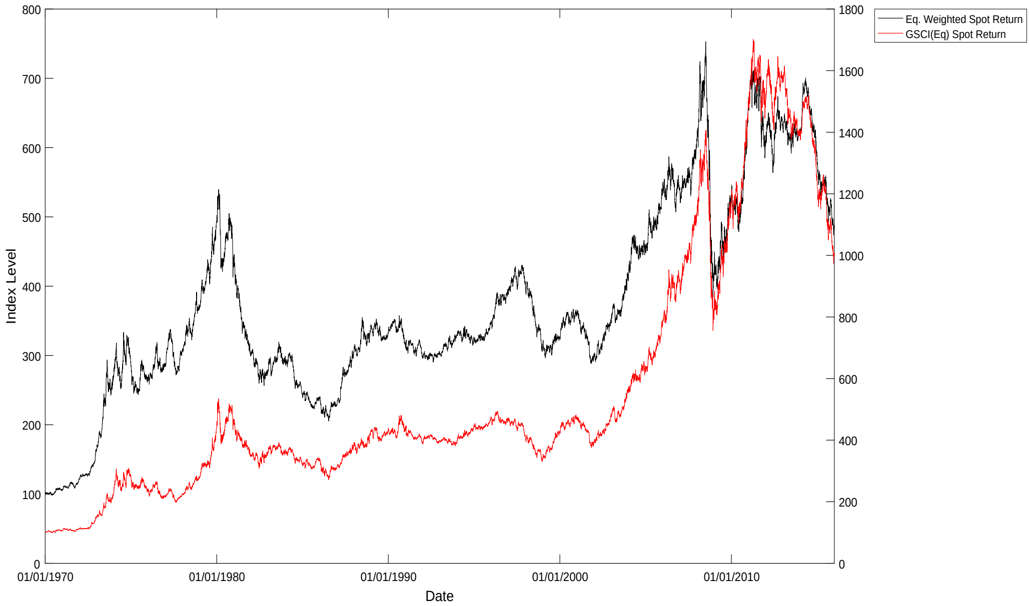


Figure B2: **Spot Return Commodity Market Indices**

This figure plots the daily levels of the equally–weighted spot return commodity market index (left vertical axis) and the GSCI(Eq) spot return index (right vertical axis). The period is from January 5, 1970 to December 31, 2015.

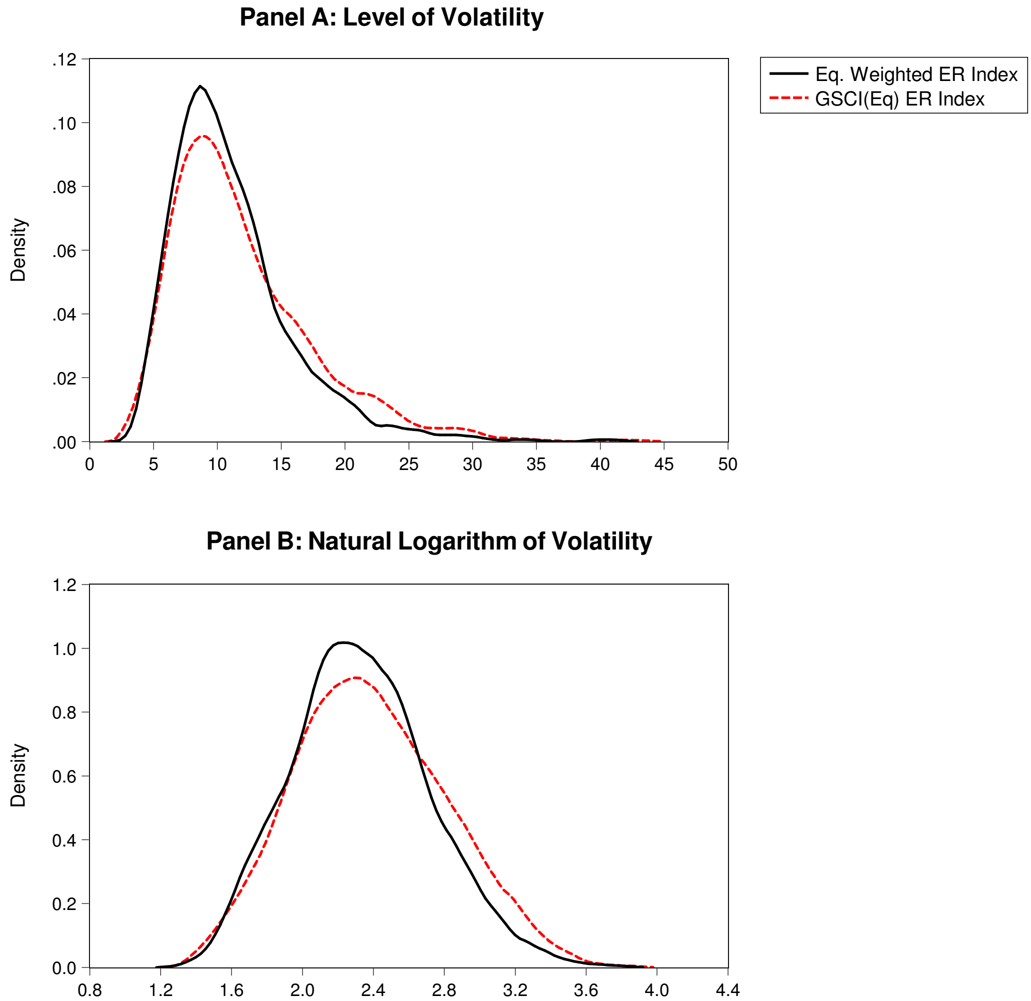


Figure B3: **Empirical Distribution of Monthly Commodity Market Volatility Estimates**

This figure shows the kernel density plots for the level (Panel A) and the logarithm (Panel B) of the volatility of the equally–weighted excess return commodity market index (solid line) and the GSCI(Eq) excess return index (dashed line). The period used for the plot is from January 1970 to December 2015.

Appendix C. Robustness Checks

C.1 Alternative Volatility Proxies: In our main analysis, monthly volatility estimates were obtained through the two–step procedure described in Section 3.1. As a robustness check, we also obtain volatility estimates via a GARCH(1,1) model:

$$Y_t = c + \sum_{i=1}^{6} \theta_i Y_{t-i} + e_t \quad (6)$$

$$h_t = \omega + a e_{t-1}^2 + b h_{t-1} \quad (7)$$

where: Y_t the growth rate of the specific economic variable, h_t is the conditional variance of month t, and $e_t \sim N(0, h_t)$. The monthly volatility series correspond to the annualized square root of the conditional variance estimate, namely $\sqrt{12 h_t}$. The results using the above method to obtain economic risk proxies are reported in Tables C.1.1–C.1.6.

C.2 Predicting the Level of Volatility: The results presented in the main manuscript focus on predicting the logarithm of volatility. As an additional robustness check, we re-estimate all models employing the level (instead of the logarithm) of commodity and macroeconomic volatilities. The results reported in Tables C.2.1–C.2.6 are qualitatively similar and in several cases stronger compared to those for the logarithmic volatility. Looking, for instance, at Table C.2.1 (C.2.2), we observe that the full set of factors explains a 9% (10%) of the variation in the volatility of the equally-weighted commodity market index (GSCI(Eq) index).

C.3 Variance Prediction: Finally, we repeat our analysis by focusing on variance rather than volatility prediction. The results presented in Tables C.3.1–C.3.6 are similar and in some cases stronger than those focusing on volatility prediction.

Appendix C.1 Alternative Volatility Proxies

Table C.1.1 **Predictive Regressions for the GARCH Volatility of the Equally-Weighted Commodity Market Index**

*This table presents results from predictive regressions of the logarithmic volatility of the equally-weighted excess return index on lagged macroeconomic and financial uncertainty variables. Macroeconomic volatilities are obtained from estimating GARCH(1,1) models. Panel I presents regressions against each variable, whereas Panel II shows results from multivariate estimations against a combination of variables. We report the results for the period from January 1990 to December 2015 as well as for two sub-periods: January 1990–December 2003 (pre-financialization period) and January 2004–December 2015 (post-financialization period). The intercept is not reported to save space. All variables are standardized prior to the estimation using the sample mean and standard deviation. For the single variable estimations we report the slope coefficient (γ) along with the change in the adjusted R^2 (labeled $\Delta\bar{R}^2$) with respect to a simple AR(6) benchmark specification that omits the specific variable. $\Delta\bar{R}^2$ is expressed in percentage terms (multiplied by 100). For the multivariate estimations, we show the F-statistic from testing the null hypothesis that all coefficients are jointly zero along with the increase in the $\bar{R}^2$ relative to the benchmark specification. The superscript ^{a} in column 3 indicates rejection of the null hypothesis of no structural break in December 2003 using a Chow (1960) test and a 10% significance level. Newey-West corrected standard errors with 12 lags are employed for the estimations. *, **, and *** indicate significance at the 10%, 5% and 1% level, respectively.*

	Full period 1990–2015		*Sub–period 1 1990–2003*		*Sub–period 2 2004–2015*	
	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$
I. Single Predictors						
Inflation vol.	0.096**	0.493^a	0.220***	3.588	0.027	−0.311
IP vol.	0.023	−0.116	0.111**	0.725	−0.027	−0.322
M2 vol.	0.056*	0.141	0.111**	0.744	0.045	−0.201
USD index vol.	0.047	0.019	0.008	−0.527	0.056	−0.236
Default yield spread	0.050	−0.024	0.045	−0.344	0.057	−0.237
Term spread	−0.006	−0.155	−0.082	0.122	0.001	−0.372
Default return spread	−0.082**	0.524^a	0.032	−0.424	−0.137***	1.448
TED spread	0.060	0.181^a	0.028	−0.453	0.155***	1.368
CFNAI	−0.078	0.328	−0.032	−0.430	−0.173*	1.350
VIX	0.053	0.078^a	0.202***	2.551	0.132**	0.549
MOVE1M	0.065	0.233^a	0.108*	0.617	0.286***	2.961
ADS	−0.095**	0.533^a	−0.036	−0.402	−0.190**	1.786
VRP	−0.005	−0.156	0.150**	1.593	−0.017	−0.346
II. Multiple Predictors						
	F-stat	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$
Combined variables	2.752**	1.338	3.068**	5.143	3.473***	4.169

Table C.1.2 **Predictive Regressions for the GARCH Volatility of the GSCI(Eq) Index**

*This table presents results from predictive regressions of the logarithmic volatility of the GSCI(Eq) excess return index on lagged macroeconomic and financial uncertainty variables. Macroeconomic volatilities are obtained from estimating GARCH(1,1) models. Panel I presents regressions against each variable, whereas Panel II shows results from multivariate estimations against a combination of variables. We report the results for the period from January 1990 to December 2015 as well as for two sub-periods: January 1990–December 2003 (pre-financialization period) and January 2004–December 2015 (post-financialization period). The intercept is not reported to save space. All variables are standardized prior to the estimation using the sample mean and standard deviation. For the single variable estimations we report the slope coefficient (γ) along with the change in the adjusted R^2 (labeled $\Delta\bar{R}^2$) with respect to a simple AR(6) benchmark specification that omits the specific variable. $\Delta\bar{R}^2$ is expressed in percentage terms (multiplied by 100). For the multivariate estimations, we show the F-statistic from testing the null hypothesis that all coefficients are jointly zero along with the increase in the $\bar{R}^2$ relative to the benchmark specification. The superscript ^{a} in column 3 indicates rejection of the null hypothesis of no structural break in December 2003 using a Chow (1960) test and a 10% significance level. Newey-West corrected standard errors with 12 lags are employed for the estimations. *, **, and *** indicate significance at the 10%, 5% and 1% level, respectively.*

	Full period 1990–2015		*Sub–period 1* 1990–2003		*Sub–period 2* 2004–2015	
	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$
I. Single Predictors						
Inflation vol.	0.107***	0.626	0.167*	1.674	0.081**	0.138
IP vol.	0.011	−0.135	0.031	−0.330	0.015	−0.394
M2 vol.	0.021	−0.104	0.041	−0.249	0.016	−0.390
USD index vol.	−0.007	−0.141	−0.045	−0.216	0.069	−0.206
Default yield spread	0.056	0.007	0.044	−0.270	0.149**	0.392
Term spread	−0.022	−0.095	−0.101	0.572	−0.009	−0.403
Default return spread	−0.084**	0.536^a	−0.007	−0.421	−0.133***	1.342
TED spread	0.018	−0.114^a	0.007	−0.421	0.142**	1.093
CFNAI	−0.076	0.290^a	−0.045	−0.232	−0.199**	1.965
VIX	0.056	0.113^a	0.221***	3.099	0.131*	0.511
MOVE1M	0.027	−0.075^a	0.021	−0.383	0.244**	2.466
ADS	−0.097**	0.549^a	−0.084*	0.239	−0.191**	1.866
VRP	−0.005	−0.143^a	0.190**	2.838	−0.065*	−0.021
II. Multiple Predictors						
	F-stat	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$
Combined variables	2.742**	1.224	2.625**	3.265	2.958**	3.715

Table C.1.3 **Predictive Regressions for the GARCH Volatility of the Agricultural Futures Index**

*This table presents results from predictive regressions of the logarithmic volatility of the equally-weighted agricultural futures index on lagged macroeconomic and financial uncertainty variables. Macroeconomic volatilities are obtained from estimating GARCH(1,1) models. Panel I presents regressions against each variable, whereas Panel II shows results from multivariate estimations against a combination of variables. We report the results for the period from January 1990 to December 2015 as well as for two sub-periods: January 1990–December 2003 (pre-financialization period) and January 2004–December 2015 (post-financialization period). The intercept is not reported to save space. All variables are standardized prior to the estimation using the sample mean and standard deviation. For the single variable estimations we report the slope coefficient (γ) along with the change in the adjusted R^2 (labeled $\Delta\bar{R}^2$) with respect to a simple AR(6) benchmark specification that omits the specific variable. $\Delta\bar{R}^2$ is expressed in percentage terms (multiplied by 100). For the multivariate estimations, we show the F-statistic from testing the null hypothesis that all coefficients are jointly zero along with the increase in the $\bar{R}^2$ relative to the benchmark specification. The superscript ^{a} in column 3 indicates rejection of the null hypothesis of no structural break in December 2003 using a Chow (1960) test and a 10% significance level. Newey–West corrected standard errors with 12 lags are employed for the estimations. *, **, and *** indicate significance at the 10%, 5% and 1% level, respectively.*

	Full period		*Sub–period 1*		*Sub–period 2*	
	1990–2015		*1990–2003*		*2004–2015*	
	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$
I. Single Predictors						
Inflation vol.	0.090	0.468^a	0.189^{***}	2.740	−0.009	−0.405
IP vol.	0.051	0.004^a	0.095	0.351	−0.028	−0.357
M2 vol.	0.056	0.091	0.045	−0.357	0.071	0.041
USD index vol.	0.050	0.001	−0.099	0.424	0.044	−0.304
Default yield spread	0.118^{***}	0.677	0.008	−0.561	0.068	−0.183
Term spread	0.033	−0.100	−0.076	0.000	0.025	−0.360
Default return spread	-0.073^{*}	0.334^a	−0.010	−0.558	-0.127^{**}	1.215
TED spread	0.063	0.177^a	0.011	−0.556	0.138^{***}	1.126
CFNAI	−0.072	0.231^a	0.083^{*}	0.173	-0.158^{*}	1.151
VIX	0.082^{**}	0.377^a	0.136^{***}	1.230	0.174^{***}	1.288
MOVE1M	0.088^{*}	0.509^a	0.043	−0.373	0.331^{***}	4.243
ADS	−0.073	0.237^a	0.107^{**}	0.673	-0.185^{**}	1.776
VRP	0.023	-0.159^a	0.103^{*}	0.503	0.033	−0.310
II. Multiple Predictors						
	F-stat	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$
Combined variables	2.279^{**}	1.307	3.655^{***}	6.911	3.967^{***}	5.455

Table C.1.4 **Predictive Regressions for the GARCH Volatility of the Livestock Futures Index**

*This table presents results from predictive regressions of the logarithmic volatility of the equally-weighted index of livestock futures on lagged macroeconomic and financial uncertainty variables. Macroeconomic volatilities are obtained from estimating GARCH(1,1) models. Panel I presents regressions against each variable, whereas Panel II shows results from multivariate estimations against a combination of variables. We report the results for the period from January 1990 to December 2015 as well as for two sub-periods: January 1990–December 2003 (pre-financialization period) and January 2004–December 2015 (post-financialization period). The intercept is not reported to save space. All variables are standardized prior to the estimation using the sample mean and standard deviation. For the single variable estimations we report the slope coefficient (γ) along with the change in the adjusted R^2 (labeled $\Delta\bar{R}^2$) with respect to a simple AR(6) benchmark specification that omits the specific variable. $\Delta\bar{R}^2$ is expressed in percentage terms (multiplied by 100). For the multivariate estimations, we show the F-statistic from testing the null hypothesis that all coefficients are jointly zero along with the increase in the $\bar{R}^2$ relative to the benchmark specification. The superscript [a] in column 3 indicates rejection of the null hypothesis of no structural break in December 2003 using a Chow (1960) test and a 10% significance level. Newey-West corrected standard errors with 12 lags are employed for the estimations. *, **, and *** indicate significance at the 10%, 5% and 1% level, respectively.*

	Full period 1990–2015		*Sub–period 1* 1990–2003		*Sub–period 2* 2004–2015	
	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$
I. Single Predictors						
Inflation vol.	0.034	−0.145	0.056	−0.216	0.001	−0.575
IP vol.	0.067	0.165	0.102	0.472	0.049	−0.357
M2 vol.	0.018	−0.220	0.092*	0.309	−0.064	−0.165
USD index vol.	0.076	0.268	0.125	1.058	0.040	−0.467
Default yield spread	0.091**	0.462	0.039	−0.381	0.126***	0.707
Term spread	0.023	−0.203	0.043	−0.330	0.001	−0.575
Default return spread	−0.102***	0.811	−0.061	−0.138	−0.132***	1.169
TED spread	0.047	−0.025	−0.057	−0.183	0.124***	0.876
CFNAI	−0.114***	1.037[a]	−0.057	−0.191	−0.192***	2.648
VIX	0.070	0.193	0.095	0.287	0.043	−0.421
MOVE1M	0.047	−0.052	0.087	0.117	0.093	0.020
ADS	−0.103**	0.804[a]	−0.030	−0.421	−0.194***	2.656
VRP	0.009	−0.247	0.071	−0.053	−0.008	−0.568
II. Multiple Predictors						
	F-stat	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$
Combined variables	1.405	0.610	0.865	−0.419	2.231**	3.987

Table C.1.5 **Predictive Regressions for the GARCH Volatility of the Energy Futures Index**

*This table presents results from predictive regressions of the logarithmic volatility of the equally-weighted index of energy futures on lagged macroeconomic and financial uncertainty variables. Macroeconomic volatilities are obtained from estimating GARCH(1,1) models. Panel I presents regressions against each variable, whereas Panel II shows results from multivariate estimations against a combination of variables. We report the results for the period from January 1990 to December 2015 as well as for two sub-periods: January 1990–December 2003 (pre-financialization period) and January 2004–December 2015 (post-financialization period). The intercept is not reported to save space. All variables are standardized prior to the estimation using the sample mean and standard deviation. For the single variable estimations we report the slope coefficient (γ) along with the change in the adjusted R^2 (labeled $\Delta\bar{R}^2$) with respect to a simple AR(6) benchmark specification that omits the specific variable. $\Delta\bar{R}^2$ is expressed in percentage terms (multiplied by 100). For the multivariate estimations, we show the F-statistic from testing the null hypothesis that all coefficients are jointly zero along with the increase in the $\bar{R}^2$ relative to the benchmark specification. The superscript ^{a} in column 3 indicates rejection of the null hypothesis of no structural break in December 2003 using a Chow (1960) test and a 10% significance level. Newey-West corrected standard errors with 12 lags are employed for the estimations. *, **, and *** indicate significance at the 10%, 5% and 1% level, respectively.*

	Full period 1990–2015		*Sub–period 1* 1990–2003		*Sub–period 2* 2004–2015	
	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$
I. Single Predictors						
Inflation vol.	0.050	−0.004	0.183*	1.715	−0.023	−0.306
IP vol.	0.044	−0.012	0.028	−0.326	0.036	−0.251
M2 vol.	0.030	−0.086	0.065	0.010	0.005	−0.335
USD index vol.	0.027	−0.112	−0.030	−0.312	0.081	0.045
Default yield spread	0.056	0.064	0.088	0.181	0.049	−0.169
Term spread	−0.063*	0.225	−0.118*	0.993	−0.019	−0.300
Default return spread	−0.116***	1.137^a	−0.067	0.048	−0.134***	1.383
TED spread	0.084**	0.487^a	0.012	−0.387	0.133***	1.137
CFNAI	−0.080**	0.379	−0.067	0.009	−0.092**	0.349
VIX	0.090*	0.465	0.249**	3.302	0.026	−0.276
MOVE1M	0.072	0.272^a	−0.038	−0.255	0.142***	1.114
ADS	−0.110***	0.850	−0.100*	0.548	−0.118***	0.738
VRP	0.012	−0.160	0.172**	2.333	−0.071***	0.173
II. Multiple Predictors						
	F-stat	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$
Combined variables	2.574**	1.603	3.110***	4.684	2.779**	3.309

Table C.1.6 **Predictive Regressions for the GARCH Volatility of the Metals Futures Index**

*This table presents results from predictive regressions of the logarithmic volatility of the equally-weighted index of metals futures on lagged macroeconomic and financial uncertainty variables. Macroeconomic volatilities are obtained from estimating GARCH(1,1) models. Panel I presents regressions against each variable, whereas Panel II shows results from multivariate estimations against a combination of variables. We report the results for the period from January 1990 to December 2015 as well as for two sub-periods: January 1990–December 2003 (pre-financialization period) and January 2004–December 2015 (post-financialization period). The intercept is not reported to save space. All variables are standardized prior to the estimation using the sample mean and standard deviation. For the single variable estimations we report the slope coefficient (γ) along with the change in the adjusted R^2 (labeled $\Delta\bar{R}^2$) with respect to a simple AR(6) benchmark specification that omits the specific variable. $\Delta\bar{R}^2$ is expressed in percentage terms (multiplied by 100). For the multivariate estimations, we show the F-statistic from testing the null hypothesis that all coefficients are jointly zero along with the increase in the $\bar{R}^2$ relative to the benchmark specification. The superscript ^{a} in column 3 indicates rejection of the null hypothesis of no structural break in December 2003 using a Chow (1960) test and a 10% significance level. Newey-West corrected standard errors with 12 lags are employed for the estimations. *, **, and *** indicate significance at the 10%, 5% and 1% level, respectively.*

	Full period 1990–2015		*Sub–period 1 1990–2003*		*Sub–period 2 2004–2015*	
	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$
I. Single Predictors						
Inflation vol.	0.112**	0.785^a	−0.009	−0.520	0.152**	1.556
IP vol.	−0.007	−0.174^a	−0.109*	0.637	0.035	−0.392
M2 vol.	0.011	−0.168	−0.034	−0.412	0.063	−0.173
USD index vol.	0.067	0.174^a	−0.013	−0.511	0.148	0.906
Default yield spread	0.036	−0.091^a	−0.087	0.250	0.131*	0.490
Term spread	0.006	−0.176	−0.064	−0.148	−0.004	−0.494
Default return spread	−0.088***	0.592^a	−0.096*	0.407	−0.101**	0.486
TED spread	0.039	−0.037^a	0.042	−0.366	0.123**	0.793
CFNAI	−0.072	0.282^a	−0.062	−0.140	−0.157*	1.250
VIX	0.041	−0.023^a	0.069	−0.055	0.168*	1.445
MOVE1M	0.008	−0.172^a	−0.101	0.501	0.168**	1.586
ADS	−0.078*	0.355^a	−0.062	−0.129	−0.150*	1.172
VRP	−0.031	−0.083	0.102	0.479	−0.016	−0.471
II. Multiple Predictors						
	F-stat	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$
Combined variables	2.779**	1.238	1.074	0.155	2.765**	3.295

Appendix C.2 Predicting the Level of Volatility

Table C.2.1 **Predictive Regressions for the Level of Volatility of the Equally–Weighted Commodity Market Index**

*This table presents results from predictive regressions of the level of volatility of the equally-weighted excess return index on lagged macroeconomic and financial uncertainty variables. Panel I presents regressions against each variable, whereas Panel II shows results from multivariate estimations against a combination of variables. We report the results for the period from January 1990 to December 2015 as well as for two sub-periods: January 1990–December 2003 (pre-financialization period) and January 2004–December 2015 (post-financialization period). The intercept is not reported to save space. All variables are standardized prior to the estimation using the sample mean and standard deviation. For the single variable estimations we report the slope coefficient (γ) along with the change in the adjusted R^2 (labeled $\Delta\bar{R}^2$) with respect to a simple AR(6) benchmark specification that omits the specific variable. $\Delta\bar{R}^2$ is expressed in percentage terms (multiplied by 100). For the multivariate estimations, we show the F-statistic from testing the null hypothesis that all coefficients are jointly zero along with the increase in the $\bar{R}^2$ relative to the benchmark specification. The superscript ^{a} in column 3 indicates rejection of the null hypothesis of no structural break in December 2003 using a Chow (1960) test and a 10% significance level. Newey-West corrected standard errors with 12 lags are employed for the estimations. *, **, and *** indicate significance at the 10%, 5% and 1% level, respectively.*

	Full period 1990–2015		*Sub–period 1* 1990–2003		*Sub–period 2* 2004–2015	
	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$
I. Single Predictors						
Inflation vol.	0.051	−0.028	0.165*	1.726	0.000	−0.363
IP vol.	−0.021	−0.119	−0.008	−0.546	−0.041	−0.302
M2 vol.	0.002	−0.143	0.036	−0.419	−0.028	−0.309
USD index vol.	0.003	−0.142	0.000	−0.553	−0.043	−0.300
Default yield spread	0.005	−0.142	0.065	−0.155	−0.010	−0.361
Term spread	−0.004	−0.141	−0.084	0.146	0.003	−0.362
Default return spread	−0.153**	2.097^a	0.037	−0.412	−0.215***	3.932
TED spread	0.089*	0.485^a	0.043	−0.369	0.206***	2.041
CFNAI	−0.096	0.466^a	−0.038	−0.407	−0.259*	2.296
VIX	0.052*	0.054^a	0.172**	1.889	0.184***	0.839
MOVE1M	0.075*	0.310^a	0.115*	0.740	0.337***	3.309
ADS	−0.125*	0.854^a	−0.036	−0.419	−0.318**	3.721
VRP	−0.010	−0.134	0.158**	1.796	−0.008	−0.359
II. Multiple Predictors						
	F-stat	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$
Combined Variables	5.609***	3.046	2.140*	3.020	6.952***	8.743

Table C.2.2 **Predictive Regressions for the Level of Volatility of the GSCI(Eq) Index**

*This table presents results from predictive regressions of the level of volatility of the GSCI(Eq) excess return index on lagged macroeconomic and financial uncertainty variables. Panel I presents regressions against each variable, whereas Panel II shows results from multivariate estimations against a combination of variables. We report the results for the period from January 1990 to December 2015 as well as for two sub-periods: January 1990–December 2003 (pre-financialization period) and January 2004–December 2015 (post-financialization period). The intercept is not reported to save space. All variables are standardized prior to the estimation using the sample mean and standard deviation. For the single variable estimations we report the slope coefficient (γ) along with the change in the adjusted R^2 (labeled $\Delta\bar{R}^2$) with respect to a simple AR(6) benchmark specification that omits the specific variable. $\Delta\bar{R}^2$ is expressed in percentage terms (multiplied by 100). For the multivariate estimations, we show the F-statistic from testing the null hypothesis that all coefficients are jointly zero along with the increase in the $\bar{R}^2$ relative to the benchmark specification. The superscript ^{a} in column 3 indicates rejection of the null hypothesis of no structural break in December 2003 using a Chow (1960) test and a 10% significance level. Newey-West corrected standard errors with 12 lags are employed for the estimations. *, **, and *** indicate significance at the 10%, 5% and 1% level, respectively.*

	Full period		*Sub–period 1*		*Sub–period 2*	
	1990–2015		*1990–2003*		*2004–2015*	
	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$
I. Single Predictors						
Inflation vol.	0.109**	0.420	0.107	0.455	0.101	0.128
IP vol.	0.013	−0.132	−0.049	−0.190	0.084	−0.044
M2 vol.	0.011	−0.136	0.010	−0.415	−0.035	−0.312
USD index vol.	−0.007	−0.141	−0.045	−0.216	0.069	−0.206
Default yield spread	0.056	0.007	0.044	−0.270	0.149**	0.392
Term spread	−0.022	−0.095	−0.101	0.572	−0.009	−0.403
Default return spread	−0.084**	0.536^a	−0.007	−0.421	−0.133***	1.342
TED spread	0.018	-0.114^a	0.007	−0.421	0.142**	1.093
CFNAI	−0.076	0.290^a	−0.045	−0.232	−0.199**	1.965
VIX	0.056	0.113^a	0.221***	3.099	0.131*	0.511
MOVE1M	0.027	-0.075^a	0.021	−0.383	0.244**	2.466
ADS	−0.097**	0.549^a	−0.084*	0.239	−0.191**	1.866
VRP	−0.005	-0.143^a	0.190**	2.838	−0.065*	−0.021
II. Multiple Predictors						
	F-stat	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$
Combined Variables	6.581***	3.685	2.995**	4.257	7.199***	9.784

Table C.2.3 **Predictive Regressions for the Level of Volatility of the Agricultural Futures Index**

*This table presents results from predictive regressions of the level of volatility of the equally-weighted index of agricultural futures on lagged macroeconomic and financial uncertainty variables. Panel I presents regressions against each variable, whereas Panel II shows results from multivariate estimations against a combination of variables. We report the results for the period from January 1990 to December 2015 as well as for two sub-periods: January 1990–December 2003 (pre-financialization period) and January 2004–December 2015 (post-financialization period). The intercept is not reported to save space. All variables are standardized prior to the estimation using the sample mean and standard deviation. For the single variable estimations we report the slope coefficient (γ) along with the change in the adjusted R^2 (labeled $\Delta\bar{R}^2$) with respect to a simple AR(6) benchmark specification that omits the specific variable. $\Delta\bar{R}^2$ is expressed in percentage terms (multiplied by 100). For the multivariate estimations, we show the F-statistic from testing the null hypothesis that all coefficients are jointly zero along with the increase in the $\bar{R}^2$ relative to the benchmark specification. The superscript ^{a} in column 3 indicates rejection of the null hypothesis of no structural break in December 2003 using a Chow (1960) test and a 10% significance level. Newey-West corrected standard errors with 12 lags are employed for the estimations. *, **, and *** indicate significance at the 10%, 5% and 1% level, respectively.*

	Full period 1990–2015		*Sub–period 1* 1990–2003		*Sub–period 2* 2004–2015	
	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$
I. Single Predictors						
Inflation vol.	0.081*	0.217^a	0.169***	2.125	−0.012	−0.408
IP vol.	0.053	−0.016^a	0.000	−0.579	−0.001	−0.418
M2 vol.	0.082**	0.360^a	0.019	−0.542	0.075	0.014
USD index vol.	0.041	−0.077^a	−0.128	1.043	0.025	−0.388
Default yield spread	0.099*	0.311^a	−0.011	−0.566	0.041	−0.357
Term spread	0.029	−0.116^a	−0.074	−0.036	0.020	−0.385
Default return spread	−0.117*	1.177^a	−0.012	−0.564	−0.183**	2.914
TED spread	0.077	0.323^a	0.020	−0.537	0.159***	1.329
CFNAI	−0.097	0.521^a	0.089*	0.258	−0.232*	2.219
VIX	0.065*	0.134^a	0.087	0.180	0.153**	0.638
MOVE1M	0.106**	0.720^a	0.046	−0.362	0.364***	4.452
ADS	−0.103	0.584^a	0.119**	0.933	−0.270**	3.207
VRP	0.028	−0.126^a	0.076	0.004	0.045	−0.256
II. Multiple Predictors						
	F-stat	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$
Combined Variables	3.566***	2.423	3.427***	6.470	5.701***	8.267

Table C.2.4 **Predictive Regressions for the Level of Volatility of the Livestock Futures Index**

*This table presents results from predictive regressions of the level of volatility of the equally-weighted index of livestock futures on lagged macroeconomic and financial uncertainty variables. Panel I presents regressions against each variable, whereas Panel II shows results from multivariate estimations against a combination of variables. We report the results for the period from January 1990 to December 2015 as well as for two sub-periods: January 1990–December 2003 (pre-financialization period) and January 2004–December 2015 (post-financialization period). The intercept is not reported to save space. All variables are standardized prior to the estimation using the sample mean and standard deviation. For the single variable estimations we report the slope coefficient (γ) along with the change in the adjusted R^2 (labeled $\Delta\bar{R}^2$) with respect to a simple AR(6) benchmark specification that omits the specific variable. $\Delta\bar{R}^2$ is expressed in percentage terms (multiplied by 100). For the multivariate estimations, we show the F-statistic from testing the null hypothesis that all coefficients are jointly zero along with the increase in the $\bar{R}^2$ relative to the benchmark specification. The superscript ^{a} in column 3 indicates rejection of the null hypothesis of no structural break in December 2003 using a Chow (1960) test and a 10% significance level. Newey-West corrected standard errors with 12 lags are employed for the estimations. *, **, and *** indicate significance at the 10%, 5% and 1% level, respectively.*

	Full period 1990–2015		*Sub–period 1* 1990–2003		*Sub–period 2* 2004–2015	
	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$
I. Single Predictors						
Inflation vol.	0.030	−0.175	0.039	−0.337	−0.015	−0.579
IP vol.	0.041	−0.108	0.049	−0.268	0.015	−0.580
M2 vol.	0.018	−0.224	0.088	0.306	−0.098	0.374
USD index vol.	0.091*	0.502	0.126*	1.093	0.083	−0.106
Default yield spread	0.098**	0.556	0.042	−0.334	0.138**	0.840
Term spread	0.017	−0.229	0.040	−0.331	−0.002	−0.596
Default return spread	−0.105***	0.850	−0.047	−0.275	−0.128***	1.039
TED spread	0.056	0.064[a]	−0.045	−0.287	0.132***	1.043
CFNAI	−0.117***	1.100[a]	−0.058	−0.151	−0.201***	2.727
VIX	0.079	0.291	0.084	0.115	0.052	−0.375
MOVE1M	0.073	0.214	0.093*	0.253	0.102	0.123
ADS	−0.104**	0.812[a]	−0.028	−0.409	−0.203***	2.761
VRP	0.014	−0.237	0.055	−0.215	−0.015	−0.574
II. Multiple Predictors						
	F-stat	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$
Combined Variables	1.509	0.772	0.723	−0.819	2.149**	3.872

Table C.2.5 **Predictive Regressions for the Level of Volatility of the Energy Futures**

*This table presents results from predictive regressions of the level of volatility of the equally-weighted index of energy futures on lagged macroeconomic and financial uncertainty variables. Panel I presents regressions against each variable, whereas Panel II shows results from multivariate estimations against a combination of variables. We report the results for the period from January 1990 to December 2015 as well as for two sub-periods: January 1990–December 2003 (pre-financialization period) and January 2004–December 2015 (post-financialization period). The intercept is not reported to save space. All variables are standardized prior to the estimation using the sample mean and standard deviation. For the single variable estimations we report the slope coefficient (γ) along with the change in the adjusted R^2 (labeled $\Delta\bar{R}^2$) with respect to a simple AR(6) benchmark specification that omits the specific variable. $\Delta\bar{R}^2$ is expressed in percentage terms (multiplied by 100). For the multivariate estimations, we show the F-statistic from testing the null hypothesis that all coefficients are jointly zero along with the increase in the $\bar{R}^2$ relative to the benchmark specification. The superscript ^{a} in column 3 indicates rejection of the null hypothesis of no structural break in December 2003 using a Chow (1960) test and a 10% significance level. Newey-West corrected standard errors with 12 lags are employed for the estimations. *, **, and *** indicate significance at the 10%, 5% and 1% level, respectively.*

	Full period		*Sub–period 1*		*Sub–period 2*	
	1990–2015		*1990–2003*		*2004–2015*	
	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$
I. Single Predictors						
Inflation vol.	0.120	0.655^a	0.249*	3.656	0.081	−0.130
IP vol.	0.082	0.254	0.007	−0.487	0.114	0.091
M2 vol.	−0.005	−0.208	0.056	−0.186	−0.042	−0.195
USD index vol.	0.039	−0.087	−0.022	−0.443	0.076	−0.072
Default yield spread	0.107	0.547	0.168	1.460	0.077	−0.039
Term spread	−0.060	0.156	−0.127*	1.141	−0.006	−0.364
Default return spread	−0.141***	1.715^a	−0.071	0.016	−0.171***	2.332
TED spread	0.136**	1.474^a	0.029	−0.403	0.211**	3.055
CFNAI	−0.124**	0.963	−0.125	0.864	−0.101	0.306
VIX	0.174**	2.109	0.270**	5.043	0.114	0.636
MOVE1M	0.114*	0.876^a	−0.014	−0.471	0.196***	2.181
ADS	−0.180***	2.178	−0.173**	2.173	−0.174**	1.511
VRP	0.004	−0.210	0.240**	4.987	−0.125***	1.127
II. Multiple Predictors						
	F-stat	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$
Combination of variables	5.320***	5.022	4.414***	8.842	4.129***	7.990

Table C.2.6 **Predictive Regressions for the Level of Volatility of the Metals Futures Index**

*This table presents results from predictive regressions of the level of volatility of the equally-weighted index of metals futures on lagged macroeconomic and financial uncertainty variables. Panel I presents regressions against each variable, whereas Panel II shows results from multivariate estimations against a combination of variables. We report the results for the period from January 1990 to December 2015 as well as for two sub-periods: January 1990–December 2003 (pre-financialization period) and January 2004–December 2015 (post-financialization period). The intercept is not reported to save space. All variables are standardized prior to the estimation using the sample mean and standard deviation. For the single variable estimations we report the slope coefficient (γ) along with the change in the adjusted R^2 (labeled $\Delta\bar{R}^2$) with respect to a simple AR(6) benchmark specification that omits the specific variable. $\Delta\bar{R}^2$ is expressed in percentage terms (multiplied by 100). For the multivariate estimations, we show the F-statistic from testing the null hypothesis that all coefficients are jointly zero along with the increase in the $\bar{R}^2$ relative to the benchmark specification. The superscript ^{a} in column 3 indicates rejection of the null hypothesis of no structural break in December 2003 using a Chow (1960) test and a 10% significance level. Newey-West corrected standard errors with 12 lags are employed for the estimations. *, **, and *** indicate significance at the 10%, 5% and 1% level, respectively.*

	Full period 1990–2015		*Sub–period 1* 1990–2003		*Sub–period 2* 2004–2015	
	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$
I. Single Predictors						
Inflation vol.	0.102	0.416	−0.051	−0.288	0.115	0.390
IP vol.	−0.012	-0.167^a	−0.189**	2.519	0.047	−0.347
M2 vol.	−0.018	−0.151	−0.075	0.038	−0.021	−0.441
USD index vol.	0.018	−0.155	−0.054	−0.260	0.029	−0.426
Default yield spread	0.024	−0.144	−0.098	0.439	0.109	0.063
Term spread	0.008	−0.171	−0.067	−0.135	0.001	−0.472
Default return spread	−0.129***	1.400^a	−0.104*	0.540	−0.142**	1.413
TED spread	0.045	0.005^a	0.039	−0.410	0.132*	0.820
CFNAI	−0.069	0.209^a	−0.040	−0.393	−0.179*	1.445
VIX	0.046	0.005^a	0.068	−0.091	0.189*	1.536
MOVE1M	0.013	-0.161^a	−0.114*	0.766	0.159**	1.189
ADS	−0.091	0.479^a	−0.050	−0.299	−0.204*	2.129
VRP	−0.028	−0.105	0.111	0.630	0.008	−0.467
II. Multiple Predictors						
	F-stat	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$
Combined Variables	3.675***	1.819	1.303	0.657	2.491**	2.674

Appendix C.3 Variance Prediction

Table C.3.1 **Predictive Regressions for the Variance of the Equally–Weighted Commodity Market Index**

*This table presents results from predictive regressions for the variance of the equally-weighted excess return index on lagged macroeconomic and financial uncertainty variables. Panel I presents regressions against each variable, whereas Panel II shows results from multivariate estimations against a combination of variables. We report the results for the period from January 1990 to December 2015 as well as for two sub-periods: January 1990–December 2003 (pre-financialization period) and January 2004–December 2015 (post-financialization period). The intercept is not reported to save space. All variables are standardized prior to the estimation using the sample mean and standard deviation. For the single variable estimations we report the slope coefficient (γ) along with the change in the adjusted R^2 (labeled $\Delta\bar{R}^2$) with respect to a simple AR(6) benchmark specification that omits the specific variable. $\Delta\bar{R}^2$ is expressed in percentage terms (multiplied by 100). For the multivariate estimations, we show the F-statistic from testing the null hypothesis that all coefficients are jointly zero along with the increase in the $\bar{R}^2$ relative to the benchmark specification. Newey-West corrected standard errors with 12 lags are employed for the estimations. *, **, and *** indicate significance at the 10%, 5% and 1% level, respectively.*

	Full period 1990–2015		*Sub–period 1* 1990–2003		*Sub–period 2* 2004–2015	
	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$
I. Single Predictors						
Inflation vol.	0.025	−0.119	0.191**	2.448	−0.020	−0.358
IP vol.	−0.038	−0.081	0.012	−0.570	−0.055	−0.278
M2 vol.	−0.006	−0.144	0.031	−0.484	−0.034	−0.295
USD index vol.	−0.086	0.174	0.002	−0.583	−0.207	0.671
Default yield spread	−0.023	−0.133	0.089	0.156	−0.058	−0.325
Term spread	−0.001	−0.147	−0.087	0.168	0.008	−0.372
Default return spread	−0.229**	4.733	0.043	−0.396	−0.286**	7.257
TED spread	0.098**	0.504	0.070	−0.111	0.209**	1.723
CFNAI	−0.148	1.103	−0.047	−0.362	−0.429*	5.280
VIX	0.043	−0.027	0.164**	1.737	0.184**	0.644
MOVE1M	0.060*	0.120	0.126*	0.959	0.284***	2.277
ADS	−0.189	1.827	−0.043	−0.396	−0.533*	8.235
VRP	0.040	−0.033	0.166**	2.034	0.103	0.178
II. Multiple Predictors						
	F-stat	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$
Combined Variables	11.285***	6.426	2.250*	3.482	12.464***	14.967

Table C.3.2 **Predictive Regressions for the Variance of the GSCI(Eq) Index**

*This table presents results from predictive regressions for the variance of the GSCI(Eq) excess return index on lagged macroeconomic and financial uncertainty variables. Panel I presents regressions against each variable, whereas Panel II shows results from multivariate estimations against a combination of variables. We report the results for the period from January 1990 to December 2015 as well as for two sub-periods: January 1990–December 2003 (pre-financialization period) and January 2004–December 2015 (post-financialization period). The intercept is not reported to save space. All variables are standardized prior to the estimation using the sample mean and standard deviation. For the single variable estimations we report the slope coefficient (γ) along with the change in the adjusted R^2 (labeled $\Delta\bar{R}^2$) with respect to a simple AR(6) benchmark specification that omits the specific variable. $\Delta\bar{R}^2$ is expressed in percentage terms (multiplied by 100). For the multivariate estimations, we show the F-statistic from testing the null hypothesis that all coefficients are jointly zero along with the increase in the $\bar{R}^2$ relative to the benchmark specification. Newey-West corrected standard errors with 12 lags are employed for the estimations. *, **, and *** indicate significance at the 10%, 5% and 1% level, respectively.*

	Full period 1990–2015		*Sub–period 1 1990–2003*		*Sub–period 2 2004–2015*	
	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$
I. Single Predictors						
Inflation vol.	0.110**	0.346	0.200*	2.654	0.056	−0.250
IP vol.	0.033	−0.106	0.011	−0.508	0.078	−0.205
M2 vol.	−0.003	−0.156	0.005	−0.516	−0.032	−0.316
USD index vol.	−0.015	−0.147	0.009	−0.512	−0.078	−0.246
Default yield spread	0.075	−0.017	0.140	0.920	0.122	−0.155
Term spread	−0.006	−0.153	−0.110	0.687	0.014	−0.374
Default return spread	−0.232**	4.915	−0.043	−0.337	−0.284**	7.165
TED spread	0.140*	1.208	0.123	0.843	0.260*	3.135
CFNAI	−0.187	1.757	−0.111	0.512	−0.464*	6.766
VIX	0.090*	0.376	0.200**	3.106	0.286**	2.135
MOVE1M	0.071	0.240	0.032	−0.415	0.317***	3.445
ADS	−0.240	2.865	−0.163	1.692	−0.532**	9.261
VRP	−0.021	−0.124	0.251**	5.434	−0.021	−0.368
II. Multiple predictors						
	F-stat	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$
Combined Variables	13.486***	8.059	2.834**	4.467	14.600***	17.430

Table C.3.3 **Predictive Regressions for the Variance of the Agricultural Futures Index**

*This table presents results from predictive regressions for the variance of the equally-weighted portfolio of agricultural futures index on lagged macroeconomic and financial uncertainty variables. Panel I presents regressions against each variable, whereas Panel II shows results from multivariate estimations against a combination of variables. We report the results for the period from January 1990 to December 2015 as well as for two sub-periods: January 1990–December 2003 (pre-financialization period) and January 2004–December 2015 (post-financialization period). The intercept is not reported to save space. All variables are standardized prior to the estimation using the sample mean and standard deviation. For the single variable estimations we report the slope coefficient (γ) along with the change in the adjusted R^2 (labeled $\Delta\bar{R}^2$) with respect to a simple AR(6) benchmark specification that omits the specific variable. $\Delta\bar{R}^2$ is expressed in percentage terms (multiplied by 100). For the multivariate estimations, we show the F-statistic from testing the null hypothesis that all coefficients are jointly zero along with the increase in the $\bar{R}^2$ relative to the benchmark specification. Newey-West corrected standard errors with 12 lags are employed for the estimations. *, **, and *** indicate significance at the 10%, 5% and 1% level, respectively.*

	Full period 1990–2015		*Sub–period 1 1990–2003*		*Sub–period 2 2004–2015*	
	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$
I. Single Predictors						
Inflation vol.	0.037	−0.113	0.163**	1.913	−0.040	−0.346
IP vol.	0.017	−0.180	0.016	−0.568	−0.033	−0.402
M2 vol.	0.056	0.068	0.005	−0.591	0.048	−0.272
USD index vol.	0.023	−0.168	−0.130*	1.065	0.011	−0.447
Default yield spread	0.066	−0.017	−0.031	−0.495	0.022	−0.438
Term spread	0.020	−0.159	−0.068	−0.139	0.017	−0.429
Default return spread	−0.182*	3.077	−0.012	−0.580	−0.241**	5.294
TED spread	0.093	0.477	0.030	−0.504	0.182**	1.504
CFNAI	−0.150	1.299	0.092*	0.279	−0.389	5.499
VIX	0.045	−0.048	0.042	−0.411	0.143*	0.350
MOVE1M	0.101**	0.571	0.054	−0.299	0.363***	3.976
ADS	−0.157	1.404	0.126**	1.087	−0.432*	6.765
VRP	0.042	−0.058	0.042	−0.420	0.089	0.061
II. Multiple Predictors						
	F-stat	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$
Combined Variables	5.998***	4.525	3.145***	5.918	8.556***	13.141

Table C.3.4 **Predictive Regressions for the Variance of the Livestock Futures Index**

*This table presents results from predictive regressions for the variance of the equally-weighted portfolio of livestock futures index on lagged macroeconomic and financial uncertainty variables. Panel I presents regressions against each variable, whereas Panel II shows results from multivariate estimations against a combination of variables. We report the results for the period from January 1990 to December 2015 as well as for two sub-periods: January 1990–December 2003 (pre-financialization period) and January 2004–December 2015 (post-financialization period). The intercept is not reported to save space. All variables are standardized prior to the estimation using the sample mean and standard deviation. For the single variable estimations we report the slope coefficient (γ) along with the change in the adjusted R^2 (labeled $\Delta\bar{R}^2$) with respect to a simple AR(6) benchmark specification that omits the specific variable. $\Delta\bar{R}^2$ is expressed in percentage terms (multiplied by 100). For the multivariate estimations, we show the F-statistic from testing the null hypothesis that all coefficients are jointly zero along with the increase in the $\bar{R}^2$ relative to the benchmark specification. Newey-West corrected standard errors with 12 lags are employed for the estimations. *, **, and *** indicate significance at the 10%, 5% and 1% level, respectively.*

	Full period		*Sub–period 1*		*Sub–period 2*	
	1990–2015		*1990–2003*		*2004–2015*	
	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$
I. Single Predictors						
Inflation vol.	0.026	−0.207	0.041	−0.313	−0.051	−0.431
IP vol.	0.036	−0.158	0.061	−0.144	−0.045	−0.480
M2 vol.	0.010	−0.262	0.078	0.134	−0.122	0.863
USD index vol.	0.097**	0.608	0.113	0.793	0.102	0.212
Default yield spread	0.103**	0.637	0.056	−0.208	0.132*	0.630
Term spread	0.012	−0.258	0.034	−0.363	−0.006	−0.614
Default return spread	−0.097***	0.666	−0.014	−0.462	−0.113***	0.637
TED spread	0.065	0.153	−0.025	−0.418	0.127**	0.884
CFNAI	−0.108**	0.875	−0.044	−0.282	−0.178**	1.920
VIX	0.081	0.308	0.087	0.155	0.037	−0.505
MOVE1M	0.080	0.303	0.100*	0.417	0.079	−0.179
ADS	−0.095**	0.621	−0.017	−0.451	−0.181**	1.982
VRP	0.024	−0.215	0.061	−0.146	−0.026	−0.550
II. Multiple Predictors						
	F-stat	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$
Combined Variables	1.340	0.548	0.723	−0.971	2.013*	3.559

Table C.3.5 **Predictive Regressions for the Variance of the Energy Commodity Futures Index**

*This table presents results from predictive regressions for the variance of the equally-weighted portfolio of energy futures index on lagged macroeconomic and financial uncertainty variables. Panel I presents regressions against each variable, whereas Panel II shows results from multivariate estimations against a combination of variables. We report the results for the period from January 1990 to December 2015 as well as for two sub-periods: January 1990–December 2003 (pre-financialization period) and January 2004–December 2015 (post-financialization period). The intercept is not reported to save space. All variables are standardized prior to the estimation using the sample mean and standard deviation. For the single variable estimations we report the slope coefficient (γ) along with the change in the adjusted R^2 (labeled $\Delta\bar{R}^2$) with respect to a simple AR(6) benchmark specification that omits the specific variable. $\Delta\bar{R}^2$ is expressed in percentage terms (multiplied by 100). For the multivariate estimations, we show the F-statistic from testing the null hypothesis that all coefficients are jointly zero along with the increase in the $\bar{R}^2$ relative to the benchmark specification. Newey-West corrected standard errors with 12 lags are employed for the estimations. *, **, and *** indicate significance at the 10%, 5% and 1% level, respectively.*

	Full period 1990–2015		*Sub–period 1 1990–2003*		*Sub–period 2 2004–2015*	
	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$
I. Single Predictors						
Inflation vol.	0.174*	1.598	0.288*	5.514	0.107	−0.006
IP vol.	0.146*	1.143	0.028	−0.524	0.217*	0.870
M2 vol.	0.009	−0.258	0.067	−0.165	−0.037	−0.271
USD index vol.	0.104	0.516	−0.004	−0.600	0.099	−0.025
Default yield spread	0.212*	2.341	0.277	4.530	0.142	0.457
Term spread	−0.049	−0.022	−0.117	0.789	0.014	−0.381
Default return spread	−0.150***	1.930	−0.054	−0.308	−0.196***	3.002
TED spread	0.213*	3.782	0.085	0.134	0.291*	5.744
CFNAI	−0.203**	2.548	−0.208*	2.918	−0.123	0.420
VIX	0.252**	4.695	0.269**	5.883	0.200	2.330
MOVE1M	0.165*	1.991	0.012	−0.587	0.251**	3.531
ADS	−0.290***	5.227	−0.271*	5.449	−0.256**	2.872
VRP	−0.011	−0.254	0.283*	7.369	−0.200***	3.160
II. Multiple Predictors						
	F-stat	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$
Combined Variables	8.075***	10.165	4.869***	12.301	5.356***	7.769

Table C.3.6 **Predictive Regressions for the Variance of the Index of Metal Futures**

*This table presents results from predictive regressions for the variance of the equally-weighted portfolio of metals futures index on lagged macroeconomic and financial uncertainty variables. Panel I presents regressions against each variable, whereas Panel II shows results from multivariate estimations against a combination of variables. We report the results for the period from January 1990 to December 2015 as well as for two sub-periods: January 1990–December 2003 (pre-financialization period) and January 2004–December 2015 (post-financialization period). The intercept is not reported to save space. All variables are standardized prior to the estimation using the sample mean and standard deviation. For the single variable estimations we report the slope coefficient (γ) along with the change in the adjusted R^2 (labeled $\Delta\bar{R}^2$) with respect to a simple AR(6) benchmark specification that omits the specific variable. $\Delta\bar{R}^2$ is expressed in percentage terms (multiplied by 100). For the multivariate estimations, we show the F-statistic from testing the null hypothesis that all coefficients are jointly zero along with the increase in the $\bar{R}^2$ relative to the benchmark specification. Newey-West corrected standard errors with 12 lags are employed for the estimations. *, **, and *** indicate significance at the 10%, 5% and 1% level, respectively.*

	Full period 1990–2015		*Sub–period 1 1990–2003*		*Sub–period 2 2004–2015*	
	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$
I. Single Predictors						
Inflation vol.	0.107*	0.456	−0.037	−0.443	0.092	0.082
IP vol.	−0.006	−0.177	−0.199**	2.867	0.036	−0.385
M2 vol.	−0.010	−0.172	−0.089	0.230	−0.024	−0.410
USD index vol.	−0.049	−0.042	−0.086	0.168	−0.098	−0.037
Default yield spread	0.031	−0.135	−0.108	0.635	0.097	−0.107
Term spread	0.008	−0.173	−0.074	−0.068	0.005	−0.452
Default return spread	−0.154**	2.000	−0.117	0.797	−0.166**	2.070
TED spread	0.047	0.001	0.042	−0.421	0.126*	0.595
CFNAI	−0.084	0.330	−0.016	−0.553	−0.220*	2.055
VIX	0.040	−0.053	0.071	−0.090	0.169*	0.981
MOVE1M	0.005	−0.177	−0.121*	0.879	0.127**	0.552
ADS	−0.124	0.912	−0.036	−0.451	−0.281**	3.695
VRP	0.006	−0.176	0.120	0.785	0.065	−0.124
II. Multiple Predictors						
	F-stat	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$
Combined Variables	4.764***	2.564	1.367	0.837	2.517**	2.614

Appendix D. Additional Sub–Samples

Table D.1 **Predictive Regressions for the Volatility of the Equally–Weighted Commodity Market Index**

*This table presents results from predictive regressions for the log volatility of the equally-weighted excess return index on lagged macroeconomic and financial uncertainty variables. Panel I presents regressions against each variable, whereas Panel II shows results from multivariate estimations against a combination of variables. We report the results for various sub–periods of the January 1970–December 2015 sample. The intercept is not reported to save space. All variables are standardized prior to the estimation using the sample mean and standard deviation. For the single variable estimations we report the slope coefficient (γ) along with the change in the adjusted R^2 (labeled $\Delta\bar{R}^2$) with respect to a simple AR(6) benchmark specification that omits the specific variable. $\Delta\bar{R}^2$ is expressed in percentage terms (multiplied by 100). For the multivariate estimations, we show the F-statistic from testing the null hypothesis that all coefficients are jointly zero along with the increase in the $\bar{R}^2$ relative to the benchmark specification. Newey-West corrected standard errors with 12 lags are employed for the estimations. *, **, and *** indicate significance at the 10%, 5% and 1% level, respectively.*

	1970-1989		*1990-2015*		*1990-2003*		*2004–2009*		*2004–2015*	
	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$
I. Single Predictors										
Inflation vol.	0.267***	3.290	0.099**	0.370	0.108	0.487	−0.017	−0.911	0.071	−0.085
IP vol.	0.049	−0.030	0.013	−0.144	−0.024	−0.474	−0.082	−0.482	0.025	−0.341
M2 vol.	0.028	−0.175	0.025	−0.105	0.016	−0.505	0.011	−0.924	0.005	−0.369
USD index vol.	–	–	0.047	0.019	0.008	−0.527	−0.013	−0.925	0.056	−0.236
Default yield spread	−0.023	−0.204	0.050	−0.024	0.045	−0.344	0.213	−0.213	0.057	−0.237
Term spread	−0.093**	0.540	−0.006	−0.155	−0.082	0.122	0.089	−0.472	0.001	−0.372
Default return spread	−0.102*	0.764	−0.082**	0.524	0.032	−0.424	−0.243***	3.995	−0.137***	1.448
TED spread	–	–	0.060	0.181	0.028	−0.453	0.240***	2.174	0.155***	1.368
CFNAI	0.035	−0.137	−0.078	0.328	−0.032	−0.430	−0.459**	3.567	−0.173*	1.350
VIX	–	–	0.053	0.078	0.202***	2.551	0.259***	1.449	0.132**	0.549
MOVE1M	–	–	0.065	0.233	0.108*	0.617	0.232***	1.757	0.286***	2.961
ADS	0.001	−0.256	−0.095**	0.533	−0.036	−0.402	−0.731***	7.670	−0.190**	1.786
VRP	–	–	−0.005	−0.156	0.150**	1.593	0.009	−0.925	−0.017	−0.346
II. Multiple Predictors										
	F-stat	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$
Combined Variables	–	–	2.671**	1.279	1.928*	2.390	3.385***	8.795	3.995***	4.958

Table D.2 **Predictive Regressions for the Volatility of the GSCI(Eq) Index**

*This table presents results from predictive regressions for the log volatility of the GSCI(Eq) excess return index on lagged macroeconomic and financial uncertainty variables. Panel I presents regressions against each variable, whereas Panel II shows results from multivariate estimations against a combination of variables. We report the results for various sub–periods of the January 1970–December 2015 sample. The intercept is not reported to save space. All variables are standardized prior to the estimation using the sample mean and standard deviation. For the single variable estimations we report the slope coefficient (γ) along with the change in the adjusted R^2 (labeled $\Delta\bar{R}^2$) with respect to a simple AR(6) benchmark specification that omits the specific variable. $\Delta\bar{R}^2$ is expressed in percentage terms (multiplied by 100). For the multivariate estimations, we show the F-statistic from testing the null hypothesis that all coefficients are jointly zero along with the increase in the $\bar{R}^2$ relative to the benchmark specification. Newey-West corrected standard errors with 12 lags are employed for the estimations. *, **, and *** indicate significance at the 10%, 5% and 1% level, respectively.*

	1970-1989		*1990-2015*		*1990-2003*		*2004–2009*		*2004–2015*	
	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$	γ	$\Delta\bar{R}^2$
I. Single Predictors										
Inflation vol.	0.143*	0.811	0.109**	0.420	0.107	0.455	0.062	−0.805	0.101	0.128
IP vol.	0.025	−0.146	0.013	−0.132	−0.049	−0.190	0.028	−1.038	0.084	−0.044
M2 vol.	−0.010	−0.195	0.011	−0.136	0.010	−0.415	−0.014	−1.078	−0.035	−0.312
USD index vol.	–	–	−0.007	−0.141	−0.045	−0.216	0.021	−1.067	0.069	−0.206
Default yield spread	−0.058	0.122	0.056	0.007	0.044	−0.270	0.432***	4.037	0.149**	0.392
Term spread	−0.088**	0.503	−0.022	−0.095	−0.101	0.572	0.055	−0.883	−0.009	−0.403
Default return spread	−0.062	0.183	−0.084**	0.536	−0.007	−0.421	−0.219***	3.125	−0.133***	1.342
TED spread	–	–	0.018	−0.114	0.007	−0.421	0.242**	2.330	0.142**	1.093
CFNAI	0.028	−0.136	−0.076	0.290	−0.045	−0.232	−0.566***	7.816	−0.199**	1.965
VIX	–	–	0.056	0.113	0.221***	3.099	0.260***	1.845	0.131*	0.511
MOVE1M	–	–	0.027	−0.075	0.021	−0.383	0.194**	1.403	0.244**	2.466
ADS	0.001	−0.206	−0.097**	0.549	−0.084*	0.239	−0.656***	9.156	−0.191**	1.866
VRP	–	–	−0.005	−0.143	0.190**	2.838	−0.048	−0.878	−0.065*	−0.021
II. Multiple Predictors										
	F-stat	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$	*F-stat*	$\Delta\bar{R}^2$
Combined Variables	–	–	2.671**	1.175	2.314**	2.665	2.902***	8.544	3.439***	4.549