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WHAT DOES FUTURES MARKET INTEREST TELL US ABOUT THE MACROECONOMY
AND ASSET PRICES?

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ABSTRACT

Economists have traditionally viewed futures prices as fully informative about future economic activity and asset prices. We argue that open interest may be more informative than futures prices in the presence of hedging and downward-sloping demand in futures markets. We find that movements in open interest are highly procyclical, correlated with both macroeconomic activity and movements in asset prices. In the commodity market, movements in open interest predict commodity returns, bond returns, and movements in the short rate even after controlling for other known predictors. To a lesser degree, we find similar phenomena in currency, bond, and stock markets.

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1. Introduction

Economists have traditionally viewed futures prices as fully informative about future economic activity and asset prices and have remained silent on the role of open interest, or the amount of futures contracts outstanding (Samuelson, 1965; Grossman, 1977). The theory of backwardation implies that risk premium depends only on the net supply-demand imbalance in the futures market, not on the gross amount of futures contracts outstanding (Keynes, 1923; Hicks, 1939). The range of empirical work that uses futures market data reflects these traditional theories. Macroeconomists use commodity futures and spot prices to forecast inflation. International economists use the forward discount, or the ratio of futures to spot price in the currency market, to forecast movements in exchange rates. Financial economists use the yield spread to forecast bond and stock returns.

In this paper, we show that open interest contains information about future economic activity and asset prices that is not fully revealed by futures prices or net supply-demand imbalances in futures markets. Our point of departure from these traditional theories is the observation that hedging demand, either by producers or consumers of commodities, tends to be pro-cyclical. For example, oil producers that anticipate higher demand may short oil futures, while utilities that anticipate higher demand from manufacturing firms may long oil futures. Importers that anticipate higher U.S. demand may short currency futures, while exporters that anticipate higher U.S. demand may long currency futures. Financial firms and insurance companies that anticipate expansion of their balance sheets may enter bond and stock market futures to hedge interest-rate and equity risk. In all of these examples, anticipation of higher economic activity leads to higher hedging demand, which drives up open interest.

In a simple model, we show that open interest is a more a reliable signal of higher economic activity, and consequently future movements in asset prices, than futures prices. The key assumption is downward-sloping demand in the futures market, arising from limits to arbitrage. If there is excess hedging demand from producers that want to short futures,

the futures price will fall due to limited arbitrage. Conversely, if there is excess hedging demand from consumers that want to long futures, the futures price will rise due to limited arbitrage. Because the futures price can either fall or rise in response to anticipation of higher economic activity, futures prices are a less reliable signal of future economic activity and asset prices than open interest.

We document a number of new facts that are consistent with this view of futures markets. First, movements in open interest are highly correlated with movements in both futures and spot prices in commodity, currency, bond, and stock markets. In each of these markets, movements in open interest are positively correlated with the Chicago Fed National Activity Index, which is a weighted average of 85 monthly indicators of U.S. economic activity. Periods of high U.S. economic activity tend to coincide with high commodity returns, appreciation of foreign currencies relative to the U.S. dollar, low bond returns, and high stock returns. The fact that movements in open interest are pro-cyclical may be surprising since open interest does not necessarily signal the direction of hedging demand.

Second, movements in open interest predict returns. Our main evidence is from the commodity market, which is a relatively ideal market for testing our hypothesis because hedging and downward-sloping demand in futures markets tend to be more important. Moreover, our sample for the commodity market starts in 1966, which is much earlier than 1984 for the other markets. We find that a standard deviation increase in commodity market interest increases expected commodity returns by 0.72% per month, which is both economically large and statistically significant. Commodity market interest remains a powerful predictor even after controlling for a number of other predictors including the short rate, the yield spread, the Chicago Fed National Activity Index, commodity basis (i.e., the ratio of futures to spot price in the commodity market), commodity market imbalance (i.e., excess hedging demand from hedgers), and past commodity returns. Interestingly, a high yield spread or a high Chicago Fed National Activity Index predicts low commodity returns, implying that expected commodity returns are pro-cyclical.

We find qualitatively similar, but statistically weaker, evidence for predictability of returns in currency, bond, and stock markets. We find that rising currency market interest, which signals higher U.S. economic activity and inflationary pressure, predicts appreciation of a portfolio of foreign currencies relative to the U.S. dollar. Notably, currency market interest has more forecasting power than the forward discount, which is a leading predictor of exchange rates in international finance. Similarly, rising bond market interest, which signals higher economic activity and inflationary pressure, predicts low bond returns. Finally, rising stock market interest predicts high stock returns, although the statistical evidence is the weakest for this market.

Third, we find that rising commodity market interest predicts low bond returns and a rising short rate. A standard deviation increase in commodity market interest decreases expected bond returns by 0.32% per month, which is highly statistically significant. This evidence is consistent with our hypothesis that commodity market interest reflects hedging in response to news about higher economic activity. Anticipation of higher economic activity and inflationary pressure, which is bad news for the bond market, predicts low bond returns and rising inflation expectations.

Our view of the commodity market is most closely related to that of Chen, Rogoff, and Rossi (2010), who find that the exchange rates of commodity-producing countries forecast movements in commodity prices better than past commodity prices. Their explanation is that currencies are financial instruments whose prices are inherently forward-looking, while commodities are like physical capital whose prices are subject to temporary supply-demand imbalances. Consequently, exchange rates are a more reliable signal of news about the demand for commodities than commodity prices. We find a similar phenomena in the commodity futures market. Open interest is a more reliable signal of news about the demand for commodities because temporary supply-demand imbalances in the futures market can contaminate the informational content of futures prices.

The remainder of the paper proceeds as follows. Section 2 presents a model in which cycli-

cal variation in open interest predicts returns. Section 3 describes the futures market data and the construction of the key variables for empirical analysis. Section 4 presents evidence that movements in open interest are highly pro-cyclical, correlated with both macroeconomic activity and movements in asset prices. Section 5 presents evidence that movements in open interest predict returns even after controlling for other known predictors. Section 6 concludes.

2. A Model in which Open Interest Predicts Returns

We develop a simple model of the futures market that explains why open interest can be a better predictor of returns than futures prices or the direction of hedging demand. For expositional purposes, the underlying asset in our model is a commodity. The economics of the model would be the same if the underlying asset were a currency, a bond, or a stock as long as hedging demand rises with economic activity.

Our model is based on two plausible assumptions. First, information diffuses only gradually in financial markets, which causes asset prices to initially under-react to news. This assumption has been used successfully in a variety of contexts including macroeconomics (Mankiw and Reis, 2002), international finance (Gourinchas and Tornell, 2004), and financial economics (Hong and Stein, 1999). Hong and Stein (2007) survey a large literature that documents evidence for the under-reaction of asset prices to news. Second, supply shocks move asset prices due to financial market frictions that limit arbitrage (De Long et al., 1990). There is now compelling evidence for downward-sloping demand in a variety of financial markets, even highly liquid ones such as bond and stock markets (see Shleifer, 1986, for early evidence on stocks).

2.1. Economic Environment

There are three periods indexed as $t = 0, 1, 2$. The riskless interest rate is constant and normalized to zero. There is a spot market for a commodity in period 2, and there is a futures contract on the same commodity that is traded in periods 0 and 1. Let S_2 denote the spot price for the commodity in period 2, which we assume is exogenous and stochastic. In period 1, the economy can be in one of two states, which we call “high” and “low”. In the high state, the spot price in period 2 is distributed as $S_2 \sim \mathbf{N}(S^H, \sigma^2)$. In the low state, the spot price in period 2 is distributed as $S_2 \sim \mathbf{N}(S^L, \sigma^2)$. There is relatively high demand for the commodity in the high state so that $S^H > S^L$. In period 0, the probability that the economy will be in the high state in period 1 is $\pi = 0.5$. Note that

$$\mathbf{E}_0[S_2] = \pi S^H + (1 - \pi) S^L = \bar{S}, \quad (1)$$

$$\text{Var}_0(S_2) = \sigma^2 + \pi S^{H2} + (1 - \pi) S^{L2} - \bar{S}^2. \quad (2)$$

In period 1, there are producers that commit to production of the commodity for delivery in period 2. Alternatively, there are producers that commit to use the commodity as an input for production in period 2. The producers know the state of the economy in period 1 (i.e., whether it is high or low), but they still face uncertainty about the spot price (captured by σ^2). Let Y^H denote the quantity of the commodity that the producers commit to selling (or buying) in the high state. Let Y^L denote the quantity of the commodity that the producers commit to selling (or buying) in the low state. In each state, $Y > 0$ if the commodity is an output, and $Y < 0$ if the commodity is an input for the producers. We make a natural assumption that there is relatively more demand for the commodity in the high state so that $|Y^H| > |Y^L|$. We normalize $Y^L = 0$ to simplify notation.

The producers are infinitely risk averse and would like to hedge all uncertainty about the spot price. They can do so by entering the futures market in period 1. Let F_t denote the futures price in period t on a contract that matures in period 2. The producers choose the

optimal futures position D_1^P to minimize the variance of their total profit from production and hedging activity:

$$\min_{D_1^P} \text{Var}_1 (S_2 Y + (S_2 - F_1) D_1^P). \quad (3)$$

The producers can perfectly hedge all uncertainty by choosing $D_1^P = -Y$. Note that the producers short futures if the commodity is an output, and they long futures if the commodity is an input. The producers are active in the futures market only in the high state since $D_1^P = -Y^L = 0$ in the low state. Otherwise, the producers do not participate in the futures market.

In addition to the producers, there are two other groups of investors in the futures market. The first group consists of “informed” one-period investors, who have mass $\lambda \in (0, 1)$ in the population of investors. They have the usual mean-variance objective function with risk-aversion parameter γ . These investors are informed in the sense that they are fully aware of the probability distribution for S_2 at each point in time. In particular, they know the state of the economy in period 1. The informed investors choose the optimal futures position D_t^I in periods $t = 0, 1$ to maximize their objective function. The optimal futures position is given by the usual mean-variance demand function:

$$D_t^I = \frac{\mathbf{E}_t[F_{t+1} - F_t]}{\gamma \text{Var}_t(F_{t+1} - F_t)}. \quad (4)$$

The second group consists of “uninformed” one-period investors, who have mass $1 - \lambda$ in the population of investors. They also have a mean-variance objective function with risk-aversion parameter γ . The key modeling assumption is that these uninformed investors under-react to news about the state of the economy. Specifically, they are unaware of the state of the economy in period 1, so their subjective distribution of S_2 in period 1 is the same as their prior about S_2 in period 0. The uninformed investors choose the optimal futures position D_t^U in periods $t = 0, 1$ to maximize their objective function. The optimal futures

position is given by the mean-variance demand function:

$$D_t^U = \frac{\bar{S} - F_t}{\gamma \text{Var}_0(S_2)}. \quad (5)$$

2.2. Equilibrium Futures Prices

We now solve for the equilibrium futures price in period 1. The market-clearing condition in period 1 is

$$\lambda D_1^I + (1 - \lambda) D_1^U + D_1^P = 0. \quad (6)$$

Substituting the demand functions, the futures price in the high state is

$$F_1^H = \omega_1 S^H + (1 - \omega_1) \bar{S} - \frac{\omega_1 \gamma \sigma^2 Y^H}{\lambda}, \quad (7)$$

where

$$\omega_1 = \frac{\lambda \text{Var}_0(S_2)}{\lambda \text{Var}_0(S_2) + (1 - \lambda) \sigma^2}. \quad (8)$$

The futures price in the low state is

$$F_1^L = \omega_1 S^L + (1 - \omega_1) \bar{S}. \quad (9)$$

We now work backwards to solve for the equilibrium futures price in period 0. The market-clearing condition in period 0 is

$$\lambda D_0^I + (1 - \lambda) D_0^U = 0. \quad (10)$$

Substituting the demand functions, the futures price is

$$F_0 = \omega_0 \left(\bar{S} - \frac{\pi \omega_1 \gamma \sigma^2 Y^H}{\lambda} \right) + (1 - \omega_0) \bar{S}, \quad (11)$$

where

$$\omega_0 = \frac{\lambda \text{Var}_0(S_2)}{\lambda \text{Var}_0(S_2) + (1 - \lambda) \text{Var}_0(F_1)}. \quad (12)$$

We now make two key observations about the model. The first observation is that the futures price in the high state is lower than that in the low state if hedging demand is sufficiently high. More formally, $F_1^H < F_1^L$ if

$$Y^H > \frac{\lambda(S^H - S^L)}{\gamma \sigma^2}. \quad (13)$$

The intuition for this result is straightforward. In the high state, good news about the economy leads to a high futures price in the absence of hedging by the producers. In the presence of hedging demand, however, the producers put a downward pressure on the futures price when $Y^H > 0$. Because investors have limited risk-bearing capacity (captured by $\gamma \sigma^2$), hedging demand can more than offset the impact of good news, leading to a low futures price.

The second observation is that open interest in the high state is always higher than that in the low state because of hedging by the producers. In the high state, the informed investors are the only ones to be long futures if $Y^H > 0$, while both the informed investors and the producers are long futures if $Y^H < 0$. Therefore, open interest in the high state is

$$O_1^H = \begin{cases} \lambda D_1^I = \frac{\lambda(1-\omega_1)(S^H - \bar{S})}{\gamma \sigma^2} + \omega_1 Y^H & \text{if } Y^H > 0 \\ \lambda D_1^I + D_1^P = \frac{\lambda(1-\omega_1)(S^H - \bar{S})}{\gamma \sigma^2} - (1 - \omega_1) Y^H & \text{if } Y^H < 0 \end{cases}. \quad (14)$$

In the low state, the uninformed investors are the only ones to be long futures. Therefore,

open interest in the low state is

$$O_1^L = (1 - \lambda)D_1^U = \frac{\lambda(1 - \omega_1)(\bar{S} - S^L)}{\gamma\sigma^2}. \quad (15)$$

Note that $O_1^H > O_1^L$ since $S^H - \bar{S} = \bar{S} - S^L$ (implied by $\pi = 0.5$). Importantly, this is true regardless of the direction of hedging demand (i.e., whether $Y^H > 0$ or $Y^H < 0$).

Define the return on futures between periods 0 and 1 as $R_1 = F_1 - F_0$. Similarly, define the return on futures between periods 1 and 2 as $R_2 = S_2 - F_1$. The expected return on futures between periods 1 and 2 is

$$\mathbf{E}_1[R_2] = \begin{cases} (1 - \omega_1)(S^H - \bar{S}) + \frac{\omega_1\gamma\sigma^2 Y^H}{\lambda} & \text{in the high state} \\ -(1 - \omega_1)(\bar{S} - S^L) & \text{in the low state} \end{cases}. \quad (16)$$

Note that the expected return in the high state is higher than that in the low state if

$$Y^H > \frac{-\lambda(1 - \omega_1)(S^H - S^L)}{\omega_1\gamma\sigma^2}. \quad (17)$$

Note that this condition is trivially satisfied when $Y^H > 0$ (i.e., the commodity is an output for the producers). In what follows, we assume that this condition is satisfied, which is the empirically relevant case. We are now ready to state our main result.

Proposition 1. *If $Y^H < \lambda(S^H - S^L)/(\gamma\sigma^2)$, high return R_1 signals high expected return $\mathbf{E}_1[R_2]$. Otherwise, high return signals low expected return. High open interest O_1 always signals high expected return $\mathbf{E}_1[R_2]$, regardless of the direction of hedging demand (i.e., whether $Y^H > 0$ or $Y^H < 0$).*

When hedging demand is sufficiently low or negative, a high return signals good news about the economy. Therefore, we would observe positive serial correlation in returns due to under-reaction by the uninformed investors. When hedging demand is sufficiently high, however, a high return does not signal good news about the economy. Consequently, past

returns are not a reliable predictor of future returns because the sign of the serial correlation depends on the importance of hedging demand. In contrast, rising open interest unambiguously signals good news about the economy and therefore high expected returns. Notably, the direction of hedging demand does not matter, that is, whether producers are long or short futures to hedge the higher economic activity.

The mechanism that generates predictability of returns in our model is distinct from that in the theory of backwardation. In the theory of backwardation, predictability arises from variation in the risk premium that speculators earn due to supply-demand imbalances in the futures market. Hence, this theory implies that the direction of hedging demand predicts returns. In our model, predictability arises from the under-reaction of asset prices to news. Our model implies that movements in open interest predict returns, better than the direction of hedging demand.

3. Futures Market Data and Variable Definitions

3.1. Futures Market Data

Our data on futures and spot prices in commodity, currency, bond, and stock markets are from the Commodity Research Bureau. This database conveniently contains a comprehensive record of daily futures and spot prices for individual futures contracts since December 1964.¹

We also use data on open interest, or the number of futures contracts outstanding, as well as the long and short positions of commercial traders (i.e., hedgers) for each futures contract. Since January 1986, the data are available electronically from the Commodity Futures Trading Commission. Prior to that date, we hand-collected data from various volumes of the *Commitments of Traders in Commodity Futures*. Data for December 1964 through June

¹This database only contains futures contracts that have survived until the present or that traded for an extended period in the past. Various futures contracts fail to survive because of the lack of investor interest, which are subsequently not recorded in the database. Due to potential survivorship bias, one must be careful in interpreting the unconditional average return, which is not the focus of this paper.

1972 are from the Commodity Exchange Authority (1964–1972). Data for July 1972 through December 1985 are from the Commodity Futures Trading Commission (1972–1985). There is an 11 month gap from January through November of 1982, during which the Commodity Futures Trading Commission did not collect data due to budgetary reasons. Our analysis uses all available data and excludes the part of the sample affected by the 11 month gap.

3.1.1. Commodity Market

We work with the broadest set of commodities for which both futures and spot prices are available. Table 1 lists the 30 commodities that are part of our analysis, together with the exchange in which they are traded and the date of the first recorded observation.² We categorize the universe of commodities into four broad sectors. Agriculture consists of 14 commodities and tends to contain the oldest futures contracts. Energy consists of 5 commodities, among which heating oil is the oldest, available since November 1978. Crude oil is available only since March 1983. Livestock consists of 5 commodities, among which live cattle and pork bellies are available since December 1964. Metals consists of six commodities, among which copper and silver are available since December 1964.

Figure 1 shows the share of total dollar open interest that each sector represents. The figure shows that agriculture is the largest sector in the early part of the sample, while energy becomes the largest sector later in the sample. The relative size of the four sectors is much more balanced later in the sample. These stylized facts have two important implications for our empirical analysis. First, we construct the commodity portfolio as an equally weighted portfolio of the four sectors, which ensures that the portfolio composition is consistent throughout the sample. Second, we have confirmed our main findings by sector and in sub-samples in an earlier version of this paper.

²A potential concern with this broad set of commodities is that not all futures contracts are equally liquid. In analysis that is not reported here, we have confirmed our main findings on a subset of 17 relatively liquid futures contracts that are in the Dow Jones-AIG Commodities Index.

3.1.2. Currency, Bond, and Stock Markets

Our sample for currency, bond, and stock markets starts in December 1982 because the *Commitments of Traders in Commodity Futures* were not available between January and November 1982, and these futures markets were relatively small prior to that date. Table 2 lists the 8 currency, 10 bond, and 14 stock futures that are part of our analysis, together with the exchange in which they are traded and the date of the first recorded observation.

The core set of currency futures for which we have data since December 1982 are the British pound, the Canadian dollar, the Deutsche mark, the Japanese yen, and the Swiss franc. The Australian dollar is available since January 1987, the New Zealand dollar since May 1997, and the Euro since May 1998. Unlike the commodity market, trading in the currency market takes place predominantly in over-the-counter forward and swap markets. This is a potential concern for measuring currency market activity because open interest in the futures market is a small share of overall activity that includes the over-the-counter market. Unfortunately, data on open interest in the over-the-counter market are not available at the frequency or sample length necessary for our analysis. Despite this problem, the growth rate of open interest in the futures market should be a good proxy for the overall growth rate of the currency market as long as the futures and forward markets move (more or less) in proportion to one another. Insofar as open interest in the futures market is a noisy proxy for hedging and speculative activity in the currency market, this measurement problem would weaken the power of our statistical tests.

The universe of bond futures includes various fixed-income instruments that vary in maturity from 30-day federal funds to the 30-year Treasury bond. The oldest bond futures, available since December 1982, are those for the 3-month Eurodollar, the 3-month Treasury bill, the 10-year Treasury note, and the 30-year Treasury bond.

The universe of stock futures includes all major indices including the Dow Jones Industrial Index, the Major Market Index, the NASDAQ 100 Index, the NYSE Composite Index, the Russell 2000 Index, the S&P 400 and 500 Indices, and the Value-Line Arithmetic Index.

The oldest stock futures, available since December 1982, are those for the NYSE Composite Index and the S&P 500 Index.

3.2. Definition of Returns

We use returns on commodity futures to measure movements in commodity prices and returns on currency futures to measure movements in exchange rates. We prefer commodity futures prices over spot prices for two reasons. First, commodity futures data are arguably higher quality with fewer missing observations because they are actual transaction prices. Second, rates of return on commodity futures have a straightforward economic interpretation as an actual rate of return on an investment strategy. That being said, we have confirmed our main findings using commodity spot prices in an earlier version of this paper.

3.2.1. Commodity Market

To construct the return on a portfolio of commodity futures, we first compute the return on a fully collateralized position for each futures contract as follows. Let $F_{i,t,T}$ be the futures price for commodity i at the end of month t , for a futures contract that matures at the end of month T . Let $R_{f,t}$ be the monthly gross return on the 1-month T-bill in month t , which is assumed to be the interest earned on collateral. The monthly gross return on a fully collateralized long position in futures contract i with maturity $T - t$ is

$$R_{i,t,T} = \frac{F_{i,t,T} R_{f,t}}{F_{i,t-1,T}}. \quad (18)$$

For each commodity, we compute its monthly gross return as an equally weighted average of returns on fully collateralized commodity futures. We exclude commodity futures with one month or less to maturity, which are typically illiquid because futures traders do not want to take physical delivery of the underlying. Similarly, we exclude futures contracts with more than twelve months to maturity because long-maturity contracts are typically

less liquid. For each sector, we construct an equally weighted portfolio of all commodities in that sector. Finally, we construct an aggregate commodity portfolio as an equally weighted portfolio of the four sectors. The advantage of equally weighting the sectors is that no sector dominates even as the number of commodities within each sector varies over time.

3.2.2. Currency, Bond, and Stock Markets

We define a long position on currency futures from the perspective of a U.S. investor that buys foreign currencies. Therefore, a high currency return refers to appreciation of foreign currencies relative to the U.S. dollar. Our construction of the return on a portfolio of currency futures is analogous to our construction of the commodity-sector portfolios. We first compute the return on a fully collateralized position for each futures contract. For each currency, we compute its monthly gross return as an equally weighted average of returns on fully collateralized currency futures. We include futures contracts with one month or less to maturity since physical delivery of the underlying is not an issue for currency futures. However, we exclude futures contracts with more than twelve months to maturity. Finally, we construct an aggregate currency portfolio as an equally weighted portfolio of all currencies.

For bond and stock markets, we simply use the usual benchmarks for returns, rather than computing these returns based on futures contracts. Bond returns are based on the 10-year U.S. Treasury note. Stock returns are based on the CRSP value-weighted portfolio of NYSE, AMEX, and NASDAQ stocks.

3.3. Definition of the Predictor Variables

3.3.1. Commodity Market

Our new predictor of commodity returns is the growth rate of commodity market interest. To construct this variable, we first compute the dollar open interest for each commodity as the spot price times the number of futures contracts outstanding. We then aggregate dollar open interest within each of the four sectors and compute its monthly growth rate. Finally,

we compute the aggregate growth rate of open interest as an equally weighted average of the growth rate for each of the four sectors.³ Because the monthly growth rate of open interest is noisy, we smooth it by taking a 12-month geometric average in the time series. We also construct a 12-month geometric average of commodity returns to test for momentum in the time series of commodity returns.

To test the incremental forecasting power of commodity market interest, we examine a number of other variables that are known to predict commodity returns. These other predictor variables can be grouped into two categories. The first category consists of aggregate market predictors, which are motivated by theories like (I)CAPM that view the commodity market as being fully integrated (Merton, 1973). We focus on the short rate and the yield spread in particular, which are known to predict the common variation in commodity, bond, and stock returns (Fama and Schwert, 1977; Campbell, 1987; Fama and French, 1989; Bessembinder and Chan, 1992).⁴ The short rate is the monthly average yield on the 1-month T-bill. The yield spread is the difference between Moody’s Aaa corporate bond yield and the short rate. In addition to these financial variables, we also examine the Chicago Fed National Activity Index as a measure of real economic activity, which is known to predict inflation (Stock and Watson, 1999).

The second category consists of commodity-specific predictors, which are motivated by the view that the commodity market is segmented from other markets. In particular, we examine two measures of supply-demand imbalances in the commodity futures market, motivated by the theory of backwardation. The first measure is an aggregate version of basis, which is known to predict returns on commodity futures (Fama and French, 1987). To con-

³We have tried an alternative construction that uses only the number of futures contracts outstanding and does not involve the spot price. We first compute the growth rate of open interest (i.e., the number of futures contracts outstanding) for each commodity. We then compute the median of the growth rate of open interest across all commodities within each sector. Finally, we compute the aggregate growth rate of open interest as an equally weighted average of the growth rate for each of the four sectors. This alternative construction leads to a time series that is very similar to our preferred construction.

⁴In analysis that is not reported here, we have also examined the default spread (i.e., the difference between Moody’s Baa and Aaa corporate bond yields) and measures of aggregate stock market volatility (i.e., both realized and implied volatility). Although these variables predict returns individually, they have weak incremental forecasting power once we control for the short rate and the yield spread.

struct commodity basis, we first compute basis for each commodity i with maturity $T - t$ as⁵

$$\text{Basis}_{i,t,T} = \left(\frac{F_{i,t,T}}{S_{i,t}} \right)^{\frac{1}{T-t}} - 1. \quad (19)$$

We then compute the median of basis across contracts for each commodity, and then the median of basis across commodities for each sector. We use the median, instead of the mean, because it is less sensitive to outliers in basis for individual futures contracts. Finally, we compute commodity basis as an equally weighted average of basis across the four sectors.

The second measure is an aggregate version of a more direct measure of supply-demand imbalances in the commodity futures market that is found in the literature (Carter, Rausser, and Schmitz, 1983; Chang, 1985; Bessembinder, 1992).⁶ We first compute futures market imbalance for each sector as the ratio of two variables. The numerator is the dollar value of short minus long positions held by commercial traders in the *Commitments of Traders in Commodity Futures*, summed across all commodities in that sector. The denominator is the dollar value of short plus long positions held by commercial traders, summed across all commodities in that sector. We then compute commodity market imbalance as an equally weighted average of futures market imbalance across the four sectors.

3.3.2. Currency, Bond, and Stock Markets

For aggregate market predictors of currency, bond, and stock returns, we examine the short rate, the yield spread, and the Chicago Fed National Activity Index. For currency-specific predictors, we examine currency market interest, currency returns, currency basis, and cur-

⁵While the Commodity Research Bureau has a reliable record of spot prices, a spot price is not always available on the same trading day as a recorded futures price. In instances where the spot price is missing, we first try to use an expiring futures contract to impute the spot price. If an expiring futures contract is not available, we then use the last available spot price within 30 days to compute basis. For example, if we have a futures price on December 31, but the last available spot price is from December 30, we compute basis as the ratio of the futures price on December 31 to the spot price on December 30.

⁶More recently, Acharya, Lochstoer, and Ramadorai (2009) find that the default risk of energy producers, which is an alternative measure of hedging demand, predicts returns on energy futures.

rency market imbalance. For bond-specific predictors, we examine bond market interest, bond returns, and bond market imbalance. For stock-specific predictors, we examine stock market interest, stock returns, stock market imbalance, and the dividend yield on the CRSP value-weighted stock portfolio. The construction of these variables for currency, bond, and stock markets are analogous to our construction of the same variables for the commodity market.

4. Summary Statistics for Returns and Open Interest

4.1. Summary Statistics for Returns

In Panel A of Table 3, we report summary statistics for monthly excess returns over the 1-month T-bill rate in the 1965–2008 sample period. The set of assets for which we have observations on returns in this sample period are the commodity portfolio, the 10-year U.S. Treasury note, and the CRSP value-weighted stock portfolio. The returns on the currency portfolio are only available since 1983.

Commodities have an average excess return of 0.64% and a standard deviation of 4.62%. This corresponds to an annualized average excess return of 7.68% and an annualized standard deviation of 16.00%. For the same sample period, bonds have an annualized average excess return of 2.04% and an annualized standard deviation of 8.00%, and stocks have an annualized average excess return of 4.32% and an annualized standard deviation of 15.66%. Thus, commodities had a higher realized Sharpe ratio than bonds or stocks (Gorton and Rouwenhorst, 2006). The first-order autocorrelation of monthly excess commodity returns is 0.07, which is virtually identical to that for bond and stock returns. The correlation between commodity and bond returns is -0.11 , which makes sense in light of the inverse relationship between bond prices and inflation. The correlation between commodity and stock returns is 0.06.

Panel B of Table 3 reports the same statistics in the 1983–2008 sub-sample, during

which we also have observations on currency returns. Commodities have an annualized average excess return of 4.80% and an annualized standard deviation of 11.12%. For the same sample period, currencies have an annualized average excess return of 1.20% and an annualized standard deviation of 7.52%. Bonds have an annualized average excess return of 3.96% and an annualized standard deviation of 7.62%, and stocks have an annualized average excess return of 5.76% and an annualized standard deviation of 15.35%. The first-order autocorrelation for monthly excess returns is close to 0.1 for all four markets. All four returns are positively correlated with each other, except for the correlation of -0.16 between commodity and bond returns. The correlation of 0.29 between commodity and currency returns is the strongest among the four markets.

4.2. Summary Statistics for the Predictor Variables

4.2.1. Commodity Market

Table 4 reports summary statistics for the predictors of commodity returns in the 1965–2008 sample period. The 12-month growth rate of commodity market interest has a mean of 1.46% per month and a standard deviation of 2.06%. 12-month commodity returns have a mean of 1.09% per month and a standard deviation of 1.29%. All the predictor variables are persistent with a monthly autocorrelation of at least 0.90, except for commodity basis, which has a relatively low autocorrelation of 0.78.

The yield spread is negatively correlated with the Chicago Fed National Activity Index, which confirms the known fact that the yield spread is counter-cyclical. Commodity market interest is positively correlated with commodity returns, and both variables are positively correlated with the Chicago Fed National Activity Index. Commodity market interest is essentially uncorrelated with commodity basis. However, commodity market interest has a correlation of 0.32 with commodity market imbalance. This means that unusually high commodity market interest tends to coincide with hedgers taking unusually strong short positions in commodity futures.

Figure 2 highlights the cyclical nature of commodity market interest, by showing its time series together with the Chicago Fed National Activity Index. During the recent commodity boom, commodity market interest grew over a five-year period from \$103 billion at the end of 2003 to \$621 billion in June 2008. Only the energy crisis of the 1970s witnessed higher activity. During these two historic periods and also more generally, there is a high degree of correlation between movements in commodity market interest and the Chicago Fed National Activity Index.

4.2.2. Currency, Bond, and Stock Markets

Panel A of Table 5 reports summary statistics for the predictors of currency returns in the 1983–2008 sample period. The correlations between the predictors of currency returns are qualitatively similar to those between the predictors of commodity returns in Table 4. In particular, currency market interest is positively correlated with currency returns, and both variables are positively correlated with the Chicago Fed National Activity Index. In other words, periods of high economic activity are associated with rising currency market interest and high currency returns.

Panel B of Table 5 reports summary statistics for the predictors of bond returns. Bond market interest is positively correlated with the Chicago Fed National Activity Index, while bond returns are negatively correlated with the Chicago Fed National Activity Index. In other words, periods of high economic activity are associated with rising bond market interest and low bond returns. This inverse relation between economic activity and bond returns makes sense in light of the fact that high economic activity leads to inflationary pressure, which is bad news for the bond market.

Panel C of Table 5 reports summary statistics for the predictors of stock returns. The correlations between the predictors of stock returns are qualitatively similar to those between the predictors of commodity returns. In particular, stock market interest is positively correlated with stock returns, and both variables are positively correlated with the Chicago Fed

National Activity Index. In other words, periods of high economic activity are associated with rising stock market interest and high stock returns.

Figure 3 highlights the cyclical nature of currency, bond, and stock market interest, by showing their time series together with the Chicago Fed National Activity Index. In each of these three markets, there is strong correlation between movements in open interest and the Chicago Fed National Activity Index. Given that movements in open interest are highly procyclical, it is a prime candidate for a predictor of returns. In the next section, we examine whether movements in open interest predict returns even after controlling for other cyclical variables.

5. Predictability of Returns by Open Interest

5.1. Commodity Market

Figure 4 shows the time series of the 12-month growth rate of commodity market interest and 12-month commodity returns. This figure confirms that these two time series are highly correlated. More interestingly, this figure reveals that commodity returns look like a version of movements in commodity market interest that is shifted forward by a few months. In other words, movements in commodity market interest lead movements in commodity prices in the same direction.

In Table 6, we formally test the hypothesis that movements in commodity market interest predict commodity returns. In column (1), we first estimate a baseline specification in which the predictor variables are the short rate, the yield spread, and commodity basis. This baseline allows us to measure the incremental forecasting power of commodity market interest, which is our main variable of interest. All coefficients are standardized so that they can be interpreted as the percentage point change in monthly expected returns per one standard deviation change in the predictor variable.

The short rate predicts commodity returns with a coefficient of -0.47 and a t -statistic

of -2.24 . More interestingly, the yield spread enters with a coefficient of -0.50 and a t -statistic of -2.61 . This means that a standard deviation increase in the yield spread decreases expected commodity returns by 0.50% per month. The fact that the yield spread predicts commodities with a negative coefficient is in sharp contrast to the positive coefficient found for bonds and stocks (Campbell, 1987; Fama and French, 1989). The conventional interpretation for bond and stock markets is that when the yield spread is high (typically in recessions), the risk premia for all risky assets are high (due to risk aversion or systemic risk). Since expected commodity returns are low (i.e., commodity prices are high) when the yield spread is high, commodities are a good hedge for time-varying investment opportunities in bond and stock markets.

Commodity basis predicts commodity returns with a coefficient of -0.57 and a t -statistic of -2.08 . This means that a standard deviation increase in commodity basis decreases expected commodity returns by 0.57% per month. The fact that low commodity basis (i.e., low futures relative to spot price) predicts high returns on being long commodity futures is consistent with the theory of backwardation. Overall, the R^2 of the forecasting regression is 2.48% . While this baseline specification follows earlier work and is not our main focus, we obtain much stronger results than previously reported. The primary reasons are that we have a longer sample period and that we use of a broader cross section of commodities in constructing commodity returns and commodity basis.

In column (2) of Table 6, we introduce commodity market interest to examine its incremental forecasting power for commodity returns. Commodity market interest enters with a coefficient of 0.72 and a t -statistic of 2.47 . This means that a standard deviation increase in commodity market interest increases expected commodity returns by 0.72% per month. The coefficients for the other three predictor variables are virtually unchanged from column (1) because commodity market interest is essentially uncorrelated with these other variables. For this sample period, commodity market interest explains a larger share of the variation in expected commodity returns than the other predictor variables. Moreover, the inclusion

of commodity market interest increases the R^2 of the forecasting regression from 2.48% to 4.81%.

In column (3) of Table 6, we introduce past commodity returns to the baseline specification and find that they enter with a coefficient of 0.30 and a t -statistic of 1.27. This means that a standard deviation increase in past commodity returns increases expected commodity returns by 0.30% per month, which is smaller than the 0.72% impact of commodity market interest. In column (4), we find that commodity market interest drives out the forecasting power of past commodity returns in a horse race between these two variables. Commodity market interest enters with a coefficient of 0.77 and a t -statistic of 1.85, while past commodity returns enter with a statistically insignificant coefficient of -0.10 . This result shows that while commodity market interest and commodity returns are highly correlated, they contain different information about future commodity returns. As shown in Figure 5, commodity market interest tends to lead commodity returns and can therefore be more informative.

In column (5) of Table 6, we introduce commodity market imbalance to the baseline specification and find that it enters with a coefficient of 0.32 and a t -statistic of 1.44. This positive coefficient is consistent with the theory of backwardation, which implies that high hedging demand predicts high returns on being long futures. In column (6), we find that commodity market interest drives out the forecasting power of commodity market imbalance in a horse race between these two variables. Commodity market interest enters with a coefficient of 0.69 and a t -statistic of 2.40, while commodity market imbalance enters with a statistically insignificant coefficient of 0.11. As shown in Table 4, commodity market interest and commodity market imbalance are positively correlated. Hence, a potential interpretation of these results is that commodity market imbalance is just a noisy proxy for commodity market interest.

In column (7) of Table 6, we introduce the Chicago Fed National Activity Index to the baseline specification and find that it enters with a coefficient of 0.46 and a t -statistic of 2.02. This positive coefficient is additional evidence that expected commodity returns

are pro-cyclical, which is the opposite of counter-cyclical expected returns found in bond and stock markets. In column (8), we find that commodity market interest reduces the forecasting power of the Chicago Fed National Activity Index in a horse race between these two variables. Commodity market interest enters with a coefficient of 0.67 and a t -statistic of 1.87, while the Chicago Fed National Activity Index enters with a statistically insignificant coefficient of 0.29.

We summarize our main findings in Tables 6 as follows. The fact that the short rate, the yield spread, and the Chicago Fed National Activity Index predict commodity returns is consistent with the integrated markets view. That is, the same aggregate factors that drive other asset prices are partly responsible for movements in commodity prices. The fact that commodity basis and commodity market imbalance predict movements in commodity prices is consistent with the segmented markets view. That is, the theory of backwardation is partly responsible for movements in commodity prices. More importantly, movements in commodity market interest predict movements in commodity prices even after controlling for these other predictors. This finding challenges us to develop a new view of the commodity market that is unrelated to these traditional theories. Our preferred hypothesis is that commodity market interest contains information about the future supply and demand for commodities, which cannot be inferred by commodity prices alone.

We now present evidence that commodity market interest not only predicts movements in commodity prices, but is more generally useful for forecasting movements in inflation expectations. In Panel A of Table 7, we predict excess returns on the 10-year U.S. Treasury note over the 1-month T-bill rate. In a baseline specification in column (1), the short rate enters with a statistically insignificant coefficient of 0.20. The yield spread enters with a coefficient of 0.49 and a t -statistic of 3.41. In column (2), we introduce commodity market interest to the baseline specification and find that it enters with a coefficient of -0.32 and a t -statistic of -3.11 . This means that a standard deviation increase in commodity market interest decreases expected bond returns by 0.32% per month. The forecasting power of

commodity market interest is comparable to that of the yield spread, which is known to be a strong predictor of bond returns. Column (3) shows that commodity returns predict bond returns, but column (4) shows that they do not have forecasting power beyond commodity market interest. Similarly, column (5) shows that the Chicago Fed National Activity Index predicts bond returns, but column (6) shows that it does not have forecasting power beyond commodity market interest.

In Panel B of Table 7, we predict movements in the 1-month T-bill rate. By the Fisher hypothesis, movements in the short rate can be interpreted as movements in expected monthly inflation if the real rate were constant. In a baseline specification in column (1), the yield spread enters with a statistically insignificant coefficient of 0.06. In column (2), we introduce commodity market interest to the baseline specification and find that it enters with a coefficient of 0.12 and a t -statistic of 3.34. This means that a standard deviation increase in commodity market interest increases the expected annualized short rate by 0.12%. Column (3) shows that commodity returns predict movements in the short rate with a coefficient of 0.12 and a t -statistic of 3.42. In column (4), commodity market interest and commodity returns enter with similar coefficients in a horse race between these two variables. Column (5) shows that the Chicago Fed National Activity Index predicts movements in the short rate, which is consistent with its ability to predict realized inflation (Stock and Watson, 1999). Column (6) shows that the Chicago Fed National Activity Index does not drive out the forecasting power of commodity market interest.

In summary, Table 7 shows that commodity market interest has incremental forecasting power for bond returns and movements in the short rate beyond conventional predictors of inflation like commodity prices and the Chicago Fed National Activity Index. This evidence suggests that commodity market interest contains information about economic activity and inflation expectations that is priced into commodity and bond markets with delay.

5.2. Currency Market

The previous section showed that movements in commodity market interest predict movements in commodity prices. This section documents an analogous relation between currency market interest and exchange rates. The economic rationale for why movements in currency market interest predicts movements in exchange rates is analogous to our hypothesis for the commodity market. A strong U.S. economy leads to inflation and consequently depreciation of the U.S. dollar relative to foreign currencies.⁷ Suppose importers expect higher future demand, and in response, enter currency futures to hedge risk arising from higher anticipated imports. Insofar as this good news about the U.S. economy diffuses gradually in the currency market, rising currency market interest predicts high returns on being long foreign currencies.

Table 8 tests whether movements in currency market interest predict currency returns. In column (1), we first estimate a baseline specification in which the predictor variables are the short rate, the yield spread, and currency basis (i.e., the forward discount). The short rate and the yield spread have little forecasting power for currency returns. However, currency basis predicts currency returns with a coefficient of -0.25 and a t -statistic of -1.56 . This means that a standard deviation increase in currency basis decreases expected currency returns by 0.25% per month. By the covered interest-rate parity, currency basis is the difference in interest rates between the U.S. and foreign countries. Therefore, the negative coefficient means that when the U.S. interest rate is low relative to the rest of the world, foreign currencies are expected to appreciate relative to the U.S. dollar. This failure of the uncovered interest-rate parity is the so-called “forward-discount puzzle” in international finance.

In column (2) of Table 8, we introduce currency market interest to examine its incremental

⁷More formally, a positive U.S. productivity shock leads to depreciation of the U.S. dollar relative to foreign currencies in a standard Ricardian model of bilateral trade (Backus, Kehoe, and Kydland, 1994). The intuition for this result is that a positive U.S. productivity shock makes goods produced by the U.S. relatively abundant, so that the price of these goods must fall relative to the price of goods produced by foreign countries.

forecasting power for currency returns. Currency market interest enters with a coefficient of 0.36 and a t -statistic of 2.53. This means that a standard deviation increase in currency market interest increases expected currency returns by 0.36% per month. Figure 5 is a visual representation of this finding. Throughout the sample period, movements in currency market interest tend to lead movements in currency returns, except perhaps for a period in the 1990s. The coefficient for currency market interest is larger in economic magnitude than that for currency basis. Moreover, the inclusion of currency market interest increases the R^2 of the forecasting regression from 2.01% to 4.61%. These findings suggest that currency market interest is a more important determinant of exchange rates than currency basis.

In column (3) of Table 8, we introduce past currency returns to the baseline specification and find that they enter with a coefficient of 0.25 and a t -statistic of 1.54. In other words, there is some evidence for momentum in the time series of currency returns, similar to one that is found for commodity returns (Moskowitz, Ooi, and Pedersen, 2010). In column (4), we find that currency market interest weakens the forecasting power of currency returns in a horse race between these two variables. Currency market interest enters with a coefficient of 0.31 and a t -statistic of 2.20, while currency returns enter with a statistically insignificant coefficient of 0.12.

In column (5) of Table 8, we introduce currency market imbalance to the baseline specification and find that it enters with a coefficient of 0.24 and a t -statistic of 1.96. This positive coefficient is consistent with the theory of backwardation, which implies that high hedging demand predicts high returns on being long futures. In column (6), we find that currency market interest drives out the forecasting power of currency market imbalance in a horse race between these two variables. Currency market interest enters with a coefficient of 0.32 and a t -statistic of 2.30, while currency market imbalance enters with a statistically insignificant coefficient of 0.14.

In column (7) of Table 8, we introduce the Chicago Fed National Activity Index to the baseline specification and find that it enters with a coefficient of 0.32 and a t -statistic of 1.47.

This positive coefficient is consistent with the hypothesis that a strong U.S. economy leads to inflation and consequently depreciation of the U.S. dollar relative to foreign currencies. In column (8), we find that currency market interest drives out the forecasting power of the Chicago Fed National Activity Index in a horse race between these two variables. Currency market interest enters with a coefficient of 0.31 and a t -statistic of 2.27, while the Chicago Fed National Activity Index enters with a statistically insignificant coefficient of 0.24.

5.3. Bond Market

Table 9 tests whether movements in bond market interest predict bond returns. In column (1), we first estimate a baseline specification in which the predictor variables are the short rate and the yield spread. The short rate enters with a statistically insignificant coefficient of 0.20. However, the yield spread is a powerful predictor of bond returns with a coefficient of 0.34 and a t -statistic of 2.39.

In column (2) of Table 9, we introduce bond market interest and find that it enters with a coefficient of -0.31 and a t -statistic of -1.91 . This means that a standard deviation increase in bond market interest decreases expected bond returns by 0.31% per month. To interpret the sign of this coefficient, recall from Table 5 that bond market interest is positively correlated with the Chicago Fed National Activity Index. A high Chicago Fed National Activity Index signals inflation, which is bad news for bonds.

In columns (3) and (4) of Table 9, we find that past bond returns do not have forecasting power for future bond returns. Similarly, columns (5) and (6) show that bond market imbalance does not have forecasting power for bond returns. In column (7), we introduce the Chicago Fed National Activity Index to the baseline specification and find that it enters with a coefficient of -0.31 and a t -statistic of -1.96 . In column (8), we find that the Chicago Fed National Activity Index slightly weakens the forecasting power of bond market interest in a horse race between these two variables. Given that bond market interest and the Chicago Fed National Activity Index both signal inflation, these findings are consistent

with our hypothesis.

5.4. Stock Market

Table 10 tests whether movements in stock market interest predict stock returns. Column (1) is our baseline specification in which the predictor variables are the short rate, the yield spread, and the dividend yield. None of these variables, which are known to predict stock returns, are statistically significant in the 1984–2008 sample period. This is perhaps not surprising given that stock returns are notoriously difficult to predict, especially in a short sample period that includes the unusual stock market behavior in the late 1990s. Hence, the results that follow for stock market interest should be interpreted with this caveat in mind.

In column (2) of Table 10, we introduce stock market interest to our baseline specification and find that it enters with a coefficient of 0.38 and a t -statistic of 1.38. This means that a standard deviation increase in stock market interest increases expected stock returns by 0.38% per month. Although this coefficient is not statistically significant in this sample period, the economic magnitude of the coefficient is comparable to that for the short rate, the yield spread, and the dividend yield.

In columns (3) and (4) of Table 10, we find that past stock returns do not have forecasting power for future stock returns. In column (5), we introduce stock market imbalance to our baseline specification and find that it enters with a coefficient of -0.45 and a t -statistic of -1.80 . In column (6), we find that stock market interest enters with a coefficient of 0.50 and a t -statistic of 1.76 in a specification that controls for stock market imbalance. In column (7), we introduce the Chicago Fed National Activity Index to our baseline specification and find that it enters with a coefficient of 0.70 and a t -statistic of 1.97. In column (8), we find that the Chicago Fed National Activity Index weakens the forecasting power of stock market interest in a horse race between these two variables.

6. Conclusion

We find that movements in open interest are highly pro-cyclical and predict movements in asset prices, even after controlling for other known predictors that include past asset prices. Most notably, commodity market interest is a more powerful predictor of commodity returns than past commodity prices, and currency market interest is a more powerful predictor of currency returns than the forward discount. Our findings may be somewhat surprising because one might have thought that open interest is a non-directional variable that is unrelated to macroeconomic activity, inflation, and asset prices. We offer a simple explanation based on hedging and downward-sloping demand in futures markets.

Commodity prices are highly volatile and arguably the least predictable component of the consumer price index. Therefore, our findings on the predictability of commodity returns have broader implications for the large macro literature on inflation forecasting. Macroeconomists have already known for some time that asset prices can be useful for forecasting inflation and output (Stock and Watson, 2003). These forecasting models generally assume that asset prices contain timely information about economic activity and inflation expectations. However, our findings suggest that asset prices initially under-react to news about economic activity and inflation expectations, which are better captured by open interest. Commodity market interest is a more powerful predictor of commodity returns, bond returns, and movements in the short rate than past commodity prices or the Chicago Fed National Activity Index. Our work opens up a new approach to inflation forecasting, in which commodity market interest may be fruitfully used to improve the forecasting power of existing models.

Our work also opens up a new approach to modeling expected returns in financial economics. Most empirical models of expected returns are premised on the notion that past prices contain all useful information for forecasting future returns, whether such predictability arises from risk premia or limits to arbitrage. Our work shows that transaction quantities, in particular open interest in the futures market, contain information that is not fully revealed

by transaction prices alone. The idea that transaction quantities may be more informative than transaction prices is entirely new and offers a richer understanding of movements in asset prices.

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Table 1: Commodity Market Futures

This table lists the 30 commodity futures included in our analysis, for which futures and spot prices are available through the Commodity Research Bureau. The futures contracts are traded on the Chicago Board of Trade (CBOT), the Chicago Mercantile Exchange (CME), the Intercontinental Exchange (ICE), and the New York Mercantile Exchange (NYMEX). The sample starts in December 1964, after which prices are available for many commodities.

Sector	Commodity	Exchange	First Observation	
			Futures Price	<i>Commitments of Traders</i>
Agriculture	Butter	CME	September 1996	May 1997
	Cocoa	ICE	December 1964	July 1978
	Coffee	ICE	August 1972	July 1978
	Corn	CBOT	December 1964	December 1964
	Cotton	ICE	December 1964	December 1964
	Lumber	CME	March 1970	July 1978
	Oats	CBOT	December 1964	December 1964
	Orange juice	ICE	May 1967	January 1969
	Rough rice	CBOT	August 1986	October 1986
	Soybean meal	CBOT	December 1964	December 1964
	Soybean oil	CBOT	December 1964	December 1964
	Soybeans	CBOT	December 1964	December 1964
	Sugar	ICE	December 1964	July 1978
	Wheat	CBOT	December 1964	December 1964
Energy	Crude oil	NYMEX	March 1983	April 1983
	Gasoline	NYMEX	December 1984	December 1984
	Heating oil	NYMEX	November 1978	October 1980
	Natural gas	NYMEX	April 1990	April 1990
	Propane	NYMEX	August 1987	August 1987
Livestock	Broilers	CME	February 1991	March 1991
	Feeder cattle	CME	March 1972	December 1975
	Lean hogs	CME	February 1966	July 1968
	Live cattle	CME	December 1964	July 1968
	Pork bellies	CME	December 1964	July 1968
Metals	Aluminum	NYMEX	December 1983	January 1984
	Copper	NYMEX	December 1964	December 1982
	Gold	NYMEX	December 1974	December 1982
	Palladium	NYMEX	January 1977	July 1978
	Platinum	NYMEX	March 1968	July 1978
	Silver	NYMEX	December 1964	December 1982

Table 2: Currency, Bond, and Stock Market Futures

This table lists the 8 currency, 10 bond, and 14 stock futures included in our analysis, for which futures and spot prices are available through the Commodity Research Bureau. The futures contracts are traded on the Chicago Board of Trade (CBOT), the Index and Option Market (IOM), the Intercontinental Exchange (ICE), the International Monetary Market (IMM), and the Kansas City Board of Trade (KCBT). The sample starts in December 1982 because the *Commitments of Traders in Commodity Futures* were not available between January and November 1982, and these futures markets were relatively small prior to that date.

Market	Financial Asset	Exchange	First Observation	
			Futures Price	<i>Commitments of Traders</i>
Currency	Australian dollar	IMM	January 1987	January 1987
	British pound	IMM	December 1982	December 1982
	Canadian dollar	IMM	December 1982	December 1982
	Deutsche mark	IMM	December 1982	December 1982
	Euro	IMM	May 1998	January 1999
	Japanese yen	IMM	December 1982	December 1982
	New Zealand dollar	IMM	May 1997	January 1999
	Swiss franc	IMM	December 1982	December 1982
Bond	30-day federal funds	CBOT	October 1988	October 1988
	1-month Eurodollar	IMM	May 1990	May 1990
	3-month Eurodollar	IMM	December 1982	December 1982
	3-month U.S. Treasury bill	IMM	December 1982	December 1982
	2-year U.S. Treasury note	CBOT	June 1990	June 1990
	5-year U.S. Treasury note	CBOT	May 1988	May 1988
	5-year U.S. Treasury note swap	CBOT	June 2002	February 2003
	10-year U.S. Treasury note	CBOT	December 1982	December 1982
	10-year U.S. Treasury note swap	CBOT	October 2001	November 2001
	30-year U.S. Treasury bond	CBOT	December 1982	December 1982
Stock	Dow Jones Industrial Index	CBOT	October 1997	October 1997
	Major Market Index	IOM	August 1985	October 1991
	NASDAQ 100 Index	IOM	April 1996	April 1996
	NASDAQ 100 Index E-Mini	IOM	June 1999	June 1999
	NYSE Composite Index	ICE	December 1982	December 1982
	Russell 2000 Index	IOM	February 1993	February 1993
	Russell 2000 Index E-Mini	IOM	November 2001	August 2002
	S&P 400 MidCap Index	IOM	February 1992	February 1992
	S&P 400 MidCap Index E-Mini	IOM	January 2002	November 2002
	S&P 500 Barra Value Index	IOM	November 1995	April 1996
	S&P 500 Barra Growth Index	IOM	November 1995	December 1995
	S&P 500 Index	IOM	April 1982	October 1983
	S&P 500 Index E-Mini	IOM	September 1997	September 1997
	Value-Line Arithmetic Index	KCBT	August 1983	October 1983

Table 3: Summary Statistics for Commodity, Currency, Bond, and Stock Returns

This table reports the mean, the standard deviation, the autocorrelation, and the pairwise correlation of monthly excess returns over the 1-month T-bill rate. The portfolio of fully collateralized commodity futures is equally weighted across agriculture, energy, livestock, and metals. The portfolio of fully collateralized currency futures is equally weighted across the 8 currencies listed in Table 2. The other assets are the 10-year U.S. Treasury note and the CRSP value-weighted stock portfolio.

Variable	Mean (%)	Standard Deviation (%)	Auto- correlation	Correlation with		
				Commodity Portfolio	Currency Portfolio	10-Year Bond
<i>Panel A: 1965:1–2008:12</i>						
Commodity portfolio	0.64	4.62	0.07			
10-year bond	0.17	2.31	0.08	-0.11		
Stock portfolio	0.36	4.52	0.09	0.06		0.18
<i>Panel B: 1983:1–2008:12</i>						
Commodity portfolio	0.40	3.21	0.14			
Currency portfolio	0.10	2.17	0.12	0.29		
10-year bond	0.33	2.20	0.07	-0.16	0.17	
Stock portfolio	0.48	4.43	0.10	0.16	0.08	0.06

Table 4: Summary Statistics for Predictors of Commodity Returns

This table reports the mean, the standard deviation, the autocorrelation, and the pairwise correlation for predictors of commodity returns. The short rate is the monthly average yield on the 1-month T-bill. The yield spread is the difference between Moody's Aaa corporate bond yield and the short rate. The Chicago Fed National Activity Index is a weighted average of 85 monthly indicators of U.S. economic activity. The next predictor variables are the 12-month geometrically averaged growth rate of commodity market interest and the 12-month geometrically averaged commodity returns. Commodity market imbalance is the ratio of short minus long positions relative to short plus long positions held by commercial traders in the *Commitments of Traders in Commodity Futures*. Commodity basis is equally weighted across agriculture, energy, livestock, and metals. The sample period is 1965:12–2008:12.

Variable	Mean (%)	Standard Deviation (%)	Auto- correlation	Correlation with					
				Short Rate	Yield Spread	Chicago Fed Index	Commodity Market Interest	Commodity Returns	Commodity Basis
Short rate	5.52	2.71	0.97						
Yield spread	2.64	1.60	0.92	-0.54					
Chicago Fed Index	0.01	0.86	0.93	-0.02	-0.12				
Commodity market interest	1.46	2.06	0.90	0.02	-0.10	0.36			
Commodity returns	1.09	1.29	0.93	0.06	-0.35	0.28	0.51		
Commodity basis	0.11	0.60	0.78	0.24	-0.24	-0.11	-0.07	0.01	
Commodity market imbalance	17.83	13.80	0.90	0.27	-0.32	0.17	0.32	0.43	0.16

Table 5: Summary Statistics for Predictors of Currency, Bond, and Stock Returns

Panel A reports the mean, the standard deviation, the autocorrelation, and the pairwise correlation for predictors of currency returns. The short rate is the monthly average yield on the 1-month T-bill. The yield spread is the difference between Moody's Aaa corporate bond yield and the short rate. The Chicago Fed National Activity Index is a weighted average of 85 monthly indicators of U.S. economic activity. The next predictor variables are the 12-month geometrically averaged growth rate of currency market interest and the 12-month geometrically averaged currency returns. Currency market imbalance is the ratio of short minus long positions relative to short plus long positions held by commercial traders in the *Commitments of Traders in Commodity Futures*. Currency basis is equally weighted across the 8 currencies listed in Table 2. Panels B and C report summary statistics for analogous predictor variables in bond and stock markets. The sample period is 1983:12–2008:12.

Variable	Mean (%)	Standard Deviation (%)	Auto- correlation	Correlation with				
				Short Rate	Yield Spread	Chicago Fed Index	Market Interest	Returns Basis
Panel A: Currency Market								
Short rate	4.58	2.14	0.98					
Yield spread	3.16	1.35	0.94	-0.48				
Chicago Fed Index	-0.04	0.61	0.94	0.27	-0.08			
Currency market interest	0.92	1.94	0.75	-0.08	-0.01	0.18		
Currency returns	0.53	0.73	0.94	-0.12	0.20	0.02	0.40	
Currency basis	0.01	0.14	0.97	0.54	-0.32	0.50	-0.06	-0.26
Currency market imbalance	6.81	26.61	0.66	0.00	0.24	0.10	0.25	0.41 0.09
Panel B: Bond Market								
Bond market interest	1.66	1.59	0.93	0.21	0.28	0.26		
Bond returns	0.69	0.67	0.92	0.05	0.08	-0.31	0.01	
Bond market imbalance	0.87	6.95	0.91	-0.28	0.24	-0.54	-0.08	0.29
Panel C: Stock Market								
Stock market interest	1.72	1.88	0.88	0.35	-0.09	0.32		
Stock returns	0.66	1.29	0.91	0.25	-0.38	0.46	0.61	
Stock market imbalance	-1.06	8.50	0.72	-0.08	0.09	-0.05	0.18	-0.11

Table 6: Predictability of Commodity Returns by Commodity Market Interest

This table tests the predictability of monthly excess returns on a portfolio of fully collateralized commodity futures over the 1-month T-bill rate. All predictor variables are lagged one month. The table reports standardized coefficients with heteroskedasticity-consistent t -statistics in parentheses. The sample period is 1966:1–2008:12.

Predictor Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Short rate	-0.47 (-2.24)	-0.46 (-1.75)	-0.42 (-1.99)	-0.47 (-1.88)	-0.52 (-2.24)	-0.48 (-1.88)	-0.49 (-2.33)	-0.53 (-2.02)
Yield spread	-0.50 (-2.61)	-0.43 (-1.97)	-0.37 (-2.03)	-0.47 (-2.39)	-0.45 (-2.12)	-0.42 (-1.85)	-0.57 (-2.74)	-0.56 (-2.49)
Commodity basis	-0.57 (-2.08)	-0.51 (-1.94)	-0.56 (-2.00)	-0.52 (-1.92)	-0.60 (-2.08)	-0.53 (-1.95)	-0.66 (-2.04)	-0.62 (-1.92)
Commodity market interest		0.72 (2.47)		0.77 (1.85)		0.69 (2.40)		0.67 (1.87)
Commodity returns			0.30 (1.27)	-0.10 (-0.27)				
Commodity market imbalance					0.32 (1.44)	0.11 (0.54)		
Chicago Fed Index							0.46 (2.02)	0.29 (0.90)
R^2 (%)	2.48	4.81	2.82	4.84	2.89	4.85	4.08	6.01

Table 7: Predictability of Bond Returns and Movements in the Short Rate by Commodity Market Interest

Panel A tests the predictability of monthly excess returns on the 10-year U.S. Treasury note over the 1-month T-bill rate. Panel B tests the predictability of movements in the 1-month T-bill rate. All predictor variables are lagged one month. The table reports standardized coefficients with heteroskedasticity-consistent t -statistics in parentheses. The sample period is 1966:1–2008:12.

Predictor Variable	(1)	(2)	(3)	(4)	(5)	(6)
<i>Panel A: Bond Returns</i>						
Short rate	0.20 (1.26)	0.14 (0.79)	0.16 (0.98)	0.13 (0.73)	0.19 (1.19)	0.15 (0.78)
Yield spread	0.49 (3.41)	0.38 (2.64)	0.39 (2.66)	0.35 (2.41)	0.48 (3.15)	0.38 (2.44)
Commodity market interest		-0.32 (-3.11)		-0.28 (-2.41)		-0.33 (-3.07)
Commodity returns			-0.23 (-1.94)	-0.08 (-0.58)		
Chicago Fed Index					-0.20 (-1.68)	-0.04 (-0.36)
R^2 (%)	3.15	4.26	3.98	4.34	3.96	4.63
<i>Panel B: Movements in the Short Rate</i>						
Yield spread	0.06 (1.22)	0.07 (1.43)	0.10 (2.06)	0.09 (1.86)	0.07 (1.43)	0.08 (1.49)
Commodity market interest		0.12 (3.34)		0.09 (1.84)		0.09 (2.66)
Commodity returns			0.12 (3.42)	0.07 (1.42)		
Chicago Fed Index					0.12 (3.07)	0.09 (2.19)
R^2 (%)	0.74	4.03	3.59	4.74	3.94	5.68

Table 8: Predictability of Currency Returns by Currency Market Interest

This table tests the predictability of monthly excess returns on a portfolio of fully collateralized currency futures over the 1-month T-bill rate. All predictor variables are lagged one month. The table reports standardized coefficients with heteroskedasticity-consistent t -statistics in parentheses. The sample period is 1984:1–2008:12.

Predictor Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Short rate	0.04 (0.26)	0.08 (0.47)	0.02 (0.13)	0.07 (0.38)	0.03 (0.16)	0.07 (0.39)	0.04 (0.22)	0.07 (0.42)
Yield spread	0.16 (1.01)	0.18 (1.14)	0.12 (0.72)	0.16 (0.96)	0.09 (0.52)	0.13 (0.82)	0.13 (0.74)	0.15 (0.91)
Currency basis	-0.25 (-1.56)	-0.24 (-1.51)	-0.18 (-1.15)	-0.21 (-1.30)	-0.29 (-1.79)	-0.26 (-1.66)	-0.42 (-1.97)	-0.36 (-1.71)
Currency market interest		0.36 (2.53)		0.31 (2.20)		0.32 (2.30)		0.31 (2.27)
Currency returns			0.25 (1.54)	0.12 (0.72)				
Currency market imbalance					0.24 (1.96)	0.14 (1.27)		
Chicago Fed Index							0.32 (1.47)	0.24 (1.08)
R^2 (%)	2.01	4.61	3.20	4.83	3.08	4.97	3.57	5.41

Table 9: Predictability of Bond Returns by Bond Market Interest

This table tests the predictability of monthly excess returns on the 10-year U.S. Treasury note over the 1-month T-bill rate. All predictor variables are lagged one month. The table reports standardized coefficients with heteroskedasticity-consistent t -statistics in parentheses. The sample period is 1984:1–2008:12.

Predictor Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Short rate	0.20 (1.18)	0.34 (1.92)	0.20 (1.11)	0.33 (1.84)	0.22 (1.25)	0.34 (1.95)	0.29 (1.81)	0.39 (2.28)
Yield spread	0.34 (2.39)	0.50 (3.00)	0.33 (2.26)	0.49 (2.87)	0.33 (2.34)	0.49 (2.95)	0.36 (2.56)	0.49 (3.05)
Bond market interest		-0.31 (-1.91)		-0.31 (-1.89)		-0.31 (-1.88)		-0.26 (-1.66)
Bond returns			0.06 (0.45)	0.05 (0.36)				
Bond market imbalance					0.06 (0.47)	0.04 (0.30)		
Chicago Fed Index							-0.31 (-1.96)	-0.26 (-1.75)
R^2 (%)	1.95	3.55	2.03	3.60	2.02	3.58	3.82	4.88

Table 10: Predictability of Stock Returns by Stock Market Interest

This table tests the predictability of monthly excess returns on the CRSP value-weighted stock portfolio over the 1-month T-bill rate. All predictor variables are lagged one month. The table reports standardized coefficients with heteroskedasticity-consistent t -statistics in parentheses. The sample period is 1984:1–2008:12.

Predictor Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Short rate	-0.55 (-0.86)	-0.73 (-1.14)	-0.62 (-1.00)	-0.73 (-1.12)	-0.30 (-0.47)	-0.49 (-0.75)	-0.98 (-1.69)	-1.06 (-1.76)
Yield spread	-0.53 (-1.28)	-0.59 (-1.42)	-0.47 (-1.09)	-0.57 (-1.22)	-0.31 (-0.75)	-0.34 (-0.83)	-0.74 (-1.83)	-0.76 (-1.86)
Dividend yield	0.77 (1.36)	0.81 (1.44)	0.82 (1.47)	0.82 (1.46)	0.48 (0.83)	0.46 (0.80)	1.02 (1.88)	1.02 (1.88)
Stock market interest		0.38 (1.38)		0.33 (0.88)		0.50 (1.76)		0.24 (0.90)
Stock returns			0.29 (0.83)	0.08 (0.17)				
Stock market imbalance					-0.45 (-1.80)	-0.56 (-2.12)		
Chicago Fed Index							0.70 (1.97)	0.65 (1.84)
R^2 (%)	1.05	1.67	1.40	1.69	1.92	2.97	3.22	3.45

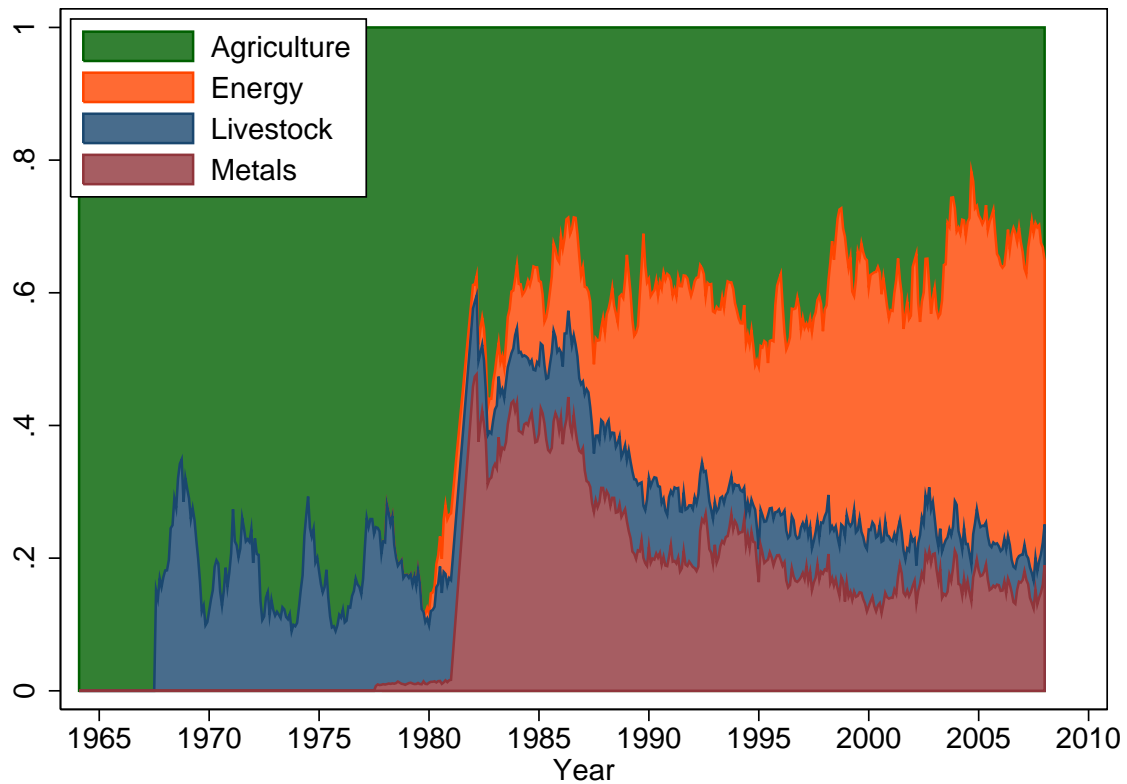


Figure 1: Open Interest in Commodity Futures by Sector

This figure shows the share of dollar open interest in commodity futures that each sector represents. The sample period is 1965:1–2008:12.

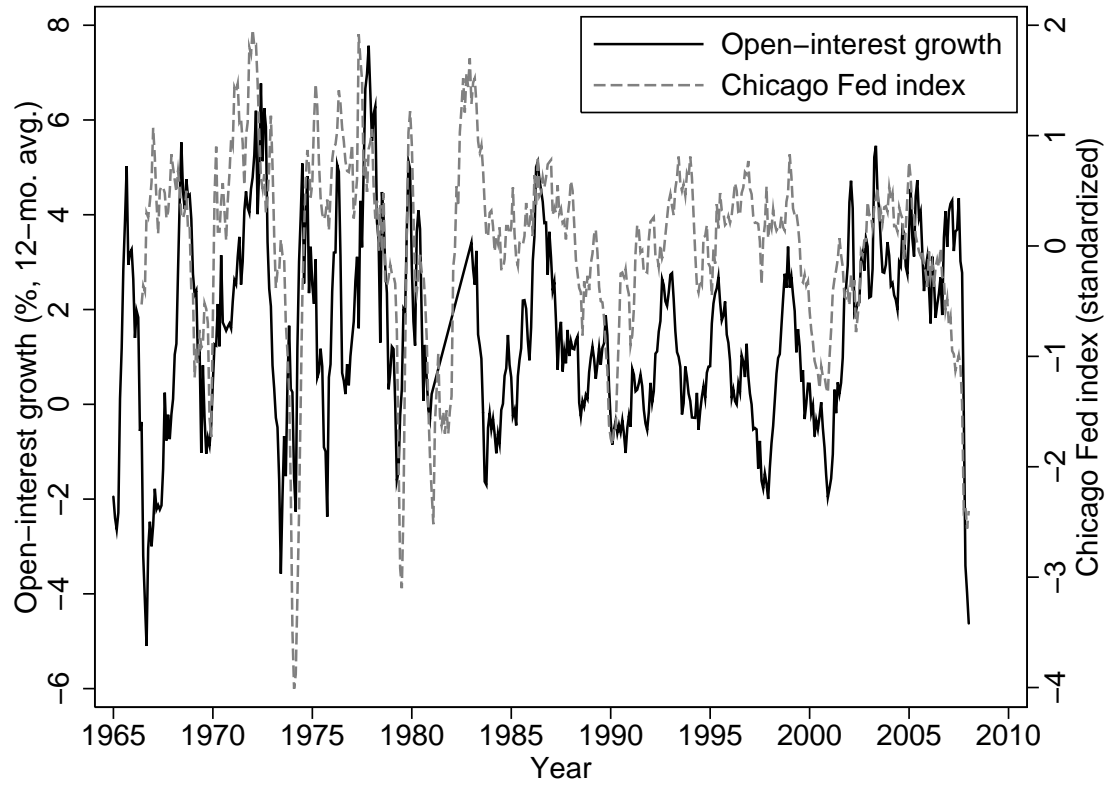


Figure 2: Commodity Market Interest and the Chicago Fed National Activity Index
This figure shows the 12-month geometrically averaged growth rate of commodity market interest. It also shows the Chicago Fed National Activity Index, which is a weighted average of 85 monthly indicators of U.S. economic activity. The sample period is 1965:12–2008:12.

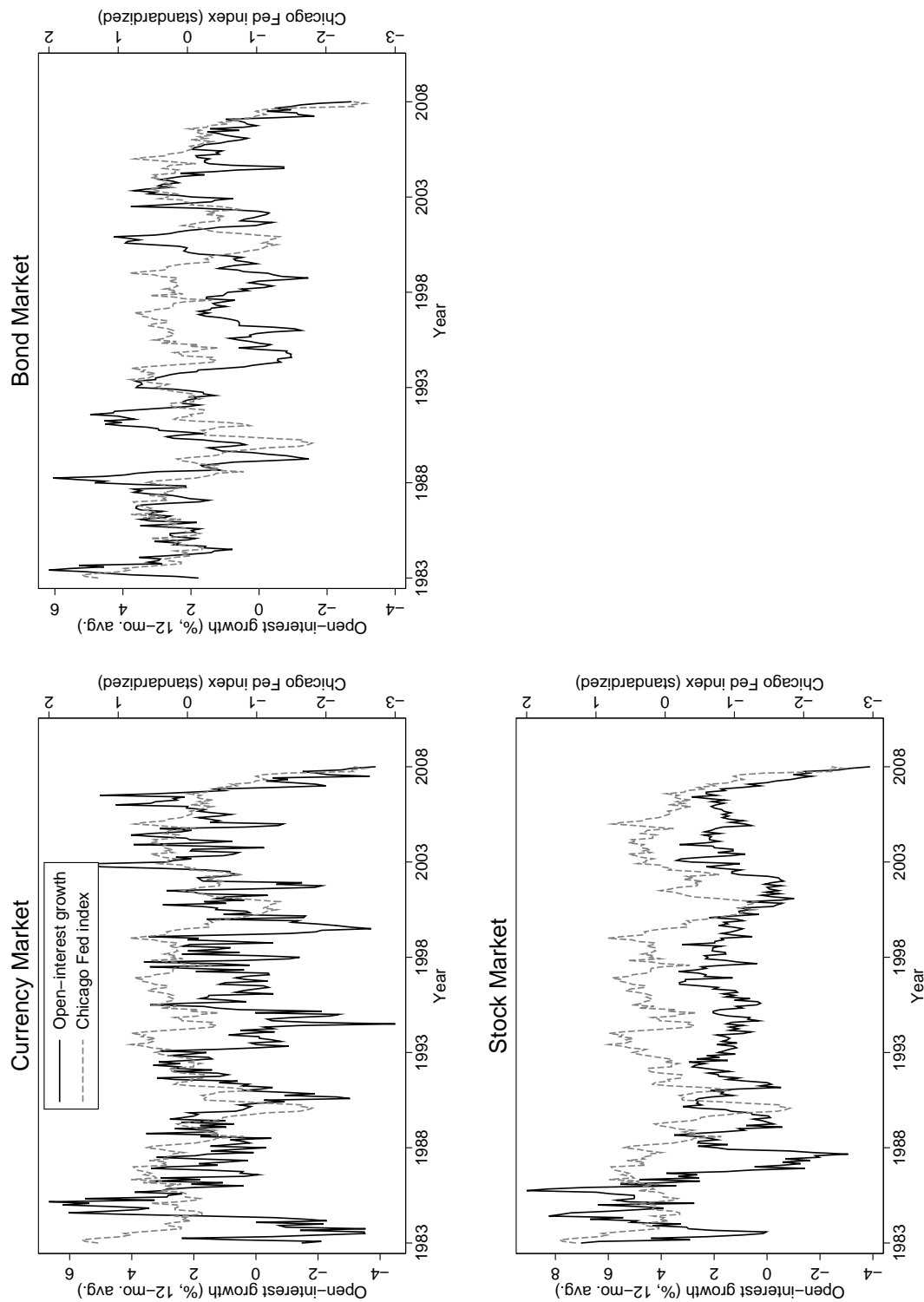


Figure 3: Currency, Bond, and Stock Market Interest and the Chicago Fed National Activity Index

This figure shows the 12-month geometrically averaged growth rate of currency, bond, and stock market interest. It also shows the Chicago Fed National Activity Index, which is a weighted average of 85 monthly indicators of U.S. economic activity. The sample period is 1983:12–2008:12.

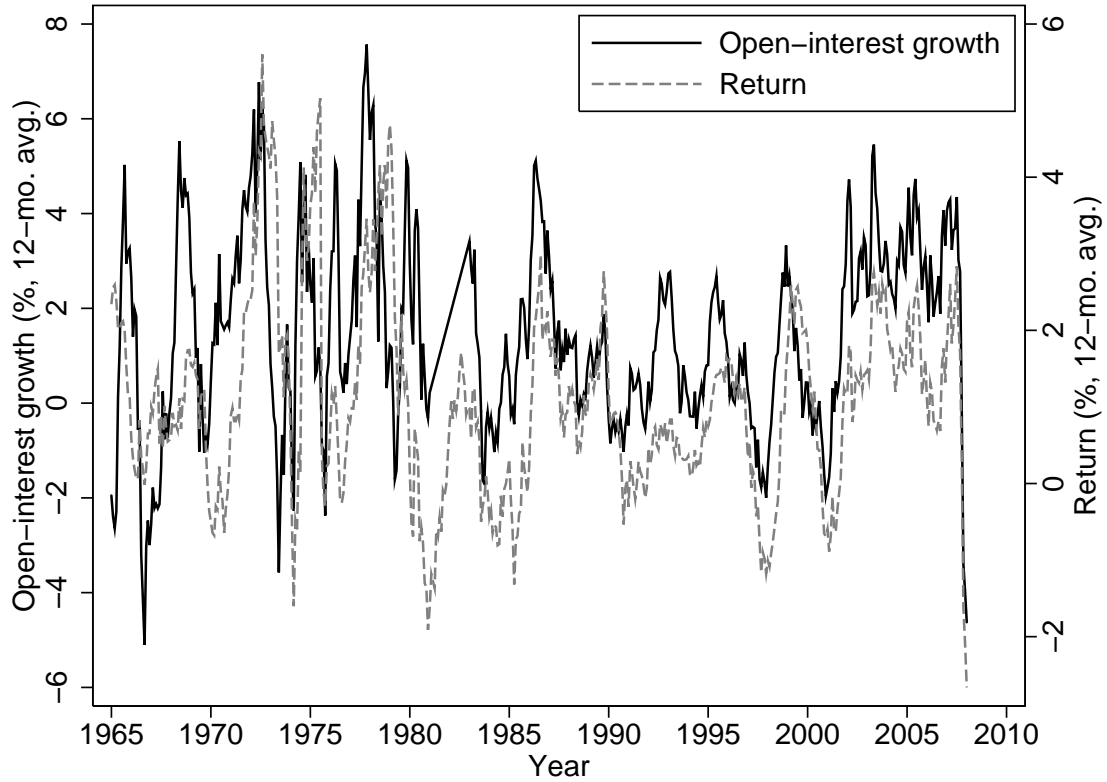


Figure 4: Commodity Market Interest and Returns

This figure shows the 12-month geometrically averaged growth rate of commodity market interest. It also shows the 12-month geometrically averaged returns on a portfolio of fully collateralized commodity futures, equally weighted across agriculture, livestock, energy, and metals. The sample period is 1965:12–2008:12.

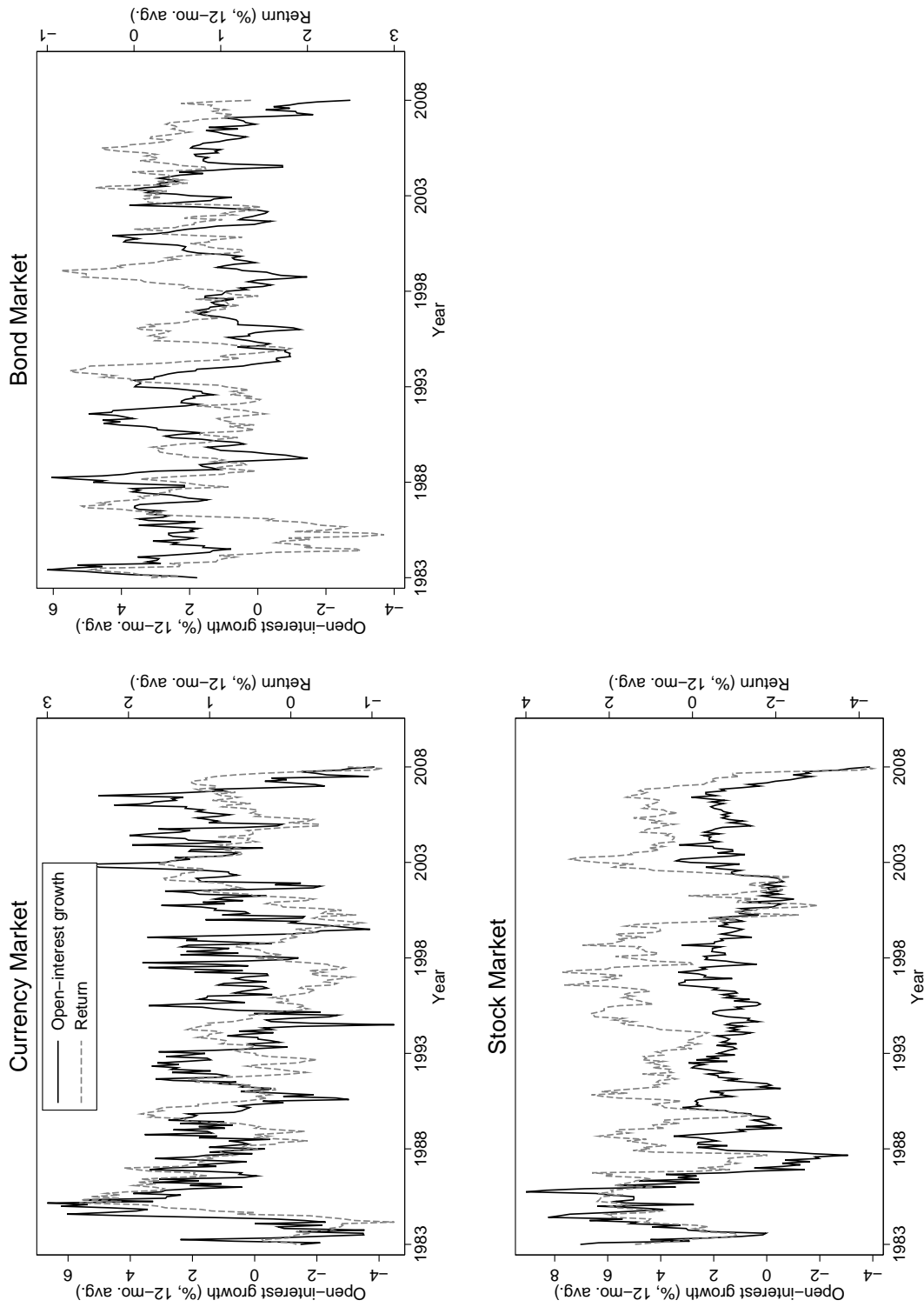


Figure 5: Currency, Bond, and Stock Market Interest and Returns

This figure shows the 12-month geometrically averaged growth rate of currency, bond, and stock market interest. It also shows the 12-month geometrically averaged returns on a portfolio of fully collateralized currency futures, the 10-year U.S. Treasury note, and the CRSP value-weighted stock portfolio. The sample period is 1983:12–2008:12.