Does the Masters Hypothesis Explain Recent Food Price Spikes?

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Abstract

The Masters Hypothesis is the claim that unprecedented buying pressure in recent years from commodity index investors created massive bubbles in food and energy prices. A number of recent studies investigate the empirical relationship between index investment and price movements in agricultural futures markets. One line of research uses time-series regression tests, such as Granger causality tests, to investigate the relationship between price movements and index positions. This research provides little evidence in support of the Masters Hypothesis in agricultural futures markets. A second line of research uses cross-sectional regression tests and studies in this area provide very limited evidence in favor of the Masters Hypothesis for agricultural futures markets. A third line of research investigates whether there is a significant relationship between commodity index trading and the difference, or spread, between futures prices of different contract maturities. These studies report a range of results depending on the type of test. However, the bulk of the evidence indicates either no relationship or a negative relationship, which is once again inconsistent with the Masters Hypothesis. Overall, this growing body of literature fails to find compelling evidence that buying pressure from commodity index investment in recent years caused a massive bubble in agricultural futures prices. The Masters Hypothesis is simply not a valid characterization of reality.

Keywords: agriculture, futures markets, index investment, Masters Hypothesis, speculation

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Does the Masters Hypothesis Explain Recent Food Price Spikes?

Food prices at the bulk commodity level have trended upward since 2006 and have experienced two rather dramatic spikes, the first in 2008 and the second in 2010 (Figure 1). Because consumers in less-developed countries devote a relatively high proportion of disposable income to food purchases, sharp increases in the price of food can be quite harmful to the health and well-being of large numbers of people. For example, Robert Zoellick, President of the World Bank Group, stated in February 2011 that, "Global food prices are rising to dangerous levels and threaten tens of millions of poor people around the world. The price hike is already pushing millions of people into poverty, and putting stress on the most vulnerable who spend more than half of their income on food." (WB, 2011) Consequently, food prices have become a high-priority issue in public policy debates (e.g., G-20, 2011). Crafting effective policy responses requires a careful assessment of the underlying causes of the spikes.

Much attention has been directed towards the trading activities of a new type of participant in commodity futures markets—financial index investors—during recent price spikes. Hedge fund manager Michael W. Masters has testified numerous times (e.g., Masters, 2008 2009) before the U.S. Congress and U.S. Commodity Futures Trading Commission (CFTC) with variations on the following theme about the market impact of index investment:

> "Institutional Investors, with nearly $30 trillion in assets under management, have decided en masse to embrace commodities futures as an investable asset class. In the last five years, they have poured hundreds of billions of dollars into the commodities futures markets, a large fraction of which has gone into energy futures. While individually these Investors are trying to do the right thing for their portfolios (and stakeholders), they are unaware that collectively they are having a massive impact on the futures markets that makes the Hunt brothers pale in comparison. In the last 4½, years assets allocated to commodity index replication trading strategies have grown from $13 billion in 2003 to $317 billion in July 2008. At the same time, the prices for the 25 commodities that make up these indices have risen by an average of over 200%. Today's commodities futures markets are excessively speculative, and the speculative position limits designed to protect the markets have been raised, or in some cases, eliminated. Congress must act to

re-establish hard and fast position limits across all markets." (Masters and White, 2008, p. 1).

In essence, Masters argues that unprecedented buying pressure from index investors created a massive bubble in commodity futures prices, and this bubble was transmitted to spot prices through arbitrage linkages between futures and spot prices. The end result was that commodity prices far exceeded fundamental values. Irwin and Sanders (2012a) use the term "Masters Hypothesis" as a short-hand label for this argument.

Several well-known international organizations (see Robles, Torero, and von Braun, 2009; De Schutter, 2010; Herman, Kelly, and Nash, 2011; UNCTAD, 2011) have been among the most ardent supporters of the Masters Hypothesis, arguing that commodity index investors were a principal driver of spikes in food commodity prices since 2007. Joachim von Braun, director of Germany's Center for Development Research, summarized this position rather bluntly, "We have good analysis that speculation played a role in 2007 and 2008… Speculation did matter and it did amplify, that debate can be put to rest. These spikes are not a nuisance, they kill. They've killed thousands of people."[1]

A number of economists have expressed skepticism about the Masters Hypothesis, citing logical inconsistencies and contrary facts (e.g., Irwin, Sanders, and Merrin, 2009; Pirrong, 2010; Wright, 2011; Dwyer, Holloway and Wright, 2012). Nonetheless, index flows may cause commodity prices to deviate from fundamental values under certain theoretical conditions. Irwin and Sanders (2012a) posit the following conditions: i) commodity futures markets may not be sufficiently liquid to absorb the large order flow of index investors, ii) index investors are in effect noise traders who make arbitrage risky, and this opens the possibility of index investors 'creating their own space' if their positions are large enough (De Long et al., 1990), and iii) the large order flow of index investors on the long side of the market may be seen (erroneously) as a reflection of valuable private information about commodity price prospects, which has the effect of driving the futures price higher as other traders subsequently revise their own demands upward (Grossman, 1986). Singleton (2011) notes that learning about economic fundamentals with heterogeneous information may induce excessive price volatility, drift in commodity prices, and a tendency towards booms and busts. He argues that under these conditions the flow of index investments into commodity futures markets may harm price discovery and social welfare.[2]

Given the world-wide nature of the debate about food price spikes it is not surprising that a number of recent studies investigate the empirical relationship between commodity index positions and price movements in agricultural futures markets. One line of research uses time-series regression tests, such as Granger causality tests. A second line of research uses cross-sectional regression tests. A third line of research investigates whether there is a significant relationship between index investor trading and the difference, or spread, between futures prices of different contract maturities. The purpose of this paper is to review the evidence from each of these lines of research.[3] The approach taken is to discuss in some detail the results of a representative study and then summarize the results of other similar studies. Before delving into the reviews, a brief overview of commodity index investment is provided in the next section.

Commodity Index Investments

The financial industry has developed products that allow institutions and individuals to invest in commodities through long-only index funds, over-the-counter (OTC) swap agreements, exchange traded funds, and other structured products. Several influential academic studies in the last decade concluded that investors could capture substantial risk premiums and reduce portfolio risk through relatively modest investments in long-only commodity index investments (e.g., Gorton and Rouwenhorst 2006; Erb and Harvey 2006). Combined with the availability of deep and liquid exchange-traded futures contracts, these conclusions fueled a dramatic surge in commodity index fund investments. Data from the CFTC shows that index investment in commodity futures markets totaled nearly $200 billion at the end of 2011.

Commodity index investments share the common goal of tracking the broad movement of commodity prices. The Standard and Poors-Goldman Sachs Commodity Index™ (S&P-GSCI), is one of the most widely tracked indices and generally considered an industry benchmark; it is computed as a quantity production-weighted average of the prices from 24 commodity futures markets. While the index is well-diversified in terms of number of markets and sectors, the production-weighting results in a relatively large 67% weight towards the energy sector, and a fairly small 21% in traditional livestock and agricultural markets. The other industry benchmark is the Dow Jones-UBS Commodity Index™ (DJ-UBS). The DJ-UBS market weights are based on a combination of economic significance and market liquidity, with a maximum weight of 33% in any sector. Energy markets receive a weight of 28%, and the livestock and agricultural sectors combine to 40% of the DJ-UBS index. In both of these popular indices, the market weights, contract switching or rollover conventions, and contract months traded are well-publicized, resulting in a transparent and well-defined index.

Investors can gain exposure to commodity indices through a number of investment vehicles. A minority of institutions and individuals may gain commodity exposure by directly purchasing futures contracts in a manner that mimics a popular index. However, this number is relatively small, as most institutions are barred from directly trading futures, and individuals generally would have difficulty replicating a broad-based index. As an alternative to directly purchasing futures, institutions often invest in a fund that promises to mimic a popular commodity index. The fund manager will then either directly invest in futures or gain the promised market exposure by entering an over-the-counter (OTC) swap contract with a swap dealer. Swaps and other OTC derivatives are popular because they can be tailored by a swap dealer to meet the specific needs of a client. The swap dealer will in turn enter the futures market and take long positions in the corresponding futures contracts to offset the risk associated with their (short) side of the OTC derivative. As an alternative, institutional investors may choose to bypass the fund and enter directly into a commodity return swap with a swap dealer. Again, the swap dealer will be the agent who actually takes the long positions in the comomodity futures markets.

For individual investors, investment firms offer funds whose returns are tied to a commodity index. Both exchange-traded funds (ETFs) and structured notes (ETNs) have been developed that track commodity indices. ETFs are essentially mutual fund shares that trade on a stock exchange and are designed such that the share price tracks a designated commodity index. ETN's are actually debt securities where the issuer promises to make pay-outs based on the value of the underlying commodity index. Both ETFs and ETNs trade on exchanges in the same manner as stocks on individual companies. The management company that initially offers and manages the fund or note collects a fee for their services. To gain commodity exposure, ETF and ETN managers can either buy futures contracts directly, or more likely, utilize OTC commodity return swaps. The swap dealer will subsequently purchase commodity futures contracts to hedge their commodity exposure related to the swap transactions.[4]

Empirical Evidence

Descriptive Analysis

Since the original analysis of Masters (2008, 2009) and Masters and White (2008) focuses on the temporal relationship between index investment and commodity prices, a useful place to begin is a descriptive analysis of the relationship. The primary source of data on index positions is the CFTC. Starting in 2007—in response to complaints by traditional traders about the rapid increase in long-only index money flowing into the markets—the CFTC began reporting the positions held by commodity index traders in 12 agricultural futures markets in the *Supplemental Commitment of Traders* (SCOT) report, as a supplement to the traditional *Commitments of Traders* (COT) report. According to the CFTC, commodity index trader (CIT) positions in the SCOT reflect both pension funds that would have previously been classified as non-commercials (speculators) as well as swap dealers who would have previously been classified as commercials (hedgers). The SCOT report is released each Friday in conjunction with the traditional COT report and show the combined futures and options positions as of Tuesday's market close. The CIT positions are simply removed from their prior categories and presented as a new category of reporting traders.

The CFTC acknowledges that the classification procedure used to create the CIT category was imperfect and that, "Some traders assigned to this category are engaged in other futures activity that could not be disaggregated. As a result, the Index Traders category, which is typically made up of traders with long-only futures positions, will include some short futures positions where traders have multi-dimensional trading activities, the preponderance of which is index trading." (CFTC, 2006) Despite these imperfections, Irwin and Sanders (2012a) show that CIT positions are highly correlated with quarterly benchmark positions available from the CFTC since the end of 2007. This indicates measurement errors associated with CIT positions in agricultural futures markets are likely rather small and supports the widespread view that CIT data provide valuable information about index trader activity in agricultural futures markets.

A significant limitation of the public CIT data is the lack of data prior to 2006. This is an important constraint because several studies show that the buildup in commodity index positions was concentrated in the two or three years preceding 2006 (Sanders, Irwin, and Merrin, 2010; Sanders and Irwin, 2011a; Brunetti and Reiffen, 2011; Aulerich, Irwin, and Garcia, 2012). The CFTC did collect additional data for selected grain futures markets over 2004-2005 at the request of the U.S. Senate Permanent Subcommittee on Investigations (USS/PSI, 2009) and these data were used by Sanders and Irwin (2011a) in their analysis of Chicago Board of Trade (CBOT) corn, CBOT wheat, CBOT soybeans, and Kansas City Board of Trade (KCBT) wheat. The sample of CIT data started in January 6, 2004 and ran through September 1, 2009 (296 weekly observations) for each of the four markets.

Table 1 from Sanders and Irwin (2011a) presents summary statistics for various position measures, average nearby futures prices, and the cumulative weekly log-relative nearby futures returns by year for 2004-2009. Several interesting trends are apparent. First, the rapid increase in commodity index positions occurred from 2004 to 2006. Over this interval, long positions held by index traders nearly tripled in both corn and CBOT wheat. Likewise, index funds percent of total open interest nearly doubled in corn and soybeans and increased 40% in CBOT wheat. It is clear that the build-up in commodity index fund positions in grain futures markets was concentrated in the 2004-2006 period, not the 2007-2008 period associated with the alleged commodity bubble.

A more complete picture of the index position buildup in 2004-2006 can be demonstrated graphically. The common association between index fund positions and prices is illustrated with selected data from 2007-2008. As shown in Figure 2, for markets such as wheat, the correlation over this time period appears to make a convincing demonstration of the relationship between index investment and price movements. However, when a larger picture is taken, using data from 2004-2009, the perceived association between prices and CIT positions breaks down substantially. Indeed, as illustrated in Figure 3, the major increase in CIT net long positions occurred from January 2004 through May 2006. During this period wheat prices were largely unchanged. Similar patterns are observed for the other three markets.

If index trader buying did have a market impact, it would have most likely occurred during 2004-2006 when their market holdings increased dramatically. It is difficult to reconcile the buildup of index positions in 2004-2006 with relatively flat prices and the assertion that index trader buying created a massive bubble in wheat futures prices. The relationships observed in the 2007-2008 period seem to be a mere coincidence. It is, of course, important to keep in mind that graphical evidence can always be deceptive. Therefore, it is important to test more formally for statistical links between index positions and prices. The following sections discuss three different approaches to determining if there is a causal link between commodity index positions and changes in agricultural futures price movements.[5]

Time-Series Tests

The first set of tests is based on time-series regressions. One widely used technique is Granger causality, which determines whether one time-series is useful in forecasting another by estimating the following regression model,

(1) $$R_t = \alpha_t + \sum_{i=1}^{m} \gamma_i R_{t-i} + \sum_{j=1}^{n} \beta_j \Delta Position_{t-j} + \varepsilon_t .$$

where R_t is the log-relative nearby futures returns for a given market in period t and $Position_t$ is a measure of commodity index positions in the same market. The null hypothesis of no causal link between index trader positions and returns is tested using an F-test of the linear restriction that $\beta_j = 0 \forall j$. As is well known (e.g., Newbold, 1982), some care is needed when interpreting statistical test results from Granger causality regressions. Hamilton (1994, p. 308) suggests it is better to describe Granger causality tests between *X* and *Y* as tests of whether *X* helps forecast *Y* rather than whether *X* truly causes *Y*.

Sanders and Irwin (2011a) estimate equation (1) for the same weekly data that was summarized in the previous section. Commodity index trader positions in equation (1) were measured in two ways. First, the position variable was calculated using the net long position of CITs (long contracts – short contracts). This measure most directly captures the essence of the charge that index positions are "too big" and have pressured prices upwards substantially. The second position measure is the percent of long positions, where CIT long positions (contracts) are divided by the total long positions in the market (contracts) to get the percent of long positions within that market held by index traders.

As shown in Table 2, the model selection procedure used by Sanders and Irwin (2011a) chose a simple (m=1, n=1) model for each market and position measure with just a one period lag of both returns and positions. Given this model selection, it was not surprising that the null hypothesis of no causality from positions to returns $\left(H_0 : \beta_j = 0\right)$ could not be rejected at the 5% level for any market or position measure. Based on these results, there was no compelling evidence that CIT positions led price changes or returns. However, it is possible that the causal relationship shifted after the initial buildup of index positions in the first half of the sample. To test this, Sanders and Irwin re-estimated the models after incorporating a 2004-2006 slope-shift variable for the estimated β coefficients. As shown in the final column of Table 2, the shift variable was not statistically different from zero. This suggests that impact of lagged positions on returns was equally unimportant in both the 2004-2006 and 2007-2009 subsamples.

Several other studies conduct similar Granger causality tests. Gilbert (2009) did not find evidence of a significant time-series relationship between weekly commodity index positions and returns in corn, soybeans, and wheat futures markets, but in subsequent work reported evidence of a significant relationship with an index of food price changes (Gilbert, 2010) and returns in less liquid agricultural futures markets such as soybean oil, feeder cattle, live cattle and lean hogs (Gilbert and Pfuderer, 2012). Stoll and Whaley (2010) used a variety of tests, including Granger causality tests, and found no evidence that the weekly positions of commodity index traders impact prices in the 12 agricultural futures markets included in the SCOT. Capelle-Blancard and Coulibaly (2011), Sanders and Irwin (2011b), and Hamilton and Wu (2012) reported similar results for the same 12 SCOT agricultural futures markets. Brunetti, Buyuksahin, and Harris (2011) conducted a battery of Granger causality tests and did not find a statistical link between daily index positions and subsequent returns or volatility in the corn futures market. Aulerich, Irwin, and Garcia (2012) also conducted Granger causality tests for the 12 SCOT agricultural markets and did not find a statistical link between daily aggregate index positions and returns or volatility. Overall, the available research using time-series regression tests provides little evidence in support of the Masters Hypothesis in agricultural futures markets.

Cross-Section Tests

A criticism of time-series Granger causality tests is that they may lack the statistical power necessary to reject the null hypothesis of non-causality because the dependent variable—the change in commodity futures prices—is extremely volatile. This is the motivation for a second line of research that uses cross-sectional regression tests.

The relationship between commodity index positions and subsequent commodity market returns can be expressed in the following cross-sectional regression model,

(2) $$R_{i,t} = \alpha + \beta Position_{i,t-j} + e_{i,t} \quad i = 1,..,N \;\; t = 1,...,T$$

where the variables are defined the same as in equation (1) except that the subscript i has been added to represent the N markets under consideration. The null hypothesis of no impact on returns is that the slope coefficient, β, in equation (2) equals zero. An alternative bubble-type hypothesis is that $\beta > 0$, such that an increase in CIT positions in market i leads to relatively large subsequent returns in that market.

Sanders and Irwin (2010) estimated equation (2) using weekly CIT positions and nearby futures returns over January 3, 2006 through December 30, 2008 (157 weekly observations). The 12 agricultural futures markets included in the SCOT report made up the cross-section of markets: corn, soybeans, soybean oil, and wheat traded at the CBOT; wheat traded at the KCBOT; feeder cattle, lean hogs, and live cattle traded at the Chicago Mercantile Exchange (CME); and cocoa, cotton, coffee, and sugar traded at the Intercontinental Exchange (ICE). Sanders and Irwin used the Fama and MacBeth (1973) method of estimating β in equation (2). With this procedure, equation (2) is estimated via ordinary least squares (OLS) regression for each time period t =1,2,3,…,T across the i =1,2,3,…,N markets. The average of the estimated slopes (β) is calculated for the T regressions and the associated standard error is $\sigma_{\bar{\beta}} / T^{1/2}$. The basic estimation strategy is to exploit the information in the cross-section of markets about the relationship between index investment and returns and then treat each cross-section as an independent sample.[6]

As an illustration of the Fama-MacBeth estimation procedure, Figure 3 from Sanders and Irwin (2010) shows one of the *T* regressions for the quarterly horizon. In this particular quarter (*t* = third quarter 2008), markets that had proportionately large long positions held by index traders indeed saw relatively stronger returns in the subsequent period, consistent with a bubble-like impact across markets. Other quarters, such as that in Figure 4 (*t* = second quarter 2007), show a negative relationship between CIT positions and subsequent returns. As noted above, the Fama-MacBeth procedure essentially averages the cross-sectional slope coefficient across all of the time-series observations and tests if the average is different from zero. Sanders and Irwin applied the Fama-Macbeth procedure to weekly, monthly, and quarterly horizons resulting in 156, 35, and 11 observation periods, respectively. The cross-section always consists of the 12 markets.

The Fama-MacBeth results are presented in Panel A of Table 1 for equation (2), where positions are represented by the percent of long positions held by index traders.[7] Somewhat surprisingly, the average slope coefficient at each horizon is negative; albeit, not statistically different from zero. These results would suggest that if anything, markets with relatively large index trader positions tend to have relatively smaller price increases in subsequent time periods. Panel B of Table 1 presents the results for the Fama-MacBeth regressions where the independent variable is the change in the percent net long position of index traders. Here, the results are similar to those in Panel A at the monthly and quarterly horizon, where the slope coefficients are negative and not statistically different from zero. A slightly different result is observed at the weekly horizon, where the slope coefficient is positive; but, it is still not statistically different from zero. Collectively, the Fama-MacBeth regressions provide no evidence that index positions cause differential returns across this cross-section of commodity futures markets.

Irwin and Sanders (2012a) conducted the only other cross-sectional tests of the impact of index investments in commodity futures markets to date. They use quarterly data on commodity index positions in 19 agricultural, energy, and metals futures markets drawn from the CFTC's new *Index Investment Data* report and found no evidence of a significant cross-sectional relationship with returns or volatility. The results were robust to whether lagged or contemporaneous effects are considered and the addition of the nearby-deferred futures spread as a conditioning variable. Irwin and Sanders argued that the findings represented the strongest evidence to date against the Masters Hypothesis because: i) the new index investment data used in the study are the best available measurement of the increase in the total effective "demand" of index investors; and ii) the Fama-MacBeth test has good power properties for the sample sizes considered in their study.

Spread Tests

A third line of research investigates whether there is a significant relationship between commodity index investor trading and the difference, or spread, between futures prices of different contract maturities. Spreads are examined because it is commonly argued that the rolling of positions simultaneously pressures the price of the nearby contract down, which index traders are selling, and pressures the price of the next contract up, which index traders are buying. The net result is that the spread between the nearby and first deferred contract expands to accommodate the movement of large index positions between contracts. This increase is argued to be permanent once index positions become large and the market expects this rolling activity to occur as each contract nears expiration.

Irwin et al. (2011) provide one type of test of the impact of index trader rolling on spreads in CBOT corn, soybeans and wheat futures. Table 4, drawn from their study, presents the average behavior of nearby spreads (expressed as a percent of full carry) during the first 13 business days of the calendar month prior to contract expiration over March 1995 through July 2010. The time window is centered on days 5-9, the time period of the so-called "Goldman roll" when index traders tend to roll their positions from the nearby to the next deferred contract. This is the event window in the terminology of event studies. Four sub-periods are represented in each market. The first is March 1995 through November or December 2001, which represents a period with very little commodity index trading. The second is January or March 2002 through November or December 2003, which is the time period when index trading first began to appear in earnest. The third is January or March 2004 through November or December 2005, which is the period of most rapid growth in index trading. The fourth is January or March 2006 through July 2010, which is the period with the largest commodity index positions.

The averages for corn and wheat in Table 4, but less so for soybeans, reveal a consistent increase in the size of the spread to the next contract (expressed as a percent of full carry) during Goldman roll days 5 through 9. When a spike in the magnitude of the spread is present it either disappears entirely or noticeably recedes during days 10 through 13, so rolling did not necessarily lead to a permanent increase in the magnitude of the spread. Irwin et al. (2011) also noted that the spike in the magnitude of the spread during the roll period was present in corn and wheat long before index investors had a major presence in these markets. This is not entirely surprising since the time window when index investors roll to the next contract is also the same period when many other traders roll their positions.

An alternative argument about the impact of commodity index investment on spreads is that the initiation of large positions by index investors in a "crowded market space" is the problem not the rolling of index positions *per se*. Specifically, if index investment effectively shifts out the demand for storage curve and the supply of storage curve is fixed and upward sloping throughout its range, then both the level of inventory and the price of storage (futures spread) increase. Irwin et al. (2011) also test this more general form of market impact using Granger causality tests of the following form,

(3) $$Spread_t = \alpha + \sum_{i=1}^{m} \gamma_i Spread_{t-i} + \sum_{j=1}^{n} \beta_i Position_{t-j} + \varepsilon_t$$

where $Spread_t$ is the difference between the prices for two futures contracts on day *t* (again measured in percent of full carry terms). The two contracts are the nearby contract closest to expiration and the first deferred contract. Two flow measures were used in order to test the sensitivity of results to the measurement of index trader positions. The first position variable was the change in the number of net long contracts held by CITs (long contracts – short contracts). The second position variable is the percentage change in the number of net long contracts held by CITs.

The Granger causality test results from Irwin et al. (2011) are shown in Table 5. Reported statistics include *p*-values for testing the null hypothesis of no causality from CIT positions to the carry $\left(H_0 : \beta_j = 0 \; \forall \, j\right)$ and no lagged carry effects. Panels A and B present standard Granger results based only on lagged CIT position flows. In none of the six cases presented in these first two panels was the null hypothesis that CIT positions do not cause the carry rejected at the five percent level of significance. Given the persistence of spreads through time it is not surprising that the null hypothesis of no lagged carry effects is rejected at this significance level in every case. As a sensitivity test, Panels C and D present results where contemporaneous (lag 0) CIT position flows are added to the specifications used in Panels A and B. The addition of contemporaneous position flows does not change hypothesis test results—CIT positions do not cause the carry in any of the six cases. The Granger causality test results were uniform in failing to reject the null hypothesis that index investor positions were not associated with changes in nearby spreads for CBOT corn, soybeans, and wheat futures. The evidence was inconsistent with the argument that large changes in index fund positions sharply expand spreads in a "crowded market space."

Several other studies analyze the impact of index investment on spreads in agricultural futures markets. Stoll and Whaley (2010) did not find evidence that index rolling activities influenced spreads in the 12 agricultural markets included in the SCOT. Mou (2010) conducted several tests and concluded that the rolling of positions by index investors led to a modest expansion of spreads in grain futures markets over time and a substantial expansion in livestock futures markets. Brunetti and Reiffen (2011) estimated a GARCH time-series model and found a negative relationship between the aggregate size of index investor positions and spreads in corn, soybeans, and wheat futures markets, but a positive relationship during roll periods. Garcia, Irwin, and Smith (2011) estimate several reduced-form regression models and did not find a systematic tendency for spreads in agricultural futures markets to increase or decrease over time as financial index positions increase. Aulerich, Irwin, and Garcia (2012) conducted Granger causality tests for the 12 SCOT agricultural markets and reported consistent evidence that daily CIT positions are negatively related to spreads during the period when CITs roll trades from the nearby to the first deferred contract; the opposite of the expected outcome if CIT rolling activity simultaneously pressures nearby prices downward and first deferred prices upward.

The available evidence about the impact of index investment on spreads in agricultural futures markets is mixed, with results ranging from a negative to a positive impact depending on the type of test. However, the bulk of the evidence indicates either no relationship or a negative relationship. This is once again inconsistent with the Masters Hypothesis.

Summary and Conclusions

Food prices at the bulk commodity level have trended upward since 2006 and have experienced two rather dramatic spikes, the first in 2008 and the second in 2010. Because consumers in less-developed countries devote a relatively high proportion of disposable income to food purchases, sharp increases in the price of food can be quite harmful to the health and well-being of large numbers of people. The nature and cause of the recent spikes in food prices is the subject of an acrimonious and world-wide debate.

Hedge fund manager Michael W. Masters has led the charge (Masters, 2008 2009; Masters and White, 2009) that unprecedented buying pressure from new commodity index investors created a massive bubble in commodity futures prices at various times in recent years. Irwin and Sanders (2012a) use the term “Masters Hypothesis” as a short-hand label for this argument. Several well-known international organizations have been among the most ardent supporters of the Masters Hypothesis (see Robles, Torero, and von Braun, 2009; De Schutter, 2010; Herman, Kelly, and Nash, 2011; UNCTAD, 2011), arguing that index investors were a principal driver of spikes in food commodity prices since 2007.

A rapidly expanding number of studies investigate the empirical relationship between commodity index investments and price movements in agricultural futures markets. Three main lines of research are reviewed in this article. One line of research uses time-series regression tests, such as Granger causality tests, to investigate the relationship between price movements and index positions. This research provides little evidence in support of the Masters Hypothesis in agricultural futures markets. A second line of research uses cross-sectional regression tests and studies in this area provide very limited evidence in favor of the Masters Hypothesis for agricultural futures markets. A third line of research investigates whether there is a significant relationship between commodity index trading and the difference, or spread, between futures prices of different contract maturities. These studies report a range of results depending on the type of test. However, the bulk of the evidence indicates either no relationship or a negative relationship, which is once again inconsistent with the Masters Hypothesis.

In sum, a growing body of literature fails to find compelling evidence that buying pressure from commodity index investment in recent years caused a massive bubble in agricultural futures prices. The Masters Hypothesis is simply not a valid characterization of reality. This is not to say that the large influx of index investment did not have any impact in agricultural futures markets. Irwin and Sanders (2012b) argue that the expanding market participation represented by index investment has the potential to decrease risk premiums, and hence the cost of hedging, dampen price volatility, and better integrate agricultural futures markets with financial markets. In addition, there is the possibility that agricultural futures prices contained a bubble component in recent years, but this was not associated with commodity index investment. There is certainly a need for continued research on this important public policy issue.

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Endnotes

[1] As quoted in: Ruitenberg, R. "Global Food Reserve Needed to Stabilize Prices, Researchers Say." *Bloomberg.com*. March 29, 2010. http://www.bloomberg.com/apps/news?pid=newsarchive&sid=au9X.0u6VpF0.

[2] Several other recent papers develop theoretical models where commodity index investment impacts the price of risk, or risk premiums, in futures markets (Acharya, Lochstoer, and Ramadorai, 2010; Etula, 2010; Brunetti and Reiffen, 2011; Hamilton and Wu, 2011 2012; Cheng, Kirilenko, and Xiong, 2012). Irwin and Sanders (2012b) argue that it is important to contrast the "rational and beneficial" impact of index investment in these theoretical models, which has the net effect of lowering the cost of hedging, with the "irrational and harmful" impact of index investment under the Masters Hypothesis.

[3] Some recent studies provide less direct tests of the relationship between financial index positions and agricultural futures prices than the research studies reviewed in this paper. For example, Tiang and Xiong (2011) concluded that index investing has an impact on commodity prices (agricultural and non-agricultural) based on a trend towards increasing co-movement of futures prices for commodities included in popular investment indexes. In contrast, Buyuksahin and Robe (2011) reported that index investment activity is not associated with the increasing correlation between commodity and stock returns. Some studies have tested for the existence of price bubbles in agricultural futures markets (Gilbert, 2009; Phillips and Yu, 2010; Adammer, Bohl, and Stephan, 2011; Gutierrez, 2011), with mixed results.

[4] See Engelke and Yuen (2008), Stoll and Whaley (2010), and Irwin and Sanders (2011) for further details on the various commodity index investments.

[5] Much of the debate about the Masters Hypothesis has focused on the crude oil market. See Fattouh, Kilian, and Mahadeva (2012) for a comprehensive review of studies on the impact of financial index investors, and speculation in general, in the crude oil market.

[6] Ibragimov and Muller (2010, p. 454) provide a formal justification for the Fama-MacBeth test and show that as long as, "…coefficient estimators are approximately normal (or scale mixtures of normals) and independent, the Fama-MacBeth method results in valid inference even for a short panel that is heterogeneous over time."

[7] The explanatory variable in cross-sectional regressions should be normalized across markets since contract and market size varies widely across the 12 agricultural futures markets.

Table 1. Summary Statistics for Commodity Index Trader (CIT) Positions and Grain Futures Prices, 2004-2009.

Year/Market	(contracts) Long Position	(contracts) Short Position	Percent of Total Open Interest	Percent of Total Long Positions	(cents) Nearby Futures Price	(%) Nearby Futures Return
2004						
CBOT Corn	118,286	455	7%	14%	255	-31.9%
CBOT Soybeans	36,862	1,717	6%	12%	748	-15.6%
CBOT Wheat	57,187	744	15%	30%	349	-33.1%
KCBT Wheat	14,792	4	10%	19%	369	-16.9%
2005						
CBOT Corn	236,424	4,135	14%	27%	211	-22.3%
CBOT Soybeans	78,740	1,973	11%	22%	610	4.0%
CBOT Wheat	138,821	1,851	24%	48%	321	-8.5%
KCBT Wheat	18,307	4	10%	19%	346	12.1%
2006						
CBOT Corn	408,138	7,662	13%	26%	262	33.4%
CBOT Soybeans	119,287	3,679	14%	26%	594	-4.6%
CBOT Wheat	201,605	4,883	21%	42%	405	21.7%
KCBT Wheat	25,954	115	8%	17%	469	18.4%
2007						
CBOT Corn	370,682	12,020	11%	21%	375	-2.6%
CBOT Soybeans	155,864	4,766	12%	23%	866	45.9%
CBOT Wheat	197,338	11,179	21%	39%	639	40.2%
KCBT Wheat	31,560	519	11%	22%	644	49.7%
2008						
CBOT Corn	405,241	44,122	12%	21%	528	-28.6%
CBOT Soybeans	162,233	12,765	14%	26%	1228	-29.2%
CBOT Wheat	198,485	27,644	24%	43%	797	-49.5%
KCBT Wheat	26,687	1,054	13%	24%	836	-46.4%
2009						
CBOT Corn	316,896	45,133	14%	25%	374	-29.8%
CBOT Soybeans	138,406	17,230	15%	27%	1037	27.1%
CBOT Wheat	168,117	23,220	24%	42%	543	-37.3%
KCBT Wheat	26,508	1,243	15%	29%	585	-27.4%

Note: CBOT denotes Chicago Board of Trade and KCBT denotes Kansas City Board of Trade. Data for 2009 ends on September 1, 2009.

Source: Sanders and Irwin (2011a)

Table 2. Granger Causality Tests for Commodity Index Trader (CIT) Positions and Grain Futures Returns, January 6, 2004 - September 1, 2009

$$R_t = \alpha_t + \sum_{i=1}^{m} \gamma_i R_{t-i} + \sum_{j=1}^{n} \beta_j Position_{t-j} + \varepsilon_t$$

		p-values for Hypothesis Tests			2004-2006
Market	**m,n**	$\beta_j=0, \forall j$	$\gamma_i=0, \forall i$	$\gamma_i=\beta_j=0, \forall i,j$	β_j **Shift**
Panel A: Positions Measured in Net Long Contracts					
CBOT Corn	1,1	0.413	0.998	0.713	0.2994
CBOT Soybeans	1,1	0.446	0.468	0.430	0.6737
CBOT Wheat	1,1	0.841	0.741	0.916	0.4387
KCBT Wheat	1,1	0.895	0.462	0.757	0.3419
Panel B: Positions Measured in Percent of Long Positions					
CBOT Corn	1,1	0.103	0.710	0.263	0.6287
CBOT Soybeans	1,1	0.171	0.256	0.225	0.3155
CBOT Wheat	1,1	0.402	0.864	0.618	0.6152
KCBT Wheat	1,1	0.384	0.481	0.473	0.7200

Note: CBOT denotes Chicago Board of Trade and KCBT denotes Kansas City Board of Trade.

Source: Sanders and Irwin (2011a)

Table 3. Fama-MacBeth Regression Test for Commodity Index Trader (CIT) Positions and Agricultural Futures Returns, January 3, 2006 - December 30, 2008

$$R_{i,t} = \alpha + \beta Position_{i,t-j} + e_{i,t} \quad i = 1,..,N \;\; t = 1,...,T$$

		Estimated Coefficients		Hypothesis Test	
Horizon	**N,T**	**α**	**β**	**β=0**	**Adj. R^2**
Panel A: Percent of Long Positions					
Week	12, 156	0.0018	-0.0112	0.2087[a]	-0.001[b]
Month	12, 35	0.0067	-0.0461	0.2520	0.021
Quarter	12, 11	0.0311	-0.1663	0.2139	0.028
Panel B: Change in Percent Net Long					
Week	12, 155[c]	-0.0010	0.1086	0.1443	0.010
Month	12, 34	-0.0102	-0.2161	0.2294	0.022
Quarter	12, 10	-0.0165	-0.0811	0.7273	-0.020

[a] P-values for two-tailed t-test of the null hypothesis.
[b] Average adjusted R-squared across the T cross-sectional regressions.
[c] One time-series observation, T, is lost by first differencing the Percent Net Long variable.

Source: Sanders and Irwin (2010)

Table 4. Average Nearby Spreads for Chicago Board of Trade (CBOT) Corn, Soybean, and Wheat Futures during the Roll Period of Commodity Index Traders (CITs), March 1995 - July 2010 contracts

	Average Nearby Spread during Roll Window				
Commodity/Contracts	**Days 1-4**	**Days 5-9**	**Days 10-13**	***t*-statistic 1**	***t*-statistic 2**
	---% of full carry---				
Corn					
March 1995 - December 2001	25	27	23	-0.109	0.069
March 2002 - December 2003	38	43	37	-0.365	0.044
March 2004 - December 2005	62	71	69	-0.860	-0.637
March 2006 - July 2010	87	88	86	-0.397	0.168
March 1995 - July 2010	50	53	49	-0.286	0.016
Soybeans					
March 1995 - November 2001	19	17	5	0.096	0.482
January 2002 - November 2003	-7	-2	-3	-0.229	-0.218
January 2004 - November 2005	31	36	27	-0.257	0.211
March 2006 - July 2010	34	18	17	0.342	0.355
March 1995 - July 2010	21	16	10	0.283	0.573
Wheat					
March 1995 - December 2001	41	51	49	-0.618	-0.452
March 2002 - December 2003	43	54	46	-0.819	-0.196
March 2004 - December 2005	77	82	77	-1.091	0.130
March 2006 - July 2010	98	99	95	-0.322	0.839
March 1995 - July 2010	63	70	66	-0.813	-0.335

Notes: The event window for each contract is the first 13 business days of the calendar month prior to contract expiration. The time window is centered on days 5-9, the time period of the "Goldman roll" where index funds tend to roll their positions from the nearby to the next deferred contract. The hypothesis tested by the *t*-statistic 1 is that the average spread on days 1-4 equals the average spread on days 5-9. The hypothesis tested by the *t*-statistic 2 is that the average spread on days 1-4 equals the average spread on days 10-13.

Source: Irwin et al. (2011)

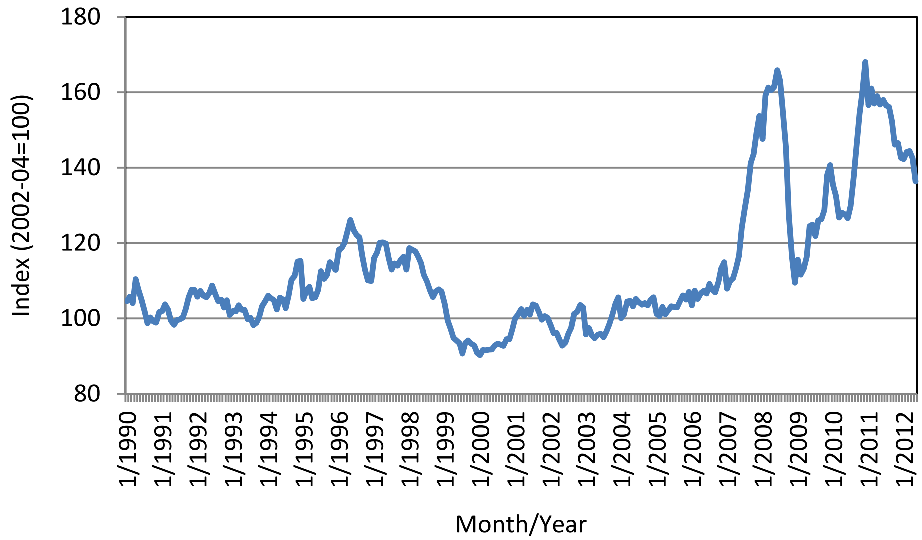
Table 5. Granger Causality Tests for Commodity Index Trader (CIT) Positions and Grain Futures Price Spreads, January 14, 2004 - September 7, 2010

$$Carry_t = \alpha + \sum_{i=1}^{m} \gamma_i Carry_{t-i} + \sum_{j=1}^{n} \beta_i Position_{t-j} + \varepsilon_t$$

Market	Optimal Lag Lengths (*m:*carry, *n:*CIT)	*p*-values for Hypothesis Tests: H_0: No CIT Effect	H_0: No Lagged Carry Effect
Panel A: Change in Net Long CIT Position (lagged)			
Corn	3,3	0.1020	0.0000
Soybeans	1,1	0.4347	0.0000
Wheat	3,3	0.4036	0.0000
Panel B: Percentage Growth Rate in CIT Position (lagged)			
Corn	3,3	0.2644	0.0000
Soybeans	1,1	0.5087	0.0000
Wheat	3,3	0.4868	0.0000
Panel C: Change in Net Long CIT Position (contemporaneous and lagged)			
Corn	3,3	0.1734	0.0000
Soybeans	1,1	0.4399	0.0000
Wheat	3,3	0.2971	0.0000
Panel D: Percentage Growth Rate in CIT Position (contemporaneous and lagged)			
Corn	3,3	0.2469	0.0000
Soybeans	1,1	0.3154	0.0000
Wheat	3,3	0.6543	0.0000

Source: Irwin et al. (2011)

Figure 1. Index of Real Food Commodity Prices, January 1990 – May 2012

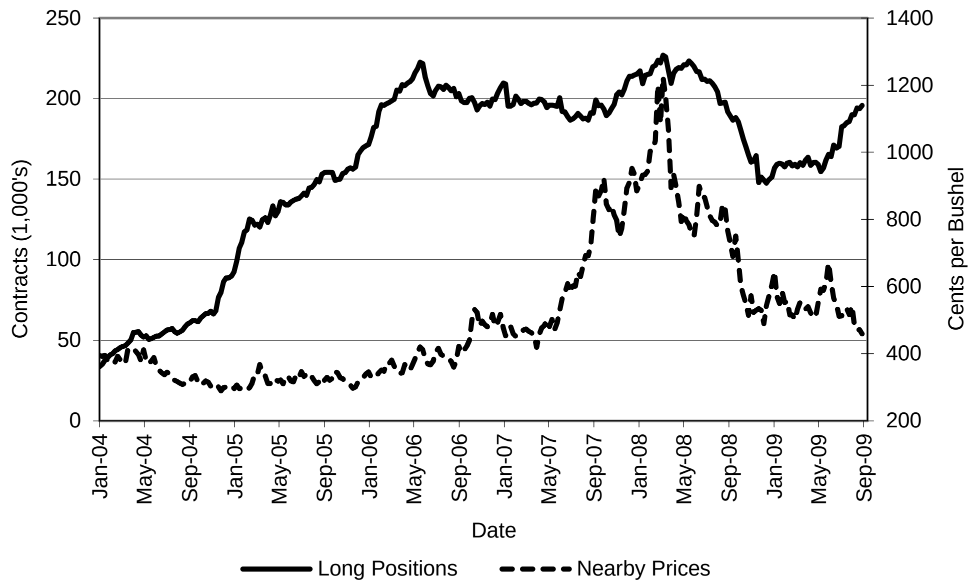


Source: Food and Agriculture Organization of the United Nations

Figure 2. Commodity Index Trader (CIT) Positions and CBOT Wheat Futures Prices, June 2007 - December 2008.

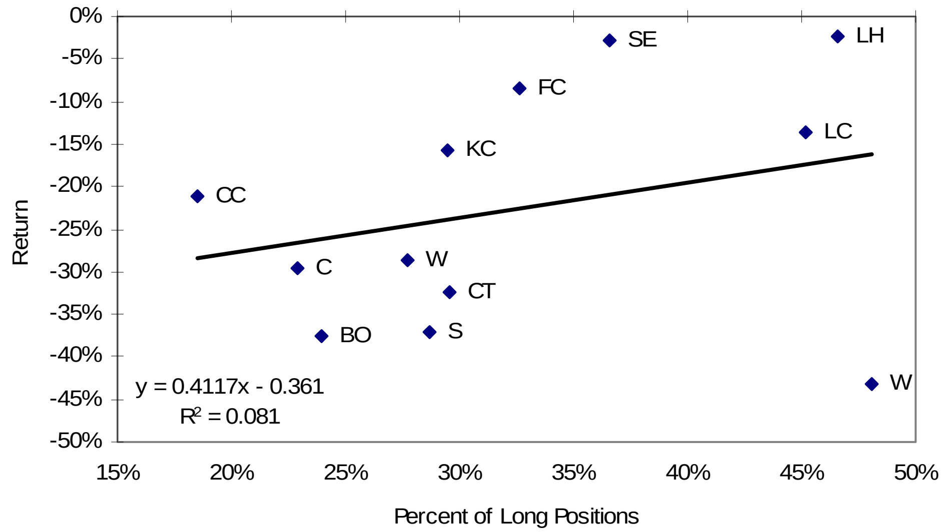
Source: Sanders and Irwin (2011a)

Figure 3. Commodity Index Trader (CIT) Positions and CBOT Wheat Futures Prices, January 2004 - September 2009.



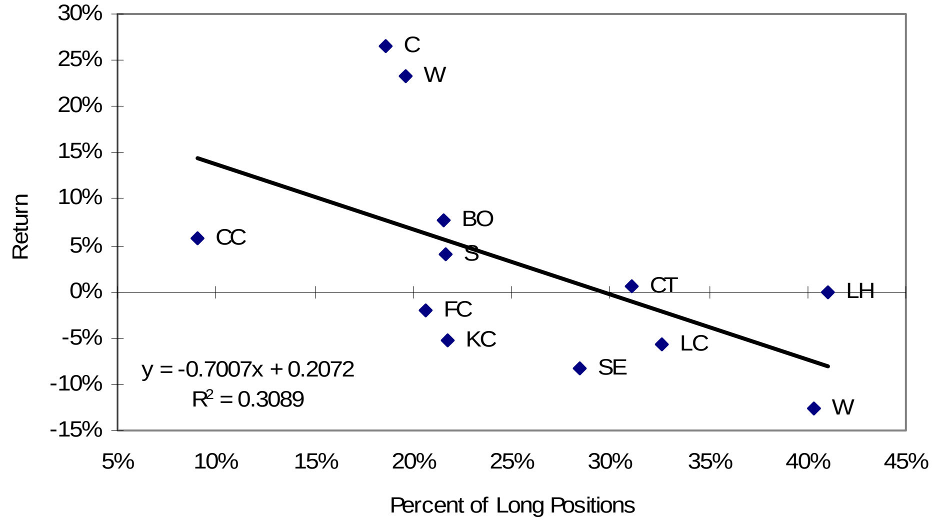
Source: Sanders and Irwin (2011a)

Figure 4. Fama-MacBeth Regression for Commodity Index Trader (CIT) Positions and Agricultural Futures Returns, Third Quarter 2008.



Source: Sanders and Irwin (2010)

Figure 5. Fama-MacBeth Regression for Commodity Index Trader (CIT) Positions and Agricultural Futures Returns, Second Quarter 2007.



Source: Sanders and Irwin (2010)