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DERIVATIVES MARKETS AND MANAGED MONEY: IMPLICATIONS FOR PRICE DISCOVERY

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ABSTRACT

Derivatives markets determination of commodities prices should largely be based on production and utilization of the underlying commodity. Certainly, government programs designed to impact production or utilization including expectations associated with those programs, as well as, weather, geopolitical issues, related commodity dynamics, terrorism, etc. could potentially impact prices. Derivatives markets participants such as producers, merchants, warehousers, processors and end users play a fundamental role of providing liquidity through their management of risk. Of increasing significance is managed money. Hedge funds, commodities index contracts, and commodity Exchange Traded Funds (ETFs) are types of managed money that look to commodity derivatives markets to speculate. This research project utilizes panel data, commodities prices and Commodities Futures Trading Commission (CFTC) data on Commitment of Traders (COT) to isolate the impact that managed money has on commodities prices. To this end we employ regression analysis to analyze various periods of time to test our hypothesis that the flow of managed money into and out of commodities derivatives markets creates price changes not consistent with production and utilization.

JEL: G10

KEYWORDS: Price Discovery, Managed Futures, Commitment of Traders, Regression, Hedge Funds, Managed Money, Speculation, Derivatives, Futures, Options, Swaps, CFTC

INTRODUCTION

Price discovery in futures markets involves many variables. Those variables certainly include production, utilization, trends in both, and other variables, including government programs, weather, geopolitical events, etc. to mention a few. In addition to these basic underlying supply and demand fundamental variables, derivatives markets have emerged for important and natural reasons, primarily, risk management for producers, merchandisers, warehousers and processors. In order for risk managers to successfully hedge their price risk associated with physical ownership of the underlying commodity, in this case cocoa, the market needs to be sufficiently liquid. Liquidity comes from other industry participants and speculators and is important for the function of the markets.

Of particular interest in this group of speculators are managed money. Managed money, including hedge funds, are actively seeking returns in many markets, including commodity derivative markets. Hedge fund activity can range from no active positions to long or short positions for various lengths of time. Regardless, the producers, merchants, swap dealers and other market participants have risk to manage. Hedge funds, Exchange Traded Funds, and Index Funds, known collectively as managed money, are not managing risk. Rather, they are seeking risk and profit opportunities. Managed money's activity in these commodities markets does bring arbitrage and liquidity, but also price movement that may not be consistent with the underlying market fundamentals. The purpose of this research is to show that managed money significantly impacts cocoa derivatives markets.

The remainder of this paper is organized as follows. We provide a review related literature and examine how it relates to this research. Next, data collection and methodology are explained, with statistical results and a corresponding analysis. The paper ends with a conclusion of this research paper, its limitations, and goals for future research.

LITERATURE REVIEW

In recent years, related literature has researched price discovery in both the spot and futures markets. Of specific interest is whether price discovery occurs in one market before the other, or both simultaneously. Additionally, it is necessary to examine which section of market participants drives the price. Price discovery means defining the actual dollar value of a commodity, security, or other similar asset. Garbade and Silber (1983) studied price discovery in the wheat and corn futures markets. Their findings supported the role of the futures market in price discovery. In this instance, around three fourths of pricing happened in the futures market. An analysis of oat futures, a smaller and less liquid market, demonstrated the significance of market size in price discovery. Price discovery of oats was determined to happen equally between the spot and futures markets. Tornell and Yuan (2011) studied how peaks and troughs in the foreign currency futures market affected the price in the corresponding spot market. They discovered that speculative peaks and hedging trough correlate to future price continuation. The opposing positions correspond with negative associations of future spot price changes.

Brandt, Kavajecz, and Underwood (2007) support the idea that the type of trader can produce contrasting results on price changes. Their regression analyses showed that retail customers drive prices in the direction of their trades, while exchange members move prices opposite of their positions. Retail customers are also referred to as speculators; they are reported as "managed money" in the Commitment of Traders report. Exchange members primarily use futures trading as a hedging method. Chen, Gau, and Liao (2014) used Commitment of Traders (COT) reports of currency futures to study the effects that speculators and hedgers had on the market. They utilized regression tests on net positions to determine that an increase in hedger positions decreases its price discovery contribution, while an increase in speculator positions has a positive effect on price discovery. This means that speculators, or large traders, have a substantially substantial impact on futures market prices.

Nardella (2007) provided an in-depth look into speculators in the cocoa futures market. As shown by Chen, Gau, and Liao (2014), speculators in a specific market positively impact the efficiency of price discovery. Nardella disproved the theory that speculators cause unfounded volatility to occur. A vector autoregressive (VAR) model was used to examine this volatility. The results showed that speculators simply reacted quicker to information regarding the market. They changed their position just before the overall market moved. Arora and Kumar (2013) studied the price discovery function of copper and aluminum futures in the India market via a Vector Error Correction Model (VECM). They found that the futures market had the most efficient price discovery. This supports the lead-lag relationship commonly found between the futures and spot markets, wherein the futures market is quicker to absorb new relative information; this is correspondingly reflected in the commodity price. This is supported by the fact that it is cheaper to invest in the futures market. With the understanding that a significant majority of price discovery happens in the futures market, and that speculators in other commodity markets have substantial influence on price, we will focus on the impact managed money has in the Cocoa futures market. Commonly accepted principles from previous academic literature are applied and evaluated in this paper.

DATA AND METHODOLOGY

This project utilizes panel data on cocoa derivatives (futures and options) traded on the Intercontinental Exchange. The data is composed of price data downloaded from Investing.com (2017) and contract positions disseminated from the Commodity Futures Trading Commission (CFTC) report known as the

Commitment of Traders (COT) report (2016 and 2017). The COT report contains data on the position of market participants regarding their holding of long and short positions of futures, options and swaps in various commodity markets, including cocoa. It is released every Friday, with data representative of the previous Tuesday. Our data spans from June 2006 until November 2017, totaling 591 total weekly observations. One cocoa futures contract is for 10 metric tons, or 22,046 pounds, of cocoa beans (Cocoa Futures, 2018). The price is quoted in US dollars per metric ton. Cocoa beans are produced in numerous equatorial countries. The top five cocoa producing countries are listed in Table 1.

Table 1: Top 5 Cocoa Producing Countries, 2013 – 2017 (1,000 Metric Tons)

Country:	2013	2014	2015	2016	2017
Ivory Coast	1499	1746	1796	1581	2010
Ghana	835	897	740	778	950
Indonesia	410	375	325	320	290
Ecuador	192	234	250	232	270
Cameroon	225	211	232	211	240

Table 1 shows data from the top 5 cocoa producing countries as obtained from Statista (2018). The countries are listed in order of highest producing to lowest producing. The top country is Ivory Coast, producing approximately one third of global output annually. Their production can be seen increasing from 2013-2017. Indonesia, on the other hand, experienced a decrease in production. The remaining three countries had stable production levels.

As can be seen in Table 1, the five largest cocoa producing countries are Ivory Coast, Ghana, Indonesia, Ecuador, and Cameroon (Statista, 2018). Ivory Coast is by far the largest producer, producing approximately one third of global output annually. It is interesting to note that Ivory Coast production is increasing while the production of Indonesia is declining. Production from the other three producers, Ghana, Ecuador, and Cameroon, are relatively stable. Summary statistics of the panel data, including minimum, maximum, range, mean, and standard deviation, as well as open contracts, are listed in Table 2.

Table 2: Select Summary Statistics of Data Set (June 2006 – November 2017)

	Price	MM	PM	SW	OT
Range (Min to Max)	$1403 - 3703	-52334 - 83674	-109661 - 20667	5103 - 26109	-9629 - 23872
Mean	$2570.57	23842	-41172	9277	3412
Standard Deviation	$498.44	1107	29122	4392	5334
Open Contracts	N/A	73202	178763	29507	13798

Table 2 shows summary statistics including range – minimum to maximum - mean, standard deviation, and open contracts for Price, Managed Money (MM), Producer Merchant (PM), Swap Dealers (SW) and Other Reportables (OT) as the designated categories in the Commitment of Traders report.

As seen in Table 2, the range of cocoa prices was from $1403 to $3703, with a mean price of $2570. The range of net open contracts for MM is -52334 to 83674 with a mean number of 23,842 contracts. The standard deviation is 1107 contracts. The range of net open contracts for PM is -109661 to 20667 with a mean number of net contract position of -41,172. This is consistent with industry practice of PM buying the physical commodity and selling derivatives (cocoa futures and options) to hedge. The range of net open contracts for SW is 5103 to 26109 with a mean contract holding of 9,277 and standard deviation of 4,392. The range of net positions for OT is -9629 to 23872 with a mean of 3412 and standard deviation of 5,334. In this research, we utilize the net position of each of the four groups reported: Producers and Merchants, Managed Money, Swap Dealers and Other Reportables. The net position is calculated by taking the difference between the long and short position. The regression model is specified as follows.

$$Price = \alpha - \beta_1 PM + \beta_2 MM + \beta_3 SW + \beta_4 OT + P_{t-1} + e_t \quad (1)$$

where:

PM = Producer / Merchant

MM = Managed Money

SW = Swap Dealers
OT = Other
P_{t-1} = Price lagged one period (one week)
e_t = Error term

Additionally, the following regression variations, Equations 2 through 6, are tested to determine select market participants' impact on price.

$$Price = \alpha - \beta_1 PM + \beta_2 MM + \beta_3 SW + \beta_4 OT + e_t \quad (2)$$

$$Price = \alpha - \beta_1 PM + e_t \quad (3)$$

$$Price = \alpha + \beta_2 MM + e_t \quad (4)$$

$$Price = \alpha + \beta_2 MM + P_{t-1} + e_t \quad (5)$$

$$Price = \alpha + \beta_3 SW + e_t \quad (6)$$

The PM group is in the market as a hedger and therefore is expected to generally be in a sell position, hence the negative sign on $\beta_1$in Equations 2 and 3. For example, specifically in the cocoa derivatives markets, a PM might be a chocolate company that buys cocoa beans to process in to its final chocolate and confectionary products. This company likely buys physical cocoa beans, then sells an equivalent tonnage worth of contracts in cocoa derivatives (futures or options) to hedge their price risk. The CFTC describes them as "an entity that predominantly engages in the production, processing, packing or handling of a physical commodity and uses the futures markets to manage or hedge risks associated with those activities." That could be a cooperative that buys beans from farmers and ships toward end users, as well as intermediate processors and end users. MM, on the other hand, is involved in the market to speculate and make a profit. According to the CFTC, they are "a registered commodity trading advisor (CTA); a registered commodity pool operator (CPO); or an unregistered fund identified by the CTFC." This group includes hedge funds, exchange traded funds and managed futures. SW participate in the derivative markets with a different twist on how to manage risk. Typically, one firm buys a fixed price contract to be swapped for a floating price contract. One trader is long, the other is short. They are "an entity that deals primarily in swaps for a commodity and uses the futures markets to manage or hedge the risk associated with those swap transactions", according to the CFTC. OT market participants who are not classified as PM, MM, or SW dealers fall into the OT category.

Our expectation, as can be seen in the regression model, is that the PM variable will have a negative impact on price. Further, our expectation is that MM will have either a positive or negative impact on price depending on the underlying market conditions. SW and OT should have a positive impact on price given the nature of their involvement and arbitrage in the market. Our hypothesis follows that MM will be a significant variable and the coefficient will be significantly different from zero.

Null Hypothesis $H_0: \beta_2 = 0$

Alternative Hypothesis $H_a: \beta_2 \neq 0$

Our expectations are as follows regarding selected time periods: 2006 - 2017, 12/2006 - 1/2008, 2011, 6/2013 - 10/2014, and 1/2016 - 1/2017.
From 2006 - 2017, PM will be significant and likely negative. MM will be indeterminate and significant. SW and OT will likely be positive and significant but have next to no impact on R^2.

December 2006 to January 2018 was selected because it was a period of substantial price appreciation. Our expectations are that MM will be positive and PM will be negative.

Weeks 2/1 through 11/29 of the year 2011 were selected because it was a period of substantial price depreciation. Our expectations are that MM will be negative and PM will be negative.

June 2013 to October 2014 was selected because it was a period of substantial price appreciation. Our expectations are that MM will be positive and PM will be negative.

January 2016 to January 2017 was selected because it was a period of substantial price depreciation. Our expectations are that MM will be negative and PM will be negative.

RESULTS AND DISCUSSION

The results of regressions from the entire time range, June 2006 to November 2017, are detailed in Table 3.

Table 3: Regression Results from 2006-2017

Regression	P/M	MM	SW	OT	P_{t-1}	R^2	Adj R^2
1	-0.00067	-0.00037	0.00082	0.0011	0.97***	0.960	0.959
2	0.043***	0.052***	0.0071***	0.084***		0.359	0.355
3	-0.007***					0.181	0.179
4		0.0063***				0.114	0.113
5		0.00024			0.978***	0.959	0.959
6			0.023***			0.040	0.038

*Table 3 shows regression results for the entire data set from 2006 – 2017. Significant regressions to examine include Regression 1, Regression 2, and Regression 4. Regression 1 shows that only lagged price is significant while none of the COT variables have a significant impact on price. Regression 2 shows that with lagged price excluded, each of the COT variables are significant but $R^2 = 0.355$. Regression 4 shows that MM is significant at the 99 percent level but R^2 is only 0.11. ***, **, and * represent significance at the 1, 5, and 10 percent levels, respectively.*

As can be seen in Table 3, regression 1 shows results for all variables, including price lagged one period. The only significant variable is P_{t-1}. PM, MM, SW and OT all have coefficients that are not significantly different from zero. Regression 2 includes all four market participant groups without lagged price. They are all significant at the 99 percent level, but the adjusted R^2 is relatively low at 0.355. Only the PM group is tested in Regression 3. The coefficient of -0.007 is significant with an R^2 of 0.181. In Regression 4, MM is significant with an R^2 of only 0.114. With the inclusion of P_{t-1} in Regression 5, MM becomes insignificant, while P_{t-1} is significant with an R^2 of 0.959. Regression 6 examines SW influence on the market, finding that it is significant at the 99 percent level with a very small R^2 of 0.040. When analyzing the entire data period, no one independent variable stands out as a driver of price. However, one should note that both PM and MM are singularly significant. PM's slightly higher R^2 makes sense, since this group is always in the market managing risk. MM does not have to be in this market and likely participates little until an event occurs, such as migrant labor problems in Ivory Coast, civil unrest, geopolitical disturbance in one of the larger producing countries, etc. To further examine participants' impact on the market during a time of substantial increase in price, we select data from December 2006 to January 2006. This totaled fifty-eight observations. Table 4 shows regression results from this selected period.

Table 4: Regression Results from December 2006-January 2008

Regression	P/M	MM	SW	OT	P_{t-1}	R^2	Adj R^2
1	-0.00305	0.0000019	-0.0072	-0.0074	.743***	0.859	0.845
2	-0.012	-0.00381	-0.026	0.018		0.594	0.563
3	-0.0085***					0.337	0.326
4		0.010***				0.423	0.413
5		0.0034***			0.791***	0.851	0.845
6			-0.016***			0.148	0.133

*Table 4 shows regression results for the selected period of 12/2006-1/2008. Regression 1 shows the only significant variable is lagged price. Regression 3 confirms our expectations that P/M is negative during a period of price appreciation; it is significant with an R^2 of 0.326. Regression 4 shows that MM is significant with an R^2 of 0.423. Inclusion of price lagged one period increases R^2 to 0.845, as seen in Regression 5. ***, **, and * represent significance at the 1, 5, and 10 percent levels, respectively.*

In Table 4, Regression 1, results are similar to those of Table 3, Regression 1. None of the COT variables are significant. Only P_{t-1} shows significance at the 99 percent confidence level. Regression 2 finds that none of the COT variables are significant. Regression 3, however, examines solely Producers/Merchants. Consistent with expectations during a period of price increases, the PM coefficient was negative and significant at the 99 percent level. Regression 4 determines that MM was positive and significant at the 99 percent level with R^2 of 0.423. By including P_{t-1} to MM in Regression 5, both variables are significant with an R^2 of 0.845. SW has a negative and significant impact; the R^2 is 0.148. Table 5 shows regression results from February 2, 2011 to November 29, 2011, a time of price decline. There were forty-four observations in this section.

Table 5: Regression Results from 2011

Regression	P/M	MM	SW	OT	P_{t-1}	R^2	Adj R^2
1	-0.041**	-0.037*	-0.036*	-0.070**	0.553***	0.912	0.900
2	-0.047*	-0.037	-0.028	-0.060		0.792	0.771
3	-0.015***					0.784	0.779
4		0.0261***				0.752	0.747
5		0.0113***			0.562***	0.897	0.891
6			0.0787***			0.662	0.654

*Table 5 shows regression results for the 2011 calendar year. Regression 1 shows that all variables are significant with an R^2 of 0.900. In Regression 4, MM by itself is significant with an R^2 of 0.752. With the addition of lagged price in Regression 5, MM remains significant at the 99 percent level, and R^2 improves to 0.891. ***, **, and * represent significance at the 1, 5, and 10 percent levels, respectively.*

In Table 5, we can see the results of Regression 1 that all variables are significant at varying levels with an adjusted R^2 of 0.900. By removing the lagged price variable in Regression 2, only PM remains statistically significant at the 90 percent level. R^2 drops to 0.771. PM stands alone with a significant coefficient and R^2 of 0.784 in Regression 3. In Regression 4, the MM coefficient, 0.0261, is significant at the 99 percent level of confidence with an R^2 of 0.752. When P_{t-1} is added in Regression 5, both variables are significant that the 99 percent level of confidence with an improved R^2 of 0.891. Regression 6 shows that SW is significant at the 99 percent level with an R^2 of 0.662. Table 6 shows regression results from the selected time period of June 2013 to October 2014. There were seventy-three observations.

Table 6: Regression Results from June 2013-October 2014

Regression	P/M	MM	SW	OT	P_{t-1}	R^2	Adj R^2
1	-0.0166**	-0.0153**	-0.0234***	-0.0011	0.772***	0.954	0.951
2	-0.0440***	-0.0372**	-0.0742***	0.0105		0.780	0.766
3	-0.0094***					0.266	0.256
4		0.0132***				0.298	0.288
5		0.00162*			0.947***	0.940	0.938
6			-0.0250***			0.104	0.091

*Table 6 shows regression results for the selected period of 6/2013-10/2014. In each regression equation, MM is significant during this time period. MM only in Regression 4 is significant with an R^2 of 0.298. The inclusion of price lagged onetime period significantly increases R^2 to 0.938, although MM is significant at only the 90 percent level. ***, **, and * represent significance at the 1, 5, and 10 percent levels, respectively.*

All variables except OT are significant in Regression 1, with an R^2 of 0.951. PM, MM, and SW remain statistically significant with the removal of P_{t-1} in Regression 2. This R^2 is 0.766. Regression 3 looks at the impact of PM alone. It finds it to be significant at the 99 percent level with the R^2 of 0.266. In Regression 4, which is singularly MM, it is significant at the 99 percent level of confidence with an R^2 of 0.298. In Regression 5, MM is significant at the 90 percent level of confidence due to the inclusion of P_{t-1}. The R^2 is substantially higher at 0.938. Swaps are significant in Regression 6, but with a minimal R^2 of 0.104. We see in this table that in Regressions 1, 2, 4, and 5, MM is significant in each one. The results of regressions from the selected time period January 2016 to January 2017 are detailed in Table 7. This period of price decline examines fifty-five observations.

Table 7: Regression Results from January 2016-January 2017

Regression	P/M	MM	SW	OT	Pt-1	R2	Adj R2
1	0.0117**	0.0160***	0.0090*	0.0140**	0.514***	0.920	0.912
2	0.0213***	0.0282***	0.0179***	0.0233***		0.858	0.846
3	-0.0063***					0.411	0.400
4		0.0081***				0.787	0.783
5		0.00433***			0.584***	0.904	0.901
6			-0.00096			0.000934	-0.0178

*Table 7 shows regression results for the selected period of 1/2016-1/2017. In Regression 2, every variable is statistically significant. The R^2 is 0.846. In Regression 4, MM only, it is significant with an R^2 of 0.787. When price lagged one week is included in Regression 5, MM remains significant at the 99 percent level, with the R^2 improving to 0.901. ***, **, and * represent significance at the 1, 5, and 10 percent levels, respectively.*

Regression 1 tests all variables and finds that they are all significant at varying levels with an adjusted R^2 of 0.912. In Regression 2, each variable is significant at the 99 percent level of confidence with a high R^2 of 0.846. PM are significant on their own with a negative coefficient. The R^2 for Regression 3 is 0.411. In Regression 4, MM is significant at the 99 percent level with an R^2 of 0.787. When P_{t-1} is added in Regression 5, MM remains significant at the 99 percent level of confidence and the R^2 rises to 0.901. We see in Regression 6 that SW have no significant impact on the market during this period.

CONCLUDING COMMENTS

The focus of this research project was to show that MM, hedge funds, play a significant role in price determination in cocoa derivatives markets. Weekly data of the positions of PM, MM, SW, and OT were obtained from the Commitment of Traders (COT) Report and sequenced to price data from Investing.com. A regression equation model was tested on the whole data set, as well as selected time periods of price increases and decreases. This research clearly shows that MM is a significant explanatory variable for cocoa price. Based on the regression results, we can reject the null hypothesis and assert that MM does have a significant impact on cocoa price in each of the specific time periods, as well as the entire time. Interestingly, during select time periods of price increases MM was significant and had a higher R^2 that PM. During periods of cocoa price decreases PM and MM were both significant but with indeterminant impacts on R^2. Hedge funds are instrumental in moving price higher during periods of contango for cocoa prices. Hedge funds are not participating out of a risk management need like PM or SW, but rather are taking risk as a profit-making opportunity. They potentially facilitate a legitimate role through arbitrage and liquidity. They significantly move the market in either direction, long or short, simply by their presence. This could warrant policy formulation and implementation regarding hedge fund activity in commodity derivatives from the CFTC, Federal Reserve, or Congress. Regarding the data from the CFTC, from a research data quality and industry point of view, it would be optimal if this data were reported with greater frequency rather than weekly. Daily reporting and streamlined release would be an improvement for industry understanding. It would also provide better analytic opportunities for research. Likely, it would increase costs of reporting and dissemination.

As commodities futures prices rise, increased margin requirements or margins calls may occur. This research suggests that hedge funds contribute to price increases and subsequent increased capital requirements. This poses a question: what is the increase in risk for PM, SW, and OT firms? They either must increase capital outlays for risk management to maintain their number of contracts to hedge, or they must reduce the number of contracts to stay in the risk management budget. The latter option can force the firm to have fewer than necessary contracts hedged. This increases risk to the firm from the unhedged portion of inventory. As a future research project, it would be interesting to look at speculation and increased price, subsequent increases in margin requirements and changes in risk management strategies. From this project, we determined that hedge funds move the cocoa market up and down. Moves happen more dramatically to the upside. It will be interesting to learn what other markets have the same occurrence.

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