The Crude Oil Price Bubble of 2008: The Role of Speculators and Devalued Dollars

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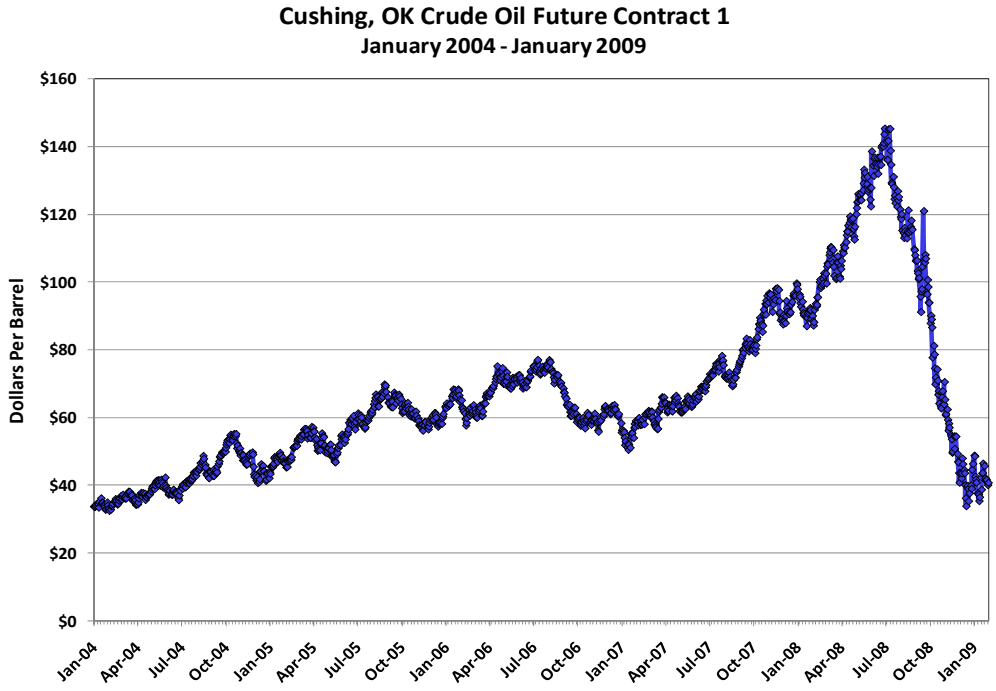
Introduction

History will remember 2008 for a wide range of events, from Barak Obama's presidential victory to the sweeping global economic crisis. Because of these headlining events, the bizarre roller-coaster ride that was the crude oil market might only be remembered by economists and energy junkies. Beginning in January, crude oil prices were hovering around the $90/barrel mark and began moving up until in July, prices reached record-breaking levels, in excess of $145 per barrel.[1] In 162 days, the crude oil price increased 66 percent, and from exactly one year prior, the price had *more than* doubled. While these price *increases* alone are worthy of examination, 2008 also saw crude oil prices drop at torrid pace back to levels not seen since the beginning of 2004. On December 23, 2008, the price of crude oil was $30.28 per barrel, a 380 percent change from just 120 days earlier![2] These trends are shown in Figure 1, where the 1-month NYMEX Crude Oil Futures Contract is plotted over the 2004-2008 time period.[3]

Figure 1



[1] According to EIA data, the Cushing, OK WTI Spot Price FOB was $145.31 on July 3, 2008 and $145.16 on July 14, 2008.
[2] Since reaching record highs in July 2008, the Cushing, OK WTI Spot Price FOB dropped to a low of $30.28 on December 23, 2008.
[3] Futures prices typically mirror spot market prices where crude oil is physically bought and sold.

Not only did crude oil prices reach unexplored heights and rapid declines, but the prices that consumers pay for gasoline and other refined products witnessed similar unprecedented volatility during 2008. The price of gasoline is heavily influenced by the price of crude oil, and this it is no surprise that the average price of a gallon of gasoline rose from $3.00 a gallon to over $4.00 per gallon during the first half of the year, and then plummeted to $1.75 by year end. Given the direct impact this had on consumers in the U.S. as well as the profits realized by oil companies, it is important to try to understand the causes of this extreme volatility in petroleum markets.

In competitive markets, price fluctuations are typically explained by supply and demand factors, but in this case, the extreme price movements cannot be explained by these factors. While we evaluate supply and demand factors, we find that these factors did not influence prices as much as other possible explanations such as movements in exchange rates and the influence of non-commercial traders (speculators) in the commodities futures market. Indeed we find that these factors explain much of the increase in crude oil prices during the first half of 2008, and that speculation alone could have cost U.S. consumers of gasoline as much as $41 billion during this period!

The remainder of this paper is organized as follows: first we explain the futures market and its role in the pricing of crude oil. Next, we summarize various explanations from other industry experts regarding the cause of this pricing volatility. Finally, we present our analysis which provides a more rigorous explanation of the cause of these price fluctuations and we develop an estimate of the cost that this speculation has had on U.S. consumers.

The Futures Market

The rise of the futures market stems back to world events of the 1970s which dramatically affected the petroleum industry. The industry had previously been dominated by the major integrated oil companies who collectively controlled the bulk of crude oil supply. However, tight international supply and demand conditions in the early 1970s gave the foreign producing countries the ability to wrest control of their producing properties from the majors, ultimately securing greater profits and in most cases full ownership of the properties either through nationalization or buyouts. Two international crises, the 1973 Arab embargo and the 1979 Iranian cut-off, eroded any semblance of stability in the petroleum industry. No longer did the majors unilaterally control the flow of international oil or the price paid for that oil. Both crises resulted in dramatic increases in the world price of crude oil.

During the late 1970s, spot transactions took on a much more important role in how crude oil was bought and sold. Supply disruptions in the late 1970s created opportunities for middlemen, i.e., traders and brokers, to enter the crude oil marketing business and thus ultimately increased the liquidity of the spot market. By 1983, spot market transactions dominated the international industry as more companies engaged in spot market transactions in order to capitalize on the downward trend in prices and the need for greater flexibility that ensued after crude oil prices peaked in 1981. While spot transactions allowed flexibility, particularly when compared to the rigidity of term contracts with little price fluctuation, they brought increased exposure to price volatility.

The risk of price volatility in the crude oil spot market was what eventually gave rise to the crude oil futures market.[4] Futures markets became the mechanism successfully used to address or hedge against price risks. When the New York Mercantile Exchange (NYMEX) introduced the crude oil futures contract it helped manage the price instability associated with the increasing use of spot market transactions. As an arena for risk management, the futures market provided a means by which those bearing the risk of price volatility, such as producers and refiners, could transfer to those who were willing and wanted to assume such risk.[5]

The crude oil futures contract for light, sweet crude oil began trading successfully on the NYMEX on March 30, 1993. A futures contract is a contractual agreement between a seller and a buyer to make or take delivery of a specified amount of a commodity (e.g., crude oil) at a certain time in the future. Crude oil futures contracts can be purchased up through 18 consecutive months and staggered thereafter up to seven years in advance.[6]

The emergence of the futures market resulted in expanded opportunities on the part of traders or speculators, ultimately increasing the liquidity of the market. A high level of liquidity is necessary for futures to trade effectively and efficiently and is a necessary component in successful hedging practices. Prior to the advent of the futures market, both the average size of a tradable lot of crude oil and the necessity of having a proven record as a trader kept many potential speculators out of the market. Futures markets, however, remove many of the barriers of entry to outside participants in petroleum trading and allow non-commercial traders and financial houses to participate without knowing all of the technical details of the petroleum industry.

The futures market provides "commercial"[7] traders with the ability to hedge against changes in the price they will receive for selling crude oil, or lock in the cost they will have to pay for crude or products. Commercial traders deal in both physical and paper barrels and therefore face some price risks in the cash market that are offset or hedged in the futures market. These traders are primarily interested in using the futures market to lock in a price. Once they hedge, they are protected against price changes in the spot market. Hedging is accomplished when a hedger assumes a position in the futures market financially opposite to his position in the spot market. Because spot and futures prices for crude oil tend to move in tandem, gains and losses in the spot market are usually offset by losses and gains in the futures market. Thus the development of the futures market was a natural result of the increased dependence on spot transactions, including how crude oil is physically bought and sold (not standardized).[8]

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[4] In addition to the NYMEX market for WTI, a futures market contract involving a North Sea crude oil, Brent, also developed and is traded in London on the International Petroleum Exchange (IPE).

[5] The increased industry reliance on spot transactions in crude oil marketing left much of the industry exposed to price risk. A buyer and seller could enter into a spot transaction today for delivery one month from now. However, there is significant risk that today's price will not equal the price in one month's time. A futures contract allows buyers and sellers of crude oil the ability to minimize such risk, hedging against future fluctuations in price movements.

[6] One crude oil futures contract is equal to 1,000 barrels (42,000 gallons).

[7] A trader is classified as a commercial if it uses futures contracts in that particular commodity for hedging.

[8] Between 2003 and 2008 only about 2% of oil futures contracts resulted in a physical delivery to settle a contract. ITF, Interim report on Crude Oil, July 2008, p. 17.

However, these industry players would not be able to hedge their position without someone to assume the opposite position. "Non-commercial" traders, or speculators, therefore assume the risk that hedgers seek to avoid and provide liquidity to the market without necessarily having physical risk exposure.[9] Speculators traditionally enter into futures contracts with the intention of reversing their positions before they would be required to deliver (short positions) or to accept physical delivery (long positions) of a commodity. Table 1 below summarizes the strategic position (i.e., short vs. long) for commercial and non-commercial traders. The type of trading conducted by speculators in the NYMEX crude oil market has changed significantly over time. For example, most speculators, rather than taking direct long or short positions in the market (where they would benefit directly from prices rising or falling), are more likely to take spread positions.[10] In fact, spread positions for NYMEX crude oil has grown from roughly 10% of the market in the mid 1990s to over 40% of the market today.[11] As we shall see, this does not mean, however, that they cannot influence the futures price.

Table 1
Strategic Positions for Commercial and Non-Commercial Traders in Futures Market

Trader	Short Position	Long Position
Commercial (i.e. Hedger)	Protection against future declining prices	Protection against future rising prices
Non-Commercial (i.e. Speculator)	Anticipation of declining prices	Anticipation of rising prices

Causes of the Price Bubble of 2008

The unprecedented price increases (and subsequent decreases) in 2008 sent analysts scurrying to find plausible explanations for the 2008 price bubble. Such explanations have included the following:

- Supply/Demand Factors
  - ✓ Production/Consumption
  - ✓ General Economic Downturn
  - ✓ Increasing Demand in China/Asia
  - ✓ Long-Term World Oil Reserves/Political Instability
- Exchange Rates

[9] As an arena for risk management, the futures market provides a means by which those bearing the risk of exposure to price fluctuations can transfer that risk to those who are willing and seek to assume it. It is the hedgers who are at risk from price instability. And it is the speculators who are looking for an opportunity to make a profit from assuming this risk. Risk transfer, then, is a mutually beneficial relationship: hedgers are able to achieve their goals by greatly decreasing their vulnerability to price fluctuations, and speculators are able to benefit by profiting from these fluctuations.

[10] Spread positions involve buying and selling in different months simultaneously to trade on pricing relationships over certain time horizons. Many of these speculators are so-called "Index speculators" who are institutional investors and who aim to profit from price movements in commodities futures by following an index's methodology.

[11] "Staff Report on Commodity Swap Dealers & Index Traders with Commission Recommendations." Commodity Futures Trading Commission, September 2008.

- Speculation in Commodities Futures Market

Supply and Demand Factors

One common explanation for the movement in crude oil prices is the forces of supply and demand. Stated simply, as demand increases, and/or supplies contract, prices will rise; and as demand declines, and/or there is excess supply, prices will fall. Thus, if there are disruptions in the ability to produce or transport crude oil around the world, we would expect that supplies would tighten and all other things being equal, we might experience an increase in the price of crude oil. For example, in August 2006, a small leak and corrosion of one of its Alaska transit pipelines caused BP to close its Alaska North Slope Prudhoe Bay oil field. Within 24 hours of the *announcement* that it would shut down the oil field and replace the faulty segment of pipeline (which would reduce output by 400,000 barrels per day) oil futures jumped over two dollars per barrel.[12] Likewise, we see every summer in the United States that due to increased road travel, that there is a general increase in the demand, i.e. consumption, of gasoline. As a result we often experience gasoline prices in summer months compared to other months.

Some industry experts have attempted to explain the recent crude oil price fluctuations as being based on supply and demand factors. J.P. Morgan banker Lawrence Eagles testified before Congress that he believed that the increase in energy prices was "fundamentally a result of supply and demand."[13] Industry experts Daniel Yergin and David Hobbs attributed the increase in prices to "demand shock" and the subsequent fall in prices to "recession shock."[14] Other industry experts claim that both the sharp increase and the subsequent decrease in prices was a result of supply and demand fundamentals, with the decrease relating to the general downturn in the economy:

> [When oil prices were up around $120 per barrel], what was motivating people to put money in the commodity markets was the perception that supply and demand imbalances were growing and there needed to be higher prices to rectify those imbalances…But over the past three months, the market has priced in a very rapid downgrade in expectations for growth next year. The market is perhaps pricing as much as 3 percent less global GDP for 2009.[15]

Other experts claim that increased demand for petroleum products in China caused the increase in prices. Over the past five and half years, consumption of petroleum products in China has increased by more than 992 million barrels, which has caused some increase in world oil prices.[16] And finally, yet another explanation examines long run supply and demand trends and claims the higher prices are due to the fact that the world is on the verge of running out of oil.

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[12] http://lugar.senate.gov/energy/security/index.cfm

[13] "Did Speculation Fuel Oil Price Swings?" Aired on: *60 Minutes*, CBS, January 11, 2009. Transcript reproduced on: http://www.cbsnews.com/stories/2009/01/08/60minutes/main4707770.shtml

[14] Yergin, Daniel and David Hobbs. "Recession Shock: The Oil Market and the Global Economy." *Wall Street Journal* – Special Advertising Section, February 10, 2009. Available at: http://online.wsj.com/ad/article/ceraweek-recession

[15] LeVine, Steve. "Falling Oil Prices: Again, Blame Speculators." Business Week, January 8, 2009.

[16] Masters, Michael W. and Adam K. White. "The Accidental Hunt Brothers: How Institutional Investors are Driving Up Food and Energy Prices." July 31, 2008.

On the other side are industry analysts who believe that supply/demand dynamics cannot possibly explain the most recent pricing volatility. One expert indicated that "short of virtually a complete shutdown of Middle East production," there was absolutely no conceivable form of demand change which would justify oil prices quadrupling.[17] Former director of the CFTC Michael Greenberger agreed, particularly in light of a single day increase in the price of oil of $25:

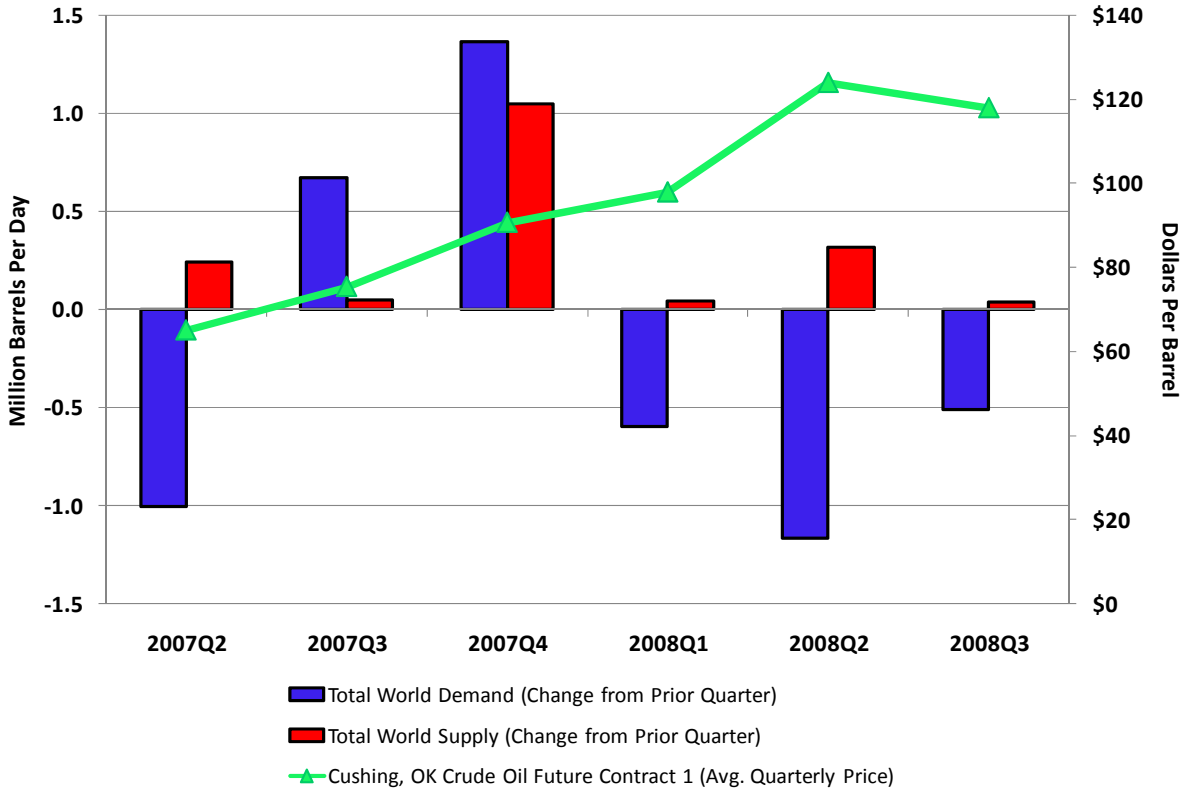
> Did China and India suddenly have gigantic needs for new oil products in a single day? No. Everybody agrees supply-demand could not drive the price up $25, which was a record increase in the price of oil.[18]

Analysis of data on supply and demand provides compelling evidence that supply and demand factors cannot explain the extreme volatility witnessed in oil prices. Figure 2 demonstrates the perverse relationship of supply and demand of crude oil vis-à-vis the movement of prices.[19] As seen in the first and second quarters of 2008, there was a *decline* in demand and a simultaneous increase in supply, yet the price continued to climb, contrary to what economic theory would predict.[20] The consequent fall in prices during the second half of the year is no doubt due in part to the economy, although the magnitude and speed of the drop has more to do with what caused the price of crude oil to be at $145 per barrel in July 2008 than with the downturn in the economy. Stated differently, the downturn should have been factored into oil prices during the first half of 2008 which as Figure 2 was a period of declining demand.

[17] Eckaus, R.S. "The Oil Price Really is a Speculative Bubble." *Massachusetts Institute of Technology*, June 13, 2008.
[18] "Did Speculation Fuel Oil Price Swings?" Aired on: *60 Minutes*, CBS, January 11, 2009. Transcript reproduced on: http://www.cbsnews.com/stories/2009/01/08/60minutes/main4707770.shtml
[19] Source: EIA
[20] Please note that the price is an average quarterly price to comply with quarterly supply and demand estimates.

Figure 2

World Crude Oil Supply and Demand vs. NYMEX Futures Price



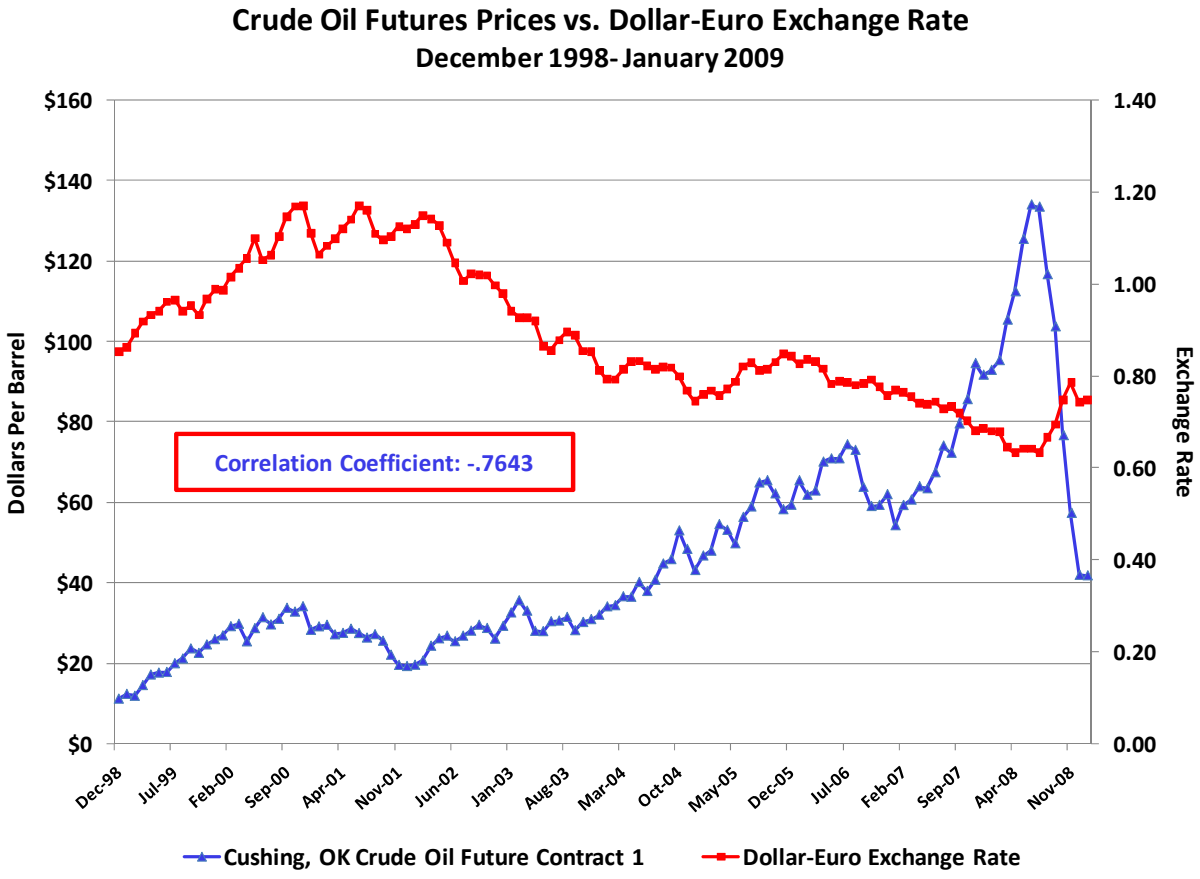
The theories of long run supply constraints and political instability in certain producing areas does not support the precipitous decline in prices witnessed during the second half of 2008. Were we really concerned about running out of oil at some point in the near future, one would certainly not expect the sharp decline in prices that we actually observed. In addition, the reserve replacement ratios of the major oil producers do not suggest that a precipitous decline in the long run supply of crude oil is imminent. Further, there was no appreciable decline in political instability in areas such as Nigeria during the second half of 2008, yet as we have seen the price of crude oil plummeted.

The Value of the Dollar

Another explanation of the increase in crude oil prices is the weakening of the dollar against other world currencies. All crude oil transactions throughout the world are denominated in dollars. Therefore, as the dollar weakens against the euro, for example, a buyer in effect has to pay in more dollars to buy a barrel of crude oil which causes prices to rise. As shown in Figure 3, we see that since the inception of the euro, there has been a negative correlation between the dollar-euro exchange rate and crude oil prices, which would in fact support this hypothesis. And when looking at the more recent downward price fluctuation, we see that the dollar was actually gaining value against the euro concurrent with the drastic drop in crude oil prices. Nevertheless, given the magnitude of the movement in the dollar vs. movement in crude oil prices, it is clear that the declining value of the dollar cannot explain the entire movement of

crude oil prices. For example, between January 2002 and July 2008, the exchange rate moved by 44 percent, yet the crude oil price moved by more than 500 percent. Given the direct relationship between exchange rates and the price of crude oil, one would not expect a shift in exchange rates to cause a significantly greater shift in the price of crude oil.

Figure 3



Others believe the impact of the devaluation of the dollar on crude oil prices was relatively minimal. One expert indicated that since 2004, the dollar depreciated against the Euro by about 9 percent, and therefore, it would have taken just a 9 percent increase in the price of oil (in dollars) to preserve the purchasing price in terms of Euros.[21] Needless to say, however, the price of crude oil has nearly quadrupled indicating that the change in the value of the dollar could hardly account for such a dramatic change. Another industry report indicated that in 2008 alone, the dollar never weakened more than 7 percent which "clearly cannot justify a 50 percent increase in WTI crude prices."[22]

[21] Eckaus, R.S. "The Oil Price Really is a Speculative Bubble." *Massachusetts Institute of Technology*, June 13, 2008.

[22] Masters, Michael W. and Adam K. White. "The 2008 Commodities Bubble: Assessing the Damage to the United States and Its Citizens." February 4, 2009.

Role of Speculative Traders in the Futures Market

Another explanation for the recent movement in the crude oil futures price is the role of speculators in the commodities futures market. Those who support this theory point to the outward signs of what is referred to as a "speculative bubble." A bubble occurs when a group of speculators, trading back and forth amongst themselves, operate under exaggerated expectations of future growth, and price expectations. While physical hedgers rely on the commodities futures markets to reduce price risk, speculators are active in the futures market with a goal of maximizing profits. When speculators become the dominant force in the market, "prices can become un-tethered from supply and demand."[23] Speculators are able to drive up the price of a commodity such as crude oil because they represent a new, large demand in the market, buying a very large volume of futures contracts. The increase in demand for futures contracts causes the price to increase even though the underlying market fundamentals have not changed. With very significant increases in demand as we witnessed in 2007 and 2008, prices rise very significantly. Even consumers themselves bought into the effect that speculators have had, as a recent survey indicated that the role of speculators on Wall Street was second only to "manipulation of prices by oil cartels" to blame for the rise in gas prices.

On the other hand, those who oppose the theory that speculators have helped cause the run-up in crude prices simply point to the other factors previously discussed in this paper (e.g., supply and demand factors, exchange rates, etc.).[24] As we have noted, these attempted explanations do not tell the whole story. Indeed there are numerous industry analysts and experts who believe that both the rise and fall of crude oil prices are directly related to the activity of speculators.

The Rise:

- "Institutional investors were accused of distorting markets by massively upping their allocations to commodity indexes, which some argued, had pushed the price of oil way beyond what could be justified by fundamentals."[25]

- "Since there is no reason based on current and expected supply and demand that justifies the current price of oil, what is left? – That the oil price is a speculative bubble."[26]

- "Institutional investors have poured hundreds of billions of dollars into the commodities futures markets as part of a portfolio allocation decision. This titanic wave of money has greatly amplified the current upward trend of commodities futures prices."[27]

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[23] Masters, Michael W. and Adam K. White. "The Accidental Hunt Brothers: How Institutional Investors are Driving Up Food and Energy Prices." July 31, 2008.

[24] In its report prepared last summer, the CFTC took a slightly different tack and indicated that if speculators had been the cause of the price increases, then one would have observed an increase in physical inventories. This argument fails to consider the role of pure speculators driving up the price by virtue of increasing demand for futures contracts which has no impact on the physical quantity of oil available ort held in inventory.

[25] Ferry, John. "The Blame Game." *Risk Magazine*, December 1, 2008.

[26] Eckaus, R.S. "The Oil Price Really is a Speculative Bubble." *Massachusetts Institute of Technology*, June 13, 2008.

The Fall:

- "Just as the stampede of nontraditional investors into the oil futures market helped to push prices up, their exit has had a hand in bringing them down. Many hedge funds and institutional investors have unwound losing positions or have been forced to sell to meet margin calls elsewhere in their portfolio."[28]

- "We see the fall in price as being directly related to traders pulling out of the futures market." Sherri Cabrera, director of government affairs at Petroleum Marketers Association of America. [29]

- "A consensus has emerged that at least part of the reason for oil's plunge stems from unprecedented financial-market strains that forced speculative investors to dump assets and raise cash… While fears of a global recession and a real contraction in oil demand are the principal reasons for the stampede out, some analysts have also seized on retreat by speculative investors as proof they were behind the rally in the first place."[30]

By examining actual trends in the data, one may test the plausibility of these arguments including the role of speculators. Figure 4 presents CFTC data which shows clearly the increase in the number of non-commercial traders over time, measured both on the basis of the absolute number of open-interest positions held by speculators, as well as the percentage share of open interest positions that are held by speculators.[31] As can be seen, both the absolute number and the percentage of open interest positions held by speculators have increased drastically over time, particularly in the past three to four years. It is also interesting to observe that more recently, i.e., during the fall of 2008, speculators have exited from the market.

Figure 5 plots the percentage of open interest held by non-commercial traders against crude oil futures prices between January 1986 and January 2009. As can be seen, there is an extremely high level of correlation between these two, particularly in the more recent time period, which supports the notion that speculators are, in fact, at least partly to blame for the run-up in crude oil prices. We will examine this notion in more detail, and with additional scrutiny in the next section, where we present our regression analyses.

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[27] Masters, Michael W. and Adam K. White. "The Accidental Hunt Brothers: How Institutional Investors are Driving Up Food and Energy Prices." July 31, 2008.
[28] LeVine, Steve. "Falling Oil Prices: Again, Blame Speculators." Business Week, January 8, 2009.
[29] Ferry, John. "The Blame Game." *Risk Magazine*, December 1, 2008.
[30] Meyer, Gregory and Ian Talley. "Bubble Burst, Washington Tries to Avert Another --- New Commodity-Trading Rules Would Target Excessive Speculation; Priority for Obama." Wall Street Journal, December 22, 2008.
[31] The level of trading activity during a given time period is measured by the "open interest," which indicates the number of futures contracts outstanding at the end of a trading day for any given month (those which have not been offset by an opposite transaction).

Figure 4

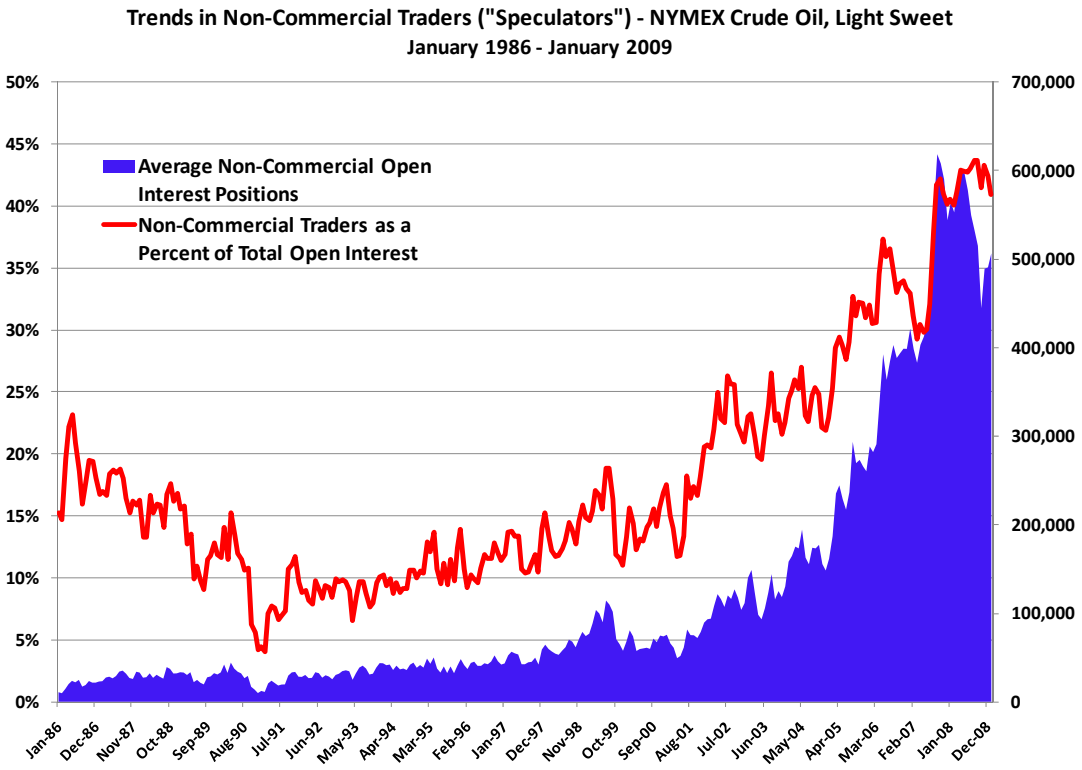
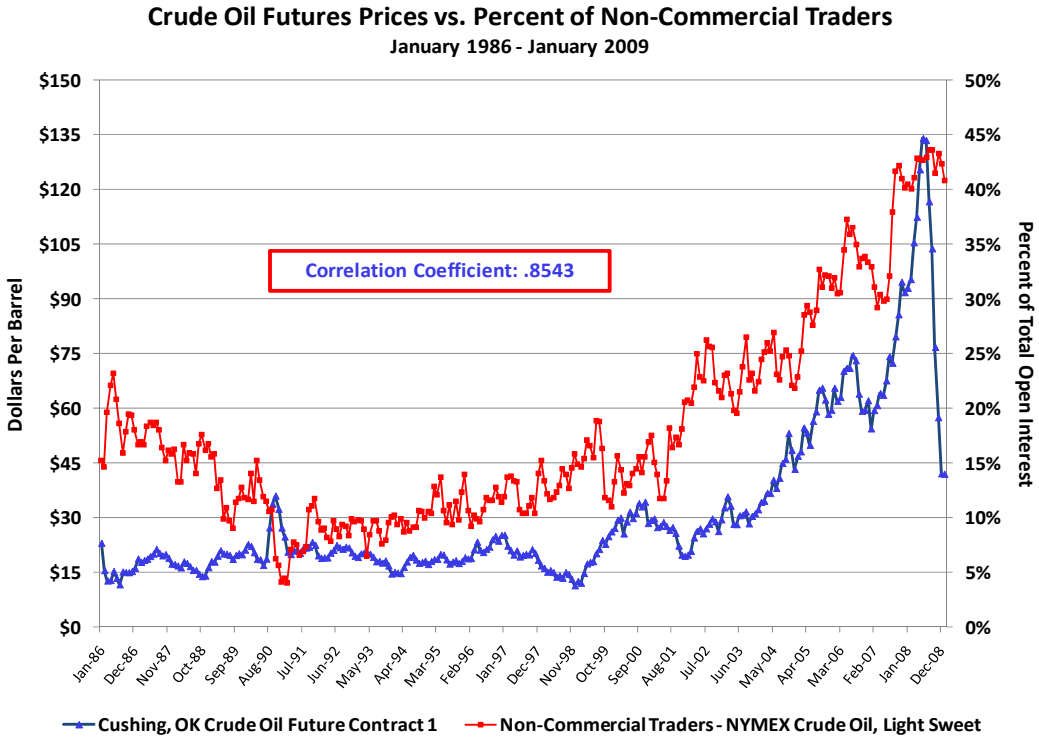


Figure 5



Regression Analysis

We have performed a series of regression analyses to test statistically the theories regarding the recent crude oil price volatility. The purpose of these analyses was to quantify the effect that each of the different explanatory factors may have had on crude oil prices. Our model includes supply and demand factors, exchange rates, the role of speculators, and general economic conditions. We will first discuss our model, and then present the results.

In order to create a robust analysis, the regressions must attempt to account for each plausible explanatory variable. In other words, excluding key variables from the analysis would inherently lead to biased and incomplete results. We therefore developed a model which aimed to include data elements which represent each of the explanations offered for crude oil price fluctuations. Our dependent variable is measured as the monthly price for the NYMEX WTI Cushing, OK Crude Oil Future 1-Month Contract. The independent variables tested in our model included the following:

Supply Variables

- World Crude Oil Production (CRUDEPROD_WORLD)
- United States Crude Oil Production (CRUDEPROD_US)
- Non-OPEC Crude Oil Production (CRUDEPROD_NONOPEC)
- OPEC Crude Oil Production (CRUDEPROD_OPEC)
- OECD Petroleum Stocks (PETROSTOCKS_OECD0
- United States Petroleum Stock (PETROSTOCKS_US)

Demand Variables

- OECD Petroleum Consumption (CRUDECONS_OECD)[32]
- United States Petroleum Consumption (CRUDECONS_US)
- Refinery Utilization (United States Only) (REFINERY_UTIL_US)

Exchange Rates

- Dollar-Pound Exchange Rate (DOLLAR_POUND)
- Dollar-Euro Exchange Rate (1998-2008 Only) (DOLLAR_EURO)

Speculators

- Total Non Commercial Open Interest Positions as a Percent of Total Open Interest (SPECULATORS_PCT)
- Average Monthly Non-Commercial Open-Interest Positions[33] (SPECULATORS_NUM)

[32] Monthly petroleum consumption figures were only available for the OECD and for the United States. World consumption figures are only provided on quarterly and annual bases.

[33] Commitments of Traders (COT) reports are published by the Commodity Futures Trading Commission (CFTC) to provide information about activity in the futures market. These reports present aggregate open interest positions for

Other

- ❖ MSCI/BARRA World Index – Measure of overall world economic conditions (WORLD_INDEX)

Our data set included data from January 1986-September 2008. To calibrate and test the model we used data for the entire time period, January 1986-September 2008. The model proved robust with the intended signs on each of the coefficients and a high degree of significance on each as well. Appendix A includes these regression results. Table 1 below presents the summary statistics for each of the variables tested in our models, for the entire period and the test period.

Table 2
Summary Statistics for Regression Variables

	January 1986-September 2008				January 2004-September 2008			
Variable	Mean	Min	Max	St. Dev.	Mean	Min	Max	St. Dev.
NYMEX_PRICE	30.82	11.31	134.02	22.50	67.67	34.22	134.02	24.53
SPECULATORS_PCT	17.69%	4.03%	43.66%	9.15%	32.42%	21.86%	43.66%	6.50%
SPECULATORS_NUM	114,049	9,560	619,018	144,226	353,492	148,256	619,018	153,819
REFINERY_UTIL_US	89.91%	74.60%	99.90%	4.70%	89.66%	74.60%	97.50%	4.12%
CRUDEPROD_WORLD	65,031	54,174	74,835	5,665	73,296	71,363	74,835	721
CRUDEPROD_US	6,479	3,960	9,173	1,076	5,156	3,960	5,607	304
CRUDEPROD_NONOPEC	37,730	33,403	41,498	2,166	40,782	39,157	41,498	427
CRUDEPROD_OPEC	27,301	16,642	34,146	4,207	32,514	30,471	34,146	841
CRUDECONS_OECD	45,412	36,329	52,207	3,721	49,165	45,961	52,207	1,375
CRUDECONS_US	18,592	15,909	21,666	1,543	20,526	17,796	21,666	613
PETROSTOCKS_OECD	3,860	3,313	4,248	176	4,091	3,874	4,248	90
PETROSTOCKS_US	1,612	1,460	1,785	67	1,688	1,556	1,785	50
DOLLAR_EURO	0.89	0.63	1.17	0.15	0.76	0.63	0.85	0.06
DOLLAR_POUND	0.60	0.48	0.71	0.06	0.53	0.48	0.58	0.03
WORLD_INDEX	855.61	259.75	1,682.35	361.38	1,315.76	1,026.99	1,682.35	193.83

We analyzed the data and regression results applying the model to two discrete time periods in order to evaluate changes between the period prior to the runup in prices and large-scale entry of speculators vs. the period when these phenomena occurred. For our analysis we selected as a base or benchmark period January 1986 through December 2003.[34] The second time period runs from January 2004 through October 2008. The basis for using January 2004 as the starting point for the "test" period is seen in Figures 4 and 5. It is at this point in time that non-commercials increased their demand for futures contracts in a very significant way and crude prices started their relatively uninterrupted march upward.

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commercial and noncommercial traders in futures markets, where the aggregate of all long open interest is equal to the aggregate of all short open interest. The COT reports also present open interest separately by reportable and non-reportable positions with additional data under reportable positions being reported for commercial and noncommercial traders. CFTC COT Reports are published on a weekly or bi-weekly basis over the time period, thus in order to put these data on a monthly basis, the average was taken of each of the observations in a given month.

[34] It is important to note that the regression data does not "match" the data presented in some of the charts in this report due to the lack of data for certain variables which are key to the analysis.

As discussed above, we believe it to be necessary to include at least one variable which represents the influence of each of the possible explanatory factors (e.g., supply, demand, etc). That is, in our "best" model, we only include one of the several supply variables, but it is necessary to employ at least one of these variables in the model, thus allowing us to measure the impact on prices of the selected supply variable. This would consequently apply to each of our different data elements. We have also lagged certain variables. This is particularly true of the supply and demand variables, as it is typical that a disruption in production, for example, might take one to two months to actually have an effect on price.[35]

It is also important to note that in our models all variables not already expressed on a percentage basis were logged. This is done, so that when interpreting the results of the model, all of the variables are presented on an "apples-to-apples" basis. That is, the coefficient of a logged variable allows one to measure the *percentage* impact of the variable as opposed to the absolute impact of the variable. Thus the relative value of the coefficient, no matter what the variable, can be placed on equal footing in terms of the percentage impact on the change in the dependent variable. Finally, autoregressive terms were added to the model in order to address issues associated with serial correlation[36] between the variables.

Benchmark Time Period: January 1986-December 2003

Table 3 below presents the results of our model covering the historical time period from January 1986 through December 2003. We use these results as a baseline model. This model reflects almost 20 years of market trends and price movements, and accounts for all of the various disruptions in supply and demand and other elements which one expects has influenced crude oil prices over time. Thus these are the types of results we would expect to see in a "normal" time period. In addition, we discussed earlier that by logging *all* of the independent variables, values of the coefficients are being placed on an apples-to-apples basis. That is, the magnitude of the impact of each of the individual variables can be compared by looking at the value of the coefficient, where the higher the absolute value of the coefficient, the greater impact that it has on the variation of the dependent variable.

[35] Note that the number of observations, and subsequently the observation period, may be slightly altered when incorporating lagged variables into the models.

[36] Serial correlation occurs when the error terms from different observations are correlated. Within a regression model output, the Durbin-Watson statistic ("D-W Stat") measures the presence of serial correlation, whereby a D-W Stat of 2 is ideal. If the D-W Stat varies drastically from a value of 2, autoregressive (AR) terms are added to the model to correct for the presence of serial correlation.

Table 3
Baseline Regression Model Results: January 1986-December 2003

Dependent Variable: LOG(NYMEX_PRICE)				
Method: Least Squares				
Sample(adjusted): **1986:05 2003:12**				
Included observations: 212 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.4463	4.6155	1.3967	0.1640
LOG(SPECULATORS_NUM)	0.0629	0.0339	1.8536	0.0652
LOG(CRUDEPROD_WORLD(-2))	-0.5750	0.4047	-1.4209	0.1569
LOG(CRUDECONS_OECD(-1))	0.2324	0.1383	1.6800	0.0945
LOG(DOLLAR_POUND)	-0.1388	0.2389	-0.5812	0.5618
LOG(WORLD_INDEX)	-0.0378	0.1101	-0.3432	0.7318
AR(1)	1.1719	0.0689	17.0072	0.0000
AR(2)	-0.2350	0.0694	-3.3872	0.0008
R-squared	0.9044	Mean dependent var		3.0241
Adjusted R-squared	0.9012	F-statistic		275.8361
S.E. of regression	0.0763	Prob(F-statistic)		0.0000
Durbin-Watson stat	1.9443			
Inverted AR Roots	0.92	0.26		

We note the following observations from the results of our base model:

- The R-Squared and adjusted R-squared collectively imply that the variation in the independent variables explain approximately 90 percent of the variation in crude oil prices.

- The positive coefficient on the number of speculators indicates as the number of speculators increases, so too does the price of oil. This variable is statistically significant at only the 10 percent confidence level. More importantly, a comparison of the relative value of the coefficient on this variable (0.0629) with those of the other variables, indicates that in a "normal" time period, an increase in the number of speculators would result in a minimal level of increase in the price.

- The negative coefficient on the 2-month lag of world crude oil production is what one would expect. If world production declines, we would expect to see an increase in crude oil prices approximately 2 months later. The relative value of the coefficient, in comparison to the other variables in the model, indicates that in a normal time period, crude oil production would have the biggest impact on crude oil prices. Interestingly however, this variable is not significant at the 10 percent level. This suggests that supply side factors exert less influence on price than may be expected.

- The positive coefficient on the one-month lag of OECD crude oil consumption is also as expected given fundamental supply/demand dynamics. As demand (i.e., crude oil consumption) increases, prices will react upward, as we see here, approximately one month later. This suggests that changes in demand have had some impact on crude prices.

- The negative coefficient on the exchange rate variable is an indication that as the dollar becomes weaker, crude oil prices rise, which again is consistent with our theory. The value of the coefficient indicates that the relative effect of changes in exchange rates is relatively small and the exchange rate variable is not statistically significant at the 10 percent level.

- The negative coefficient on the World Index variable, which measures general world economic conditions, indicates that as economic conditions worsen, the price of crude oil rises. This trend is contrary to what one would expect, but it is also not statistically significant which suggests that over this time period general economic conditions had a weak effect on crude oil prices.

Recent Test Period: January 2004-September 2008

We apply our "base" model, which covered the historical time period to the data covering the January 2004-September 2008 time period to test whether we see similar results during the price fluctuation time period. According to the CFTC, activity in the crude oil futures market began to steadily increase beginning in 2004. In fact, between 2004 and July 2008, the level of open interest more than tripled, and the number of traders almost doubled which serves as the basis for selecting this as the "test" period.[37] Table 4 below presents the results of our model covering the January 2004-September 2008 time period.[38]

[37] Interagency Task Force on Commodity Markets. "Interim Report on Crude Oil," July 2008.

[38] For comparison purposes, the model covering the January 2004-September 2008 time period included identical specifications as those used in the January 1986-September 2008 model.

Table 4
Test Period Regression Model Results: January 2004-September 2008

Dependent Variable: LOG(NYMEX_PRICE)				
Method: Least Squares				
Sample(adjusted): 2004:01 2008:10				
Included observations: 58 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-6.6531	15.0889	-0.4409	0.6612
LOG(SPECULATORS_NUM)	0.3905	0.1027	3.8038	0.0004
LOG(CRUDEPROD_WORLD(-2))	0.0440	1.2910	0.0341	0.9729
LOG(CRUDECONS_OECD(-1))	0.4100	0.3156	1.2991	0.1999
LOG(DOLLAR_EURO)	-1.3117	0.4547	-2.8847	0.0058
LOG(WORLD_INDEX)	0.0845	0.2212	0.3821	0.7040
AR(1)	1.1019	0.1421	7.7548	0.0000
AR(2)	-0.2309	0.1445	-1.5977	0.1164
R-squared	0.9684	Mean dependent var		4.1592
Adjusted R-squared	0.9639	F-statistic		218.6852
S.E. of regression	0.0643	Prob(F-statistic)		0.0000
Durbin-Watson stat	2.0233			
Inverted AR Roots	0.82	0.28		

We note the following regarding the results of applying our baseline model to the data covering the January 2004-September 2008 time period:

- The R-squared and Adjusted R-squared indicate that the variation in the independent variables included in the model represent approximately 96 percent of the variation in the price of crude oil. This is means this model is more robust than our base model.

- The positive correlation on the number of speculators is the same as in the baseline model, and the variable is now statistically significant at the 1 percent level. It is noteworthy, however, to observe the change in the value of the coefficient. Where before we saw a value of .06, we now see a value of .39. Taken by itself, this indicates that during the price fluctuation period, changes in the number of speculators had a much stronger impact on the observed price fluctuations.

- The positive coefficient on crude oil production indicates that a decrease in supply would subsequently lead to a decrease in crude oil prices, which is contrary to supply/demand fundamentals and further supports our position that supply factors did not have a significant influence on crude prices during this time period. This variable is not statistically significant in this model, and thus the unexpected sign on the coefficient could in fact support some of the arguments made by industry analysts with regard to the "speculative bubble."

- As with the base model, the positive coefficient on the one-month lag of OECD crude oil consumption is as expected given supply/demand dynamics. However, this variable is

not significant at the tested levels and thus appears not to have had a major impact on crude prices.

- Unlike our previous model where we used the Dollar-Pound exchange rate, we used the Dollar-Euro exchange rate in this model, as it is a more universal estimate of the relative value of the dollar. Again, the coefficient is negative, indicating that the devaluation of the dollar relative to other currencies, holding all else constant, results in a corresponding increase in crude oil prices. The value on the coefficient here is noteworthy, as it has the most profound influence on crude oil prices. Furthermore, this coefficient is statistically significant at the 1 percent level.

- Unlike our baseline model, the coefficient on the World Index variable in this model is positive, indicating that poor world economic conditions will subsequently lead to a decrease in crude oil prices. This trend does correlate well with what we are currently experiencing in our economy, however, as before, this variable is not statistically significant.

Implications of the Results

The results of our statistical analysis suggest that two factors have had a significant impact on the crude oil price volatility during the 2008. The large increase in futures trading activity by non-commercial speculators influenced the futures (and hence spot) price of crude oil by increasing the demand for futures contracts. Underlying market fundamentals (e.g., supply and demand factors) did not influence crude oil prices as some analysts suggested. This is consistent with the data we reviewed indicating counterintuitive movements in prices relative to changes in world supply and demand factors. In addition, the decline in the relative value of the dollar also contributed significantly to the increase in crude oil prices, as crude oil became relatively more expensive to acquire as the dollar cheapened.

While our statistical results are not as robust as we might like, taken together with the other empirical evidence we have reviewed in this paper, it is clear that analysts and industry observers who tried to explain the price increase (and consequent decline) on the basis of "market fundamentals" or supply/demand" factors were simply very wrong. It may not take an advanced degree in economics to understand that a doubling of the price of oil in less than a year is highly unlikely absent a halving of supply or a doubling of demand, yet this was the explanation frequently offered during 2008 for the rise and then fall of crude oil prices. The role of speculation in commodity markets including crude oil cannot be overemphasized. Speculative traders entered these markets on a large scale and drove up the price in search of ever greater profits. Not surprising once the bubble burst, many such traders left. In addition, it is clear that speculation was not the only force driving up (and down) the price of crude oil. Shifts in the relative value of the dollar vis-à-vis other currencies also had a significant impact.

While interesting from a purely theoretical standpoint, the impact of this price bubble has far reaching effects. As noted at the outset we noted that the price of gasoline and other refined products is closely tied to the price of crude oil. To the extent the price of crude oil was

artificially raised as a result of speculation, consumers were directly harmed. We attempt to develop a rough estimate of this impact to place this episode of price volatility in context.

Assume that market fundamentals during the first half of 2008 supported an average crude oil price of a barrel of oil of $60 per barrel as opposed to the actual average of about $110 per barrel.[39] Further assume that speculation was the cause of 33 percent of this difference, quite possibly a conservative estimate.[40] Thus over the course of the first half of 2008, speculation may have been responsible for as much as $0.40 per gallon of the increase in the price of gasoline at a net cost to U.S. drivers of **$27 billion.** This computation is shown in Table 5 below. This calculation simply focuses on gasoline and thus doe not include impact to consumers from the purchase of other refined products such as heating oil, jet fuel, etc.

Table 5
Possible Loss to Consumers as a Result of Speculation

Actual Price of WTI (1H of 2008)	$	110.00
"Market" Price of WTI (1H of 2008)	$	60.00
Difference	$	50.00
33% of Difference due to Speculation	$	16.50
Consumption of gasoline (1H of 2008)		1,640,412,000
Loss Due to Speculation	$	27,066,798,000

Conclusion

Greater oversight and analysis of commodity markets is necessary to protect consumers, particularly in markets as important as energy markets. Speculators played a role in driving up the price of crude oil futures contracts during 2007 and especially during the first half of 2008. This in turn caused spot markets for crude oil to rise commensurately and gasoline and other refined products also increased by similar amounts. Consumers were directly harmed by $27 billion and perhaps more as there was a transfer of wealth directly from consumers to the oil companies and others as a result of this speculative activity in the futures market.

[39] $60 per barrel is roughly the average price of WTI during the 2005-2006 time period.
[40] Our regression analysis suggest that at least 25 percent of the movement if futures prices was due to speculation throughout the 2004-2008 period and additional analyses focused on just 2008 suggest that during that time period it was an even greater percentage.

Appendix A

Full Time Period Regression Results

Dependent Variable: LOG(NYMEX_PRICE)
Method: Least Squares
Sample(adjusted): **1986:05 2008:10**
Included observations: 270 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	8.0745	4.6256	1.7456	0.0821
LOG(SPECULATORS_NUM)	0.0935	0.0325	2.8743	0.0044
LOG(CRUDEPROD_WORLD(-2))	-0.7327	0.3931	-1.8639	0.0635
LOG(CRUDECONS_OECD(-1))	0.2328	0.1288	1.8076	0.0718
LOG(DOLLAR_POUND)	-0.3826	0.2169	-1.7640	0.0789
LOG(WORLD_INDEX)	-0.0139	0.1104	-0.1257	0.9001
AR(1)	1.2003	0.0626	19.1713	0.0000
AR(2)	-0.2140	0.0633	-3.3829	0.0008
R-squared	0.9798	Mean dependent var		3.2680
Adjusted R-squared	0.9793	F-statistic		1817.8310
S.E. of regression	0.0773	Prob(F-statistic)		0.0000
Durbin-Watson stat	1.9250			
Inverted AR Roots	0.98	0.22		