



The Financialization of Oil Markets: Potential Impacts and Evidence

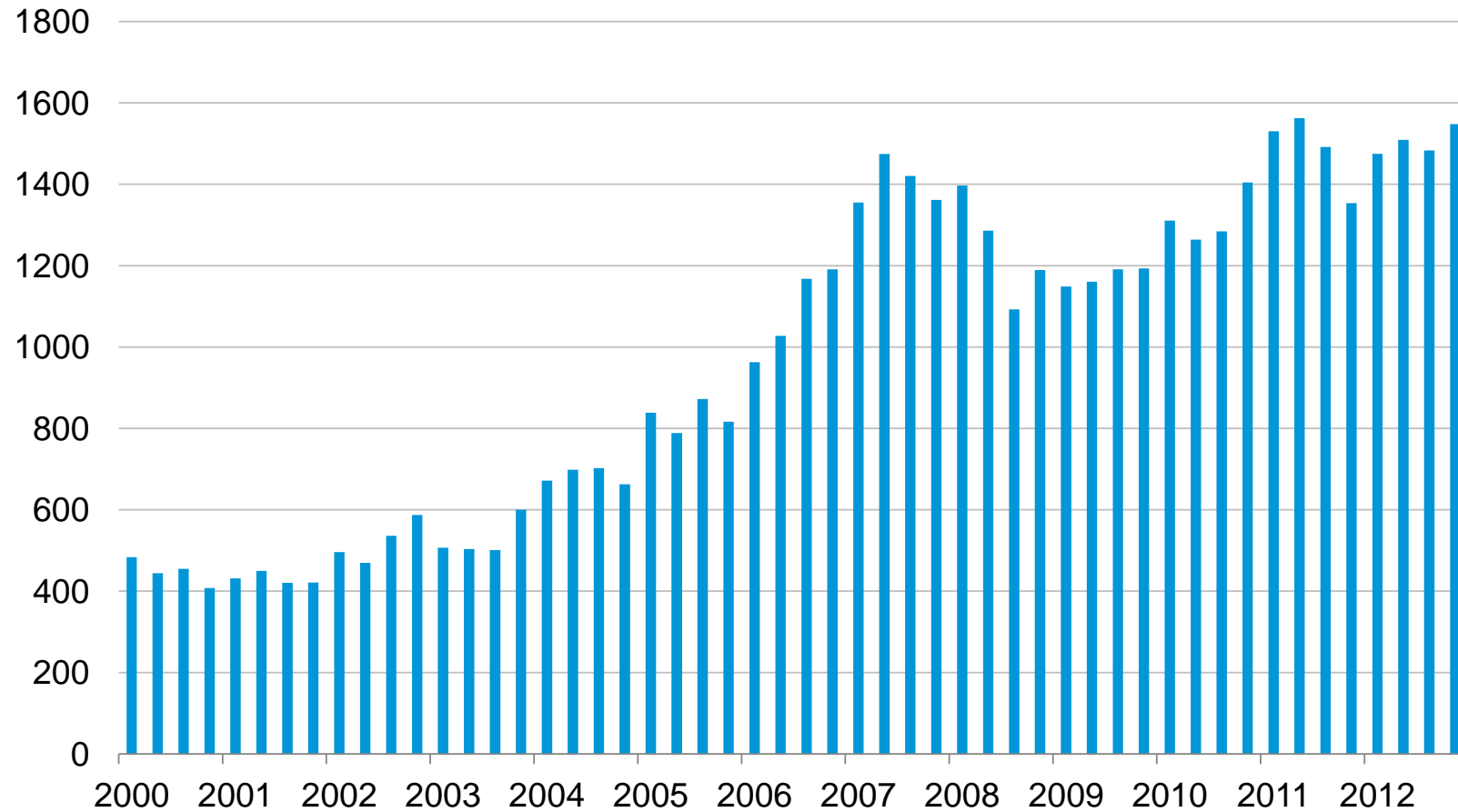
Bassam Fattouh
Oxford Institute for Energy Studies
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1. Background

- Sharp oil price cycle during 2002-2008 cycle and more recently oil price rises in 2012 and 2013 polarised debate about drivers of oil prices
 - Fundamentals
 - Expectations about these fundamentals
 - Financialization of oil markets
 - Speculation
 - Market manipulation
- All of the last three are often treated as one group
- Massive expansion in the financial layers of oil: more funds, higher trading volumes, more instruments, increasing sophistication of financial instruments

Rapid Growth in Open Interest on Crude Oil Futures Exchanges

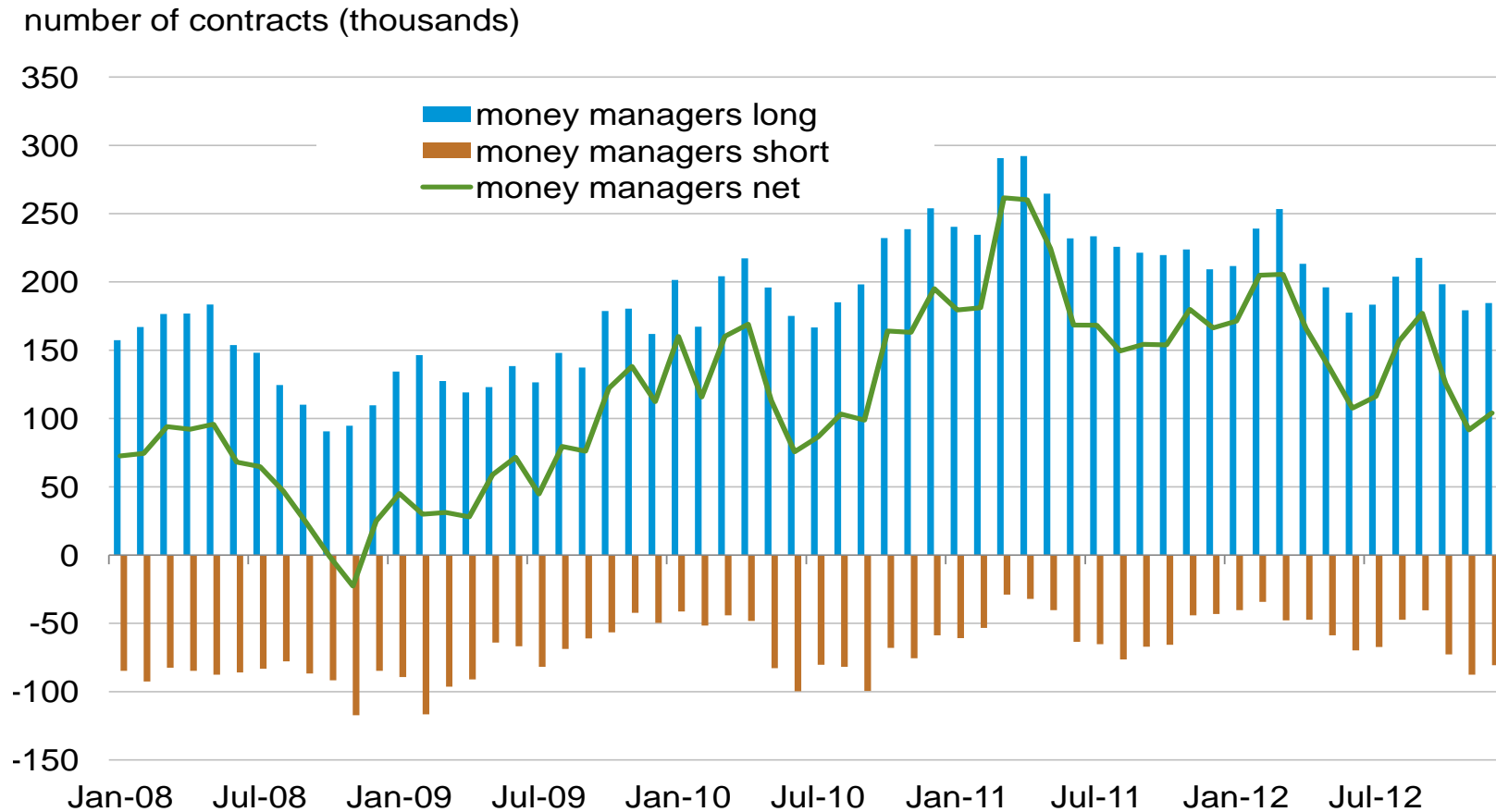
**Average Daily Open Interest in Crude Oil Futures in US Exchange
(number of contracts, thousands)**



Source: EIA

Money Managers Net Long in U.S. Oil Futures Market

US Exchange Traded Futures Positions by Money Managers

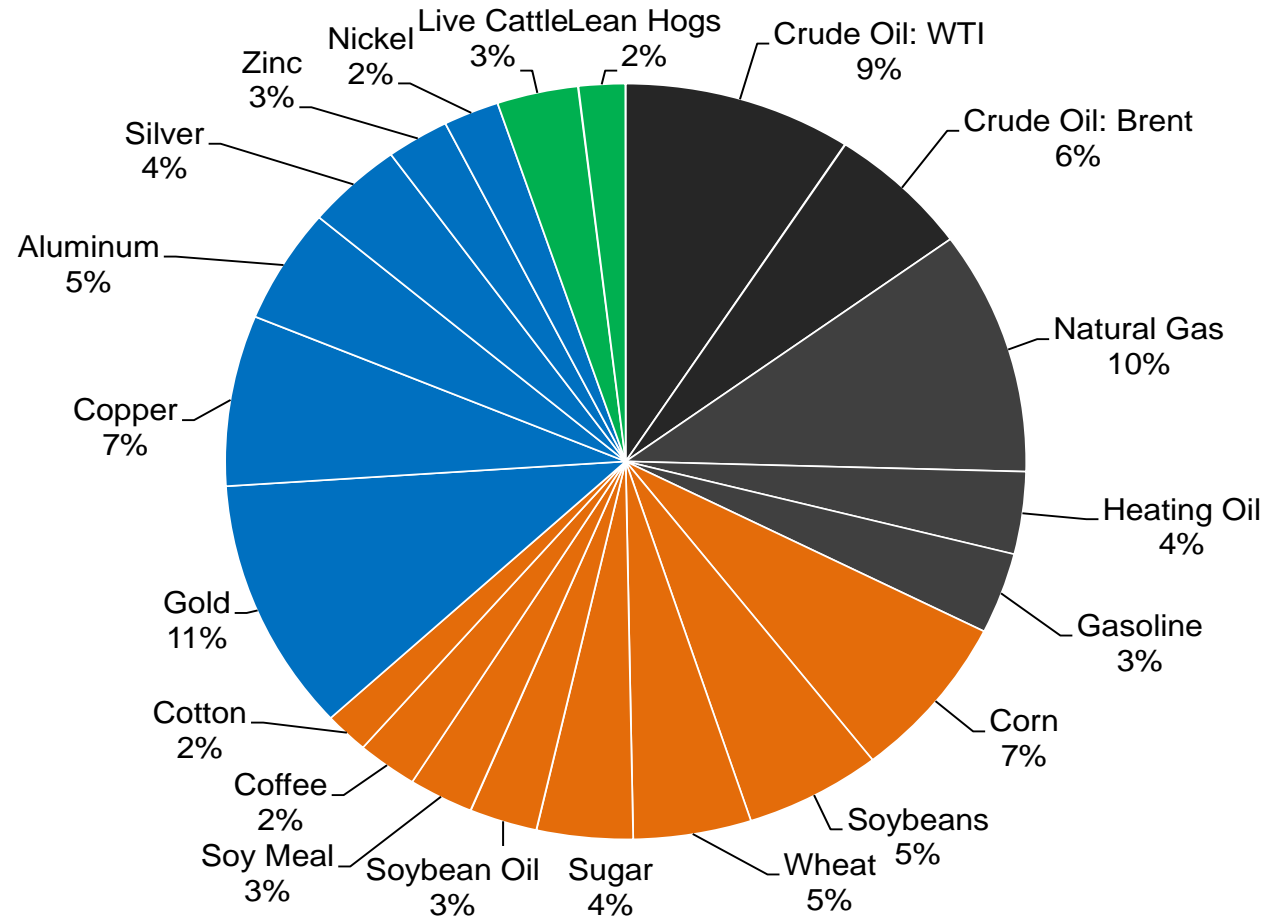


Source: CFTC Commitment of Traders

Source: EIA

Crude oil plays a major role in commodity investment

2013 Target Weights of the Dow Jones - UBS Commodity Index



Source: Dow Jones Indexes, CME Group

Context and Research Question

- Do the changes in the financial layers of the oil market impact price behaviour? And how?
- Does financialization represent "a welcome improvement in market efficiency" or "a worrisome development"?
- Does financialization improve or reduce consumer welfare?
- Our answer:
 - Financialization has little effect on key oil market variables and final consumers' welfare
 - From a regulatory point of view crucial to identify channels through which financialization can result in market failure and design policies accordingly

2. Financialization in Oil Markets

- Captures increasing exposure to commodities by a wide set of financial players with no physical interest such as hedge funds, pension funds, insurance companies and retail investors
- Exposure through variety of financial instruments: futures, options, exchange traded funds, index funds, and bespoke products
 - Financial innovation provided an easy and a cheap way for various participants to gain exposure to commodities
- Motives of entry
 - Return enhancement
 - Commodities performance counter-cyclical with stocks and bonds and hence diversification benefits
 - Inflation hedge
 - Hedge against a weak dollar

Financial Players Not Homogenous

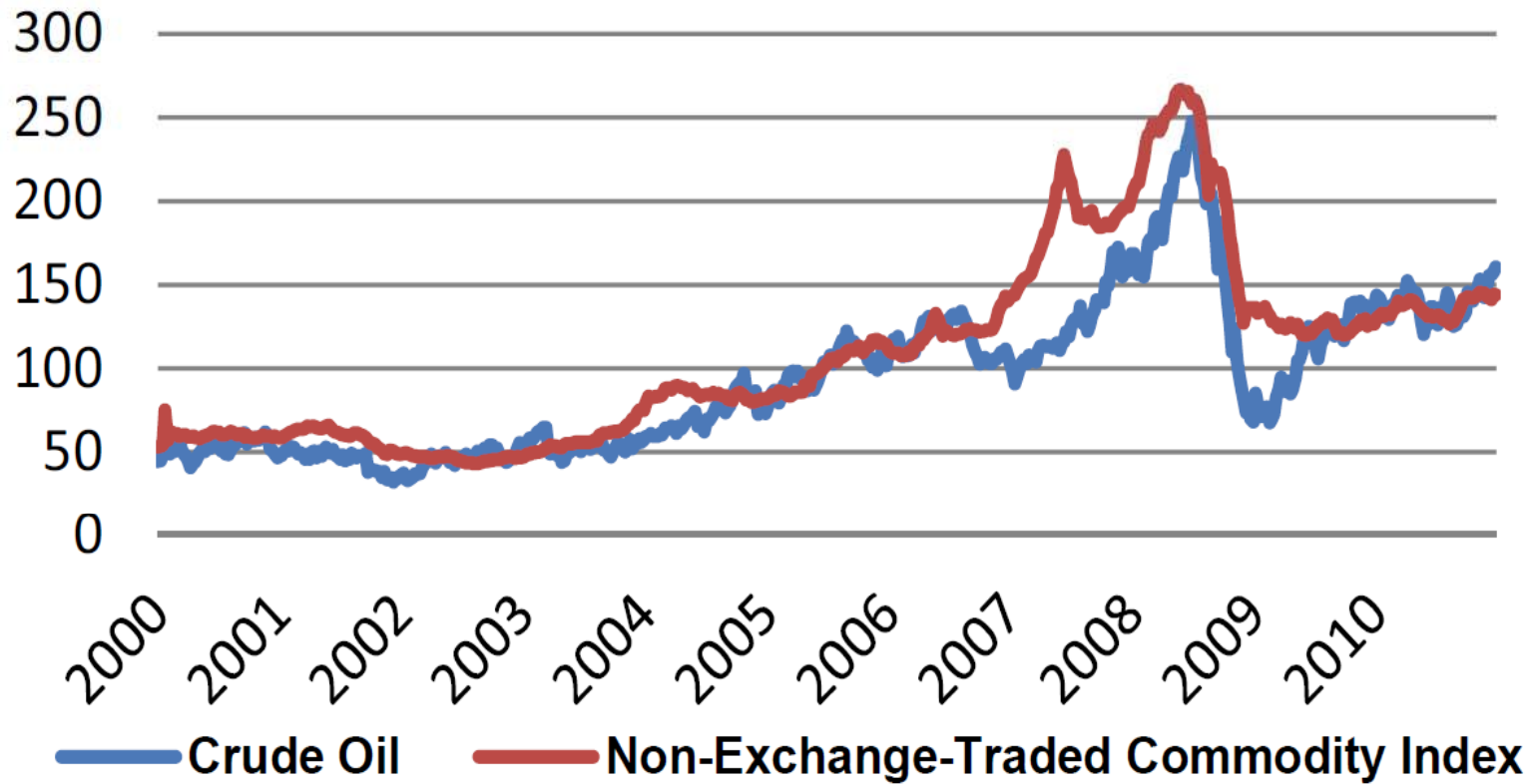
- **Investment banks / Swap dealers**
 - Largest traders of oil since collapse of OPEC administered pricing system in 1986
 - More involved in bridging gaps between producers and a more diverse set of customers
- **Hedge funds**
 - Macro hedge funds
 - Trade in a range of markets (not just commodities)
 - Have a top-down approach and take a view on macroeconomic issues
 - Specialist commodity hedge funds
 - Bottom-up approach, use large quantities of data; take a strong view of fundamentals of supply and demand
 - ‘Black box’ hedge funds
 - Have a view of the oil price based on calculations known only to themselves
- **Institutional investors** primarily consist of pension funds, insurance companies, sovereign wealth funds
 - Typically put a small share of their funds into commodities for sake of portfolio diversification
 - Tend to sell when prices are high and buy when they are low, stabilising the market, owing to limits in their portfolios
- **Retail investors**, including private investors and high net worth individuals
 - one of the fastest growing categories

3. The Potential Impacts on Oil Markets

- Several arguments
 - Increases the spot price
 - Increases oil price volatility and more uncertainty in oil prices
 - Leads to higher oil price co-movement with financial assets and other energy and non-energy commodities (shocks from financial layers transmitted to commodities)
 - Affects crude oil futures returns and risk premia
 - Break inventory-oil price relationship
 - worse outcome for final consumers . . .
 - leave consumers more exposed to vagaries about supply and demand prospects.
- Is the empirical evidence supportive of these effects?
- Several empirical approaches (most of the literature is empirical)
 - Dynamic Correlation Analysis (
 - Granger Causality
 - VAR approach
 - Calibrated macro finance Structural models

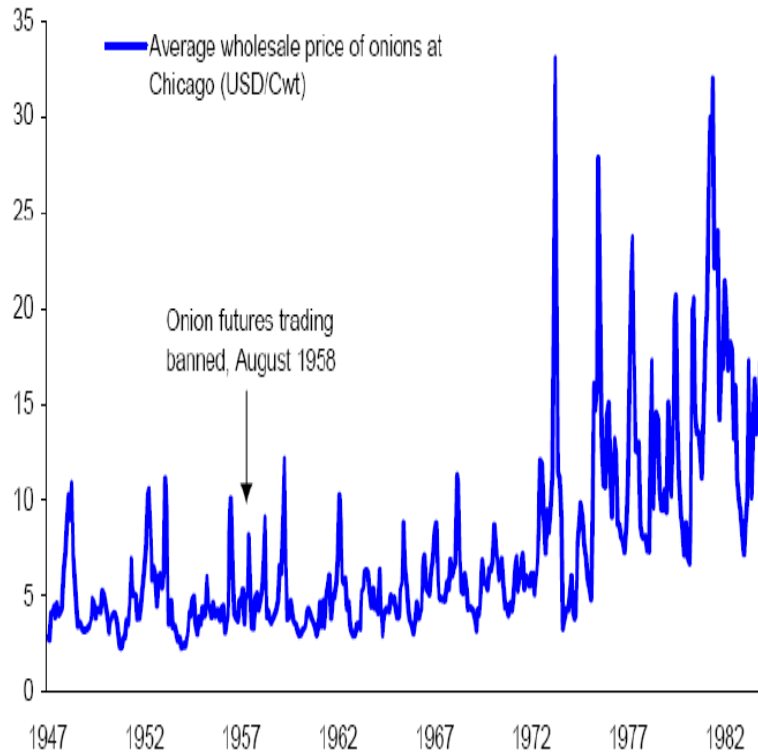
3.1 Some 'Crude' Facts

Figure 1: Price of Non-Exchange Traded Commodities and Price of Crude Oil

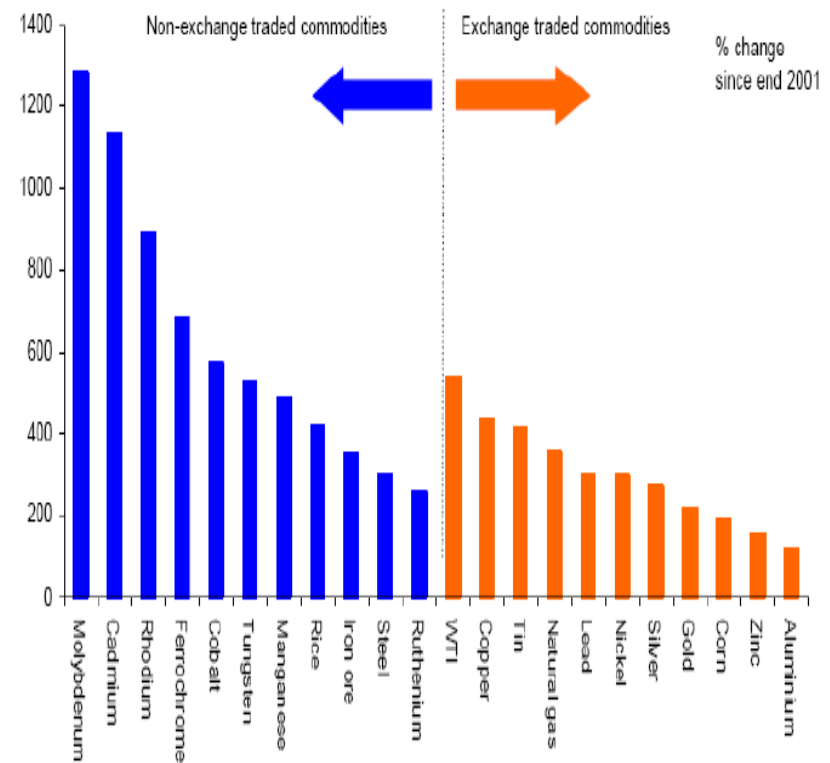


Source: IEA Oil Market Report, March 15, 2011

Exchange VS Non-Exchange Traded Commodities



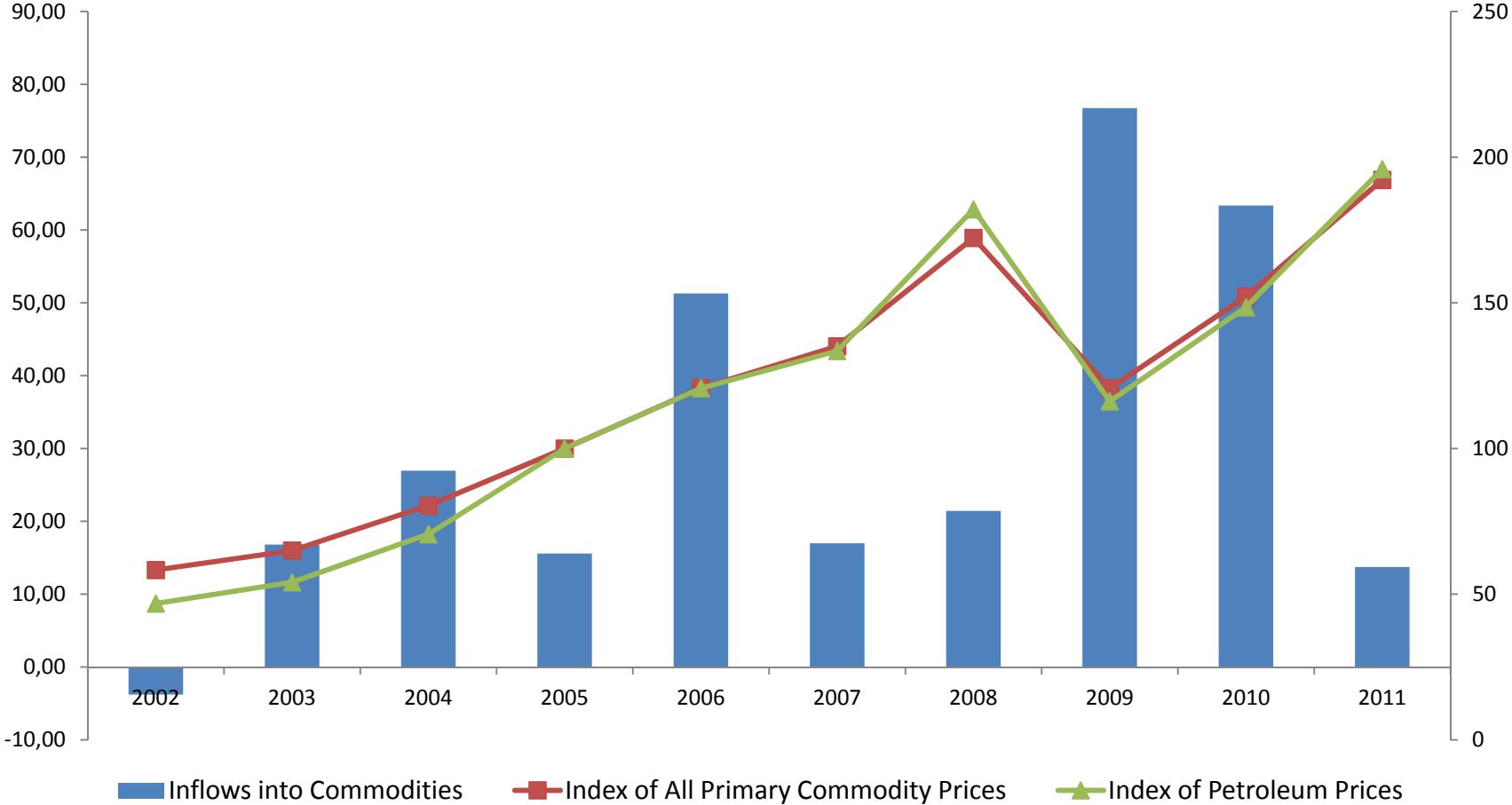
Source: Deutsche Bank, Commodities Weekly, 14 August 2009, Figure 1.



Source: Deutsche Bank, Commodities Weekly, 14 August 2009, Figure 2.

Investment Inflows into Commodities and Prices

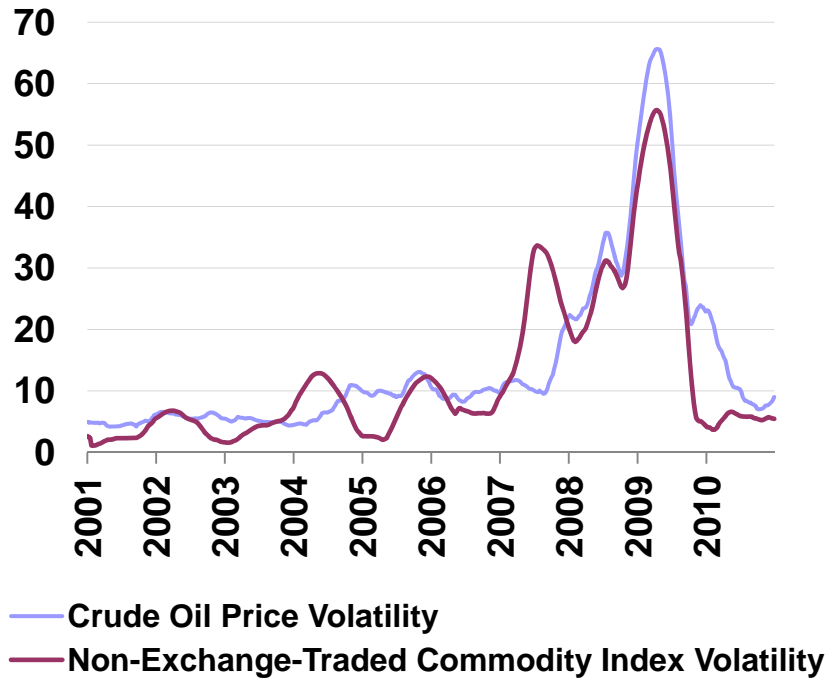
Investment inflows to commodities, (Indices, ETP, MTNs, \$bn) and Commodity Price Indices



Source: Barclays Capital, IMF

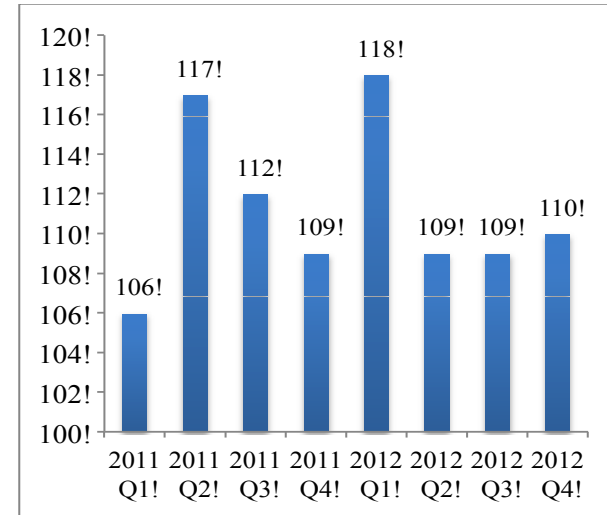
Price Volatility

Price Volatility in Crude Oil and Non-Exchange-Traded Commodities

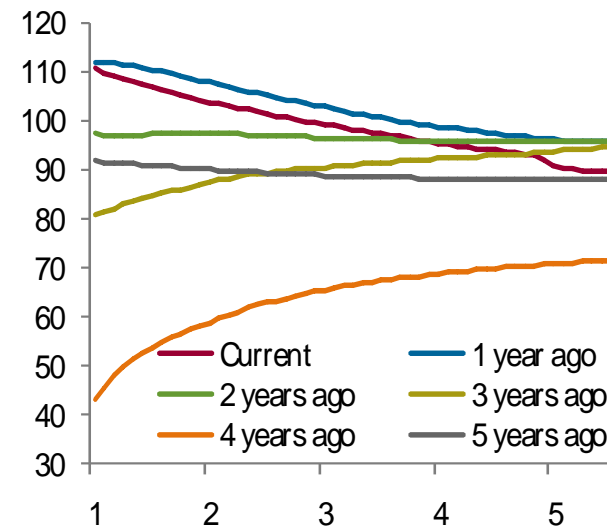


Source: IEA Oil Market Report, March 15, 2011

Quarterly Average Prices of Brent, \$/Barrel

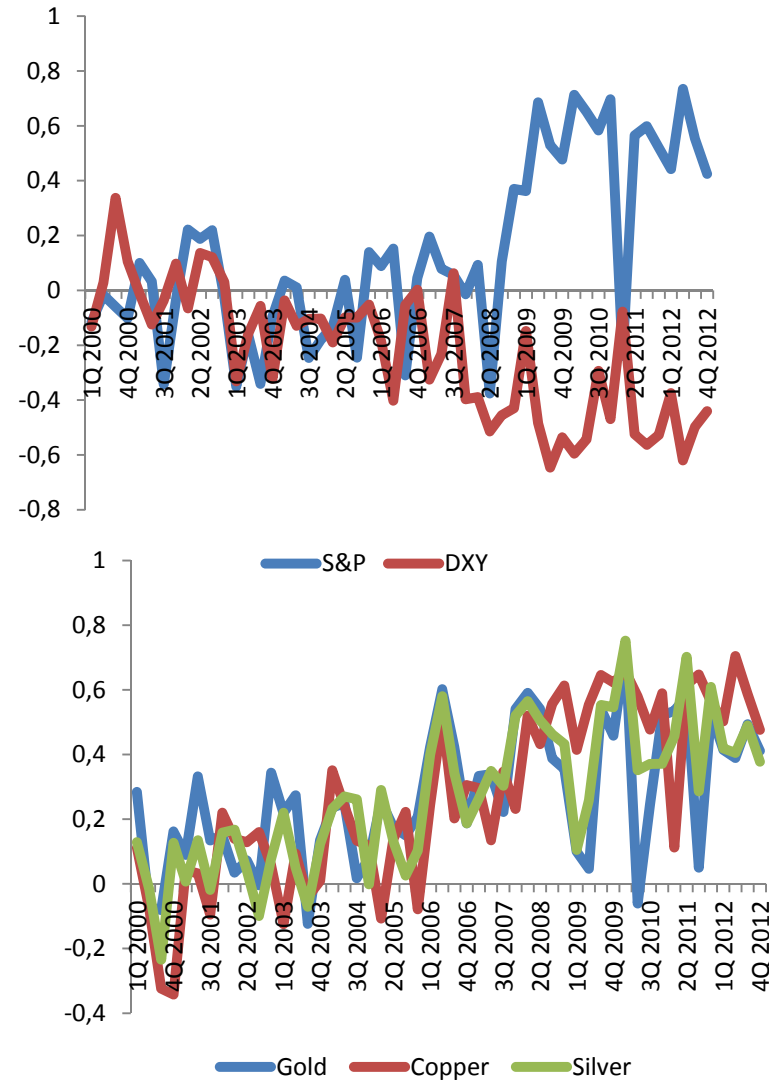


Brent Forward Price, \$/Barrel



3.2 Correlation Analysis

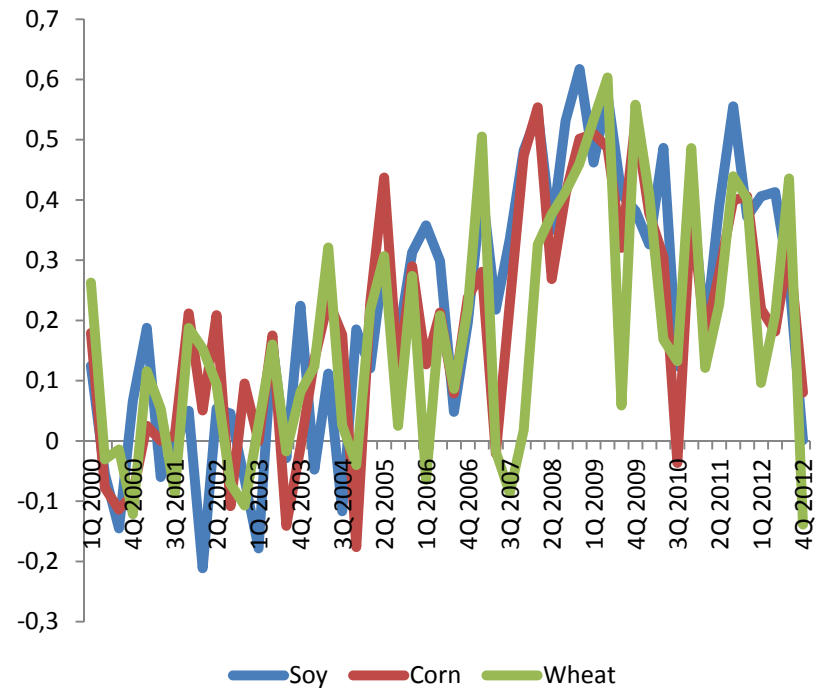
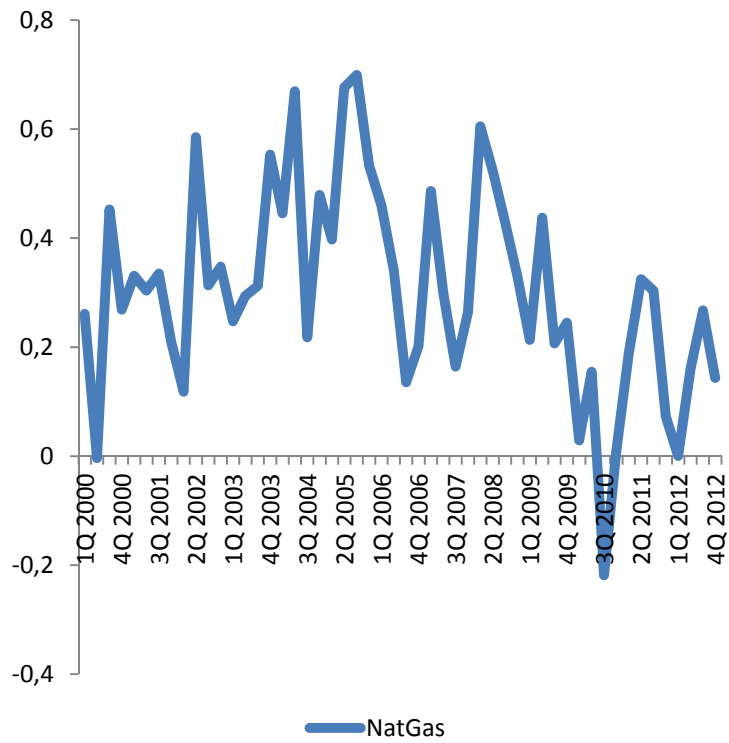
- Increased price co-movements between equity and oil returns
- Increased correlation between exchange rates and oil prices
- Increased price co-movements between energy and non-energy commodities' returns
- Correlation between index investment commodities is higher than those for commodities outside index



Drawbacks

- Correlation not stable over time
- Structural break in correlation depends on frequency used (1 week, 1- day, 1-hour, 5-minute, 10-second, and 1-second frequencies)
- Evidence not fully supportive (Stoll and Whaley , 2010)
 - Price of index commodities don't necessarily move together (Oil and Gas or energy and food)
- Not clear which players are driving these correlations
 - Hedge funds investing in many markets (Büyükhahin and Robe, 2011)
 - High frequency trading activities and algorithm strategies (Bichetti and Maystre, 2012)
 - Index investors (Masters, 2008)
 - Institutional investors (Basak and Pavlova, 2013)
- Common real macroeconomic shocks driving correlation (can't infer causation)
 - News about global demand drives traders' positions
 - News about global demand drives oil prices
 - i.e. correlation driven by one fundamental factor
- Why does all this matter? Any welfare consequences?
 - Markets have become less segmented and more interconnected. Is this a good thing or a bad thing?

Correlation Highly Unstable



Source: EIA

Why all this Matters?

- Büyükşahin and Robe (2011):
 - “additional work is needed, if one is to ascertain whether the impact of financialization on cross-correlations represents a welcome improvement in market efficiency or, instead, is a worrisome development”
- Potential negative consequences of financialization
 - ‘Spill over price volatility from outside to commodities markets and also across commodities’ (Tang and Xiong, 2010). But how?
 - Erode the long-run diversification benefits as systematic risk dominates futures return
 - Prone to bubbles as in financial markets
- Potential positive consequences of financialization
 - Reduce the market price of risk with stabilising effect on the oil price (Pirrong, 2011)
 - More efficient derivatives pricing methods through linking futures prices at different maturities (Buyuksahin et al, 2008)
 - Helped physical crude oil markets become more integrated by reducing transaction costs and facilitate arbitrage across geographically distant markets and across crude oil of different quality (Fattouh, 2010)
- Are we asking the right question?

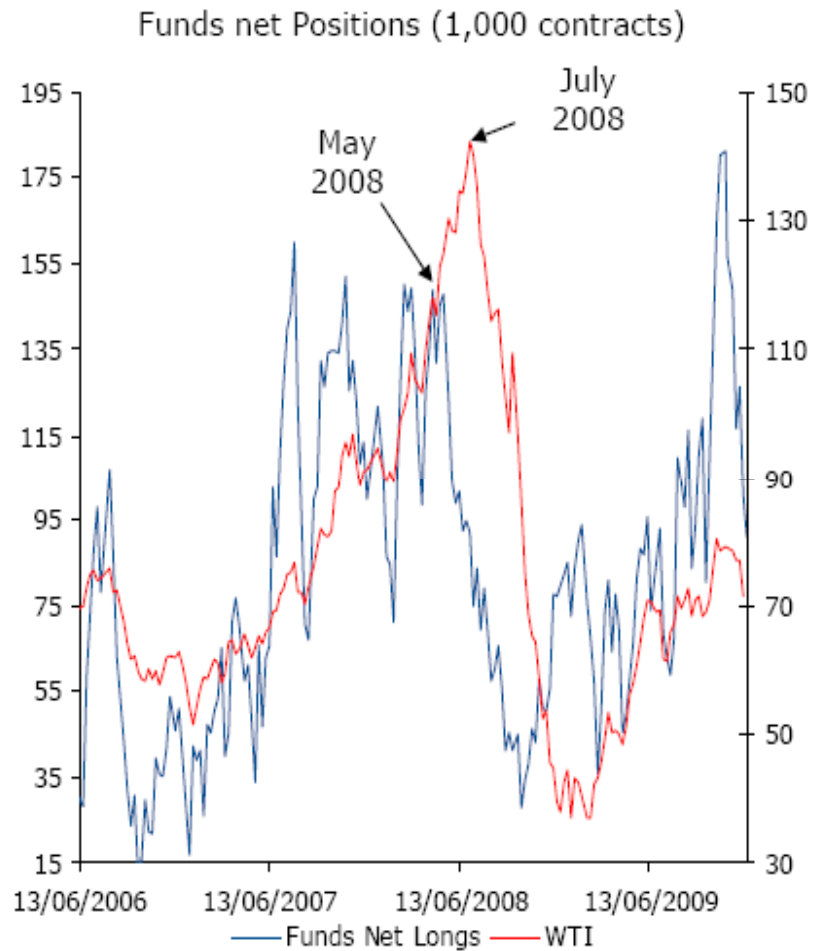
3.3 Granger Causality

- Have price movements typically been preceded by changes in trading positions of hedge funds and other types of financial investors?
- Empirical evidence mixed at best
- Causality cannot be inferred from predictive correlations

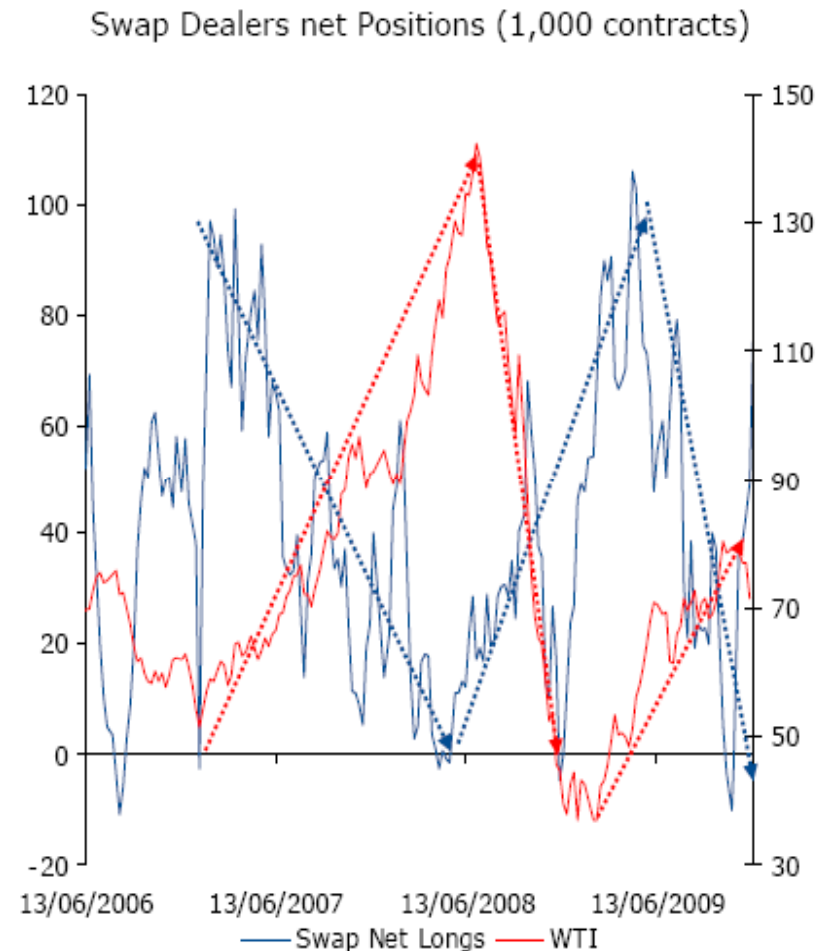
	<u>1993M1– 2010M12</u>	<u>2003M1– 2008M6</u>	<u>2003M1– 2010M12</u>
<u>Non-Commercial</u>			
Do changes in net positions predict price changes?	Yes	No	No
Do price changes predict changes in net positions?	Yes	Yes	Yes
<u>Commercial</u>			
Do changes in net positions predict price changes?	Yes	No	No
Do price changes predict changes in net positions?	Yes	Yes	Yes

Notes: The change in price is the log change in the spot price of oil. The net positions of the commercial and non-commercial firms are defined as the net (long – short) open position. The null hypothesis is no Granger causality between the two variables. An entry of “Yes” indicates that we reject the null hypothesis of no Granger causality at the 5 per cent significance level; an entry of “No” indicates that we fail to reject the null hypothesis of no Granger causality at the 5 per cent significance level. The number of lags in the Granger causality tests was chosen based on the Akaike Information Criterion (AIC).

Net Positions and Oil Prices



Funds cut their positions in May 2008, before prices reached historical high levels.



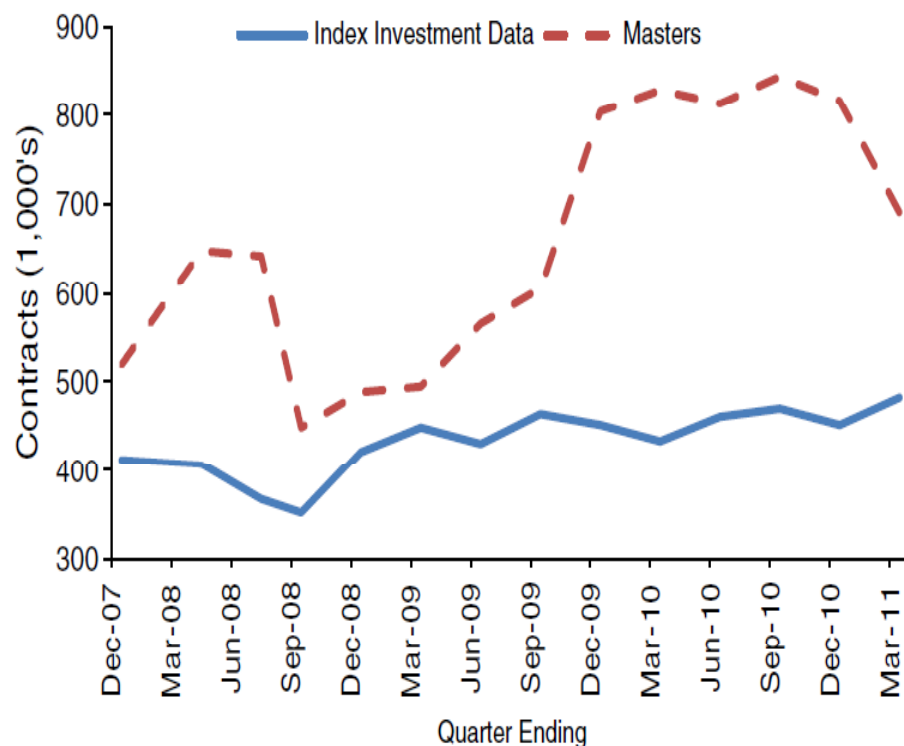
Swap dealers cut their positions when prices increase and increase their positions when prices decline.

3.4 Predictability of Crude Oil Futures Returns

- Financial flows into commodities can predict crude oil futures returns (Singleton, 2011)
 - Empirical Result: Increases in financial flows into index funds predict higher subsequent futures returns
- But....
 - Based on inaccurate measure of investment flows into index funds
 - Does not imply causation
 - How to interpret such a result?

Index Investment Flows

Comparison of quarterly WTI crude oil net long index positions based on Index Investment Data (IID) and Masters Algorithm Estimates





Source: Irwin and Sanders (2011)

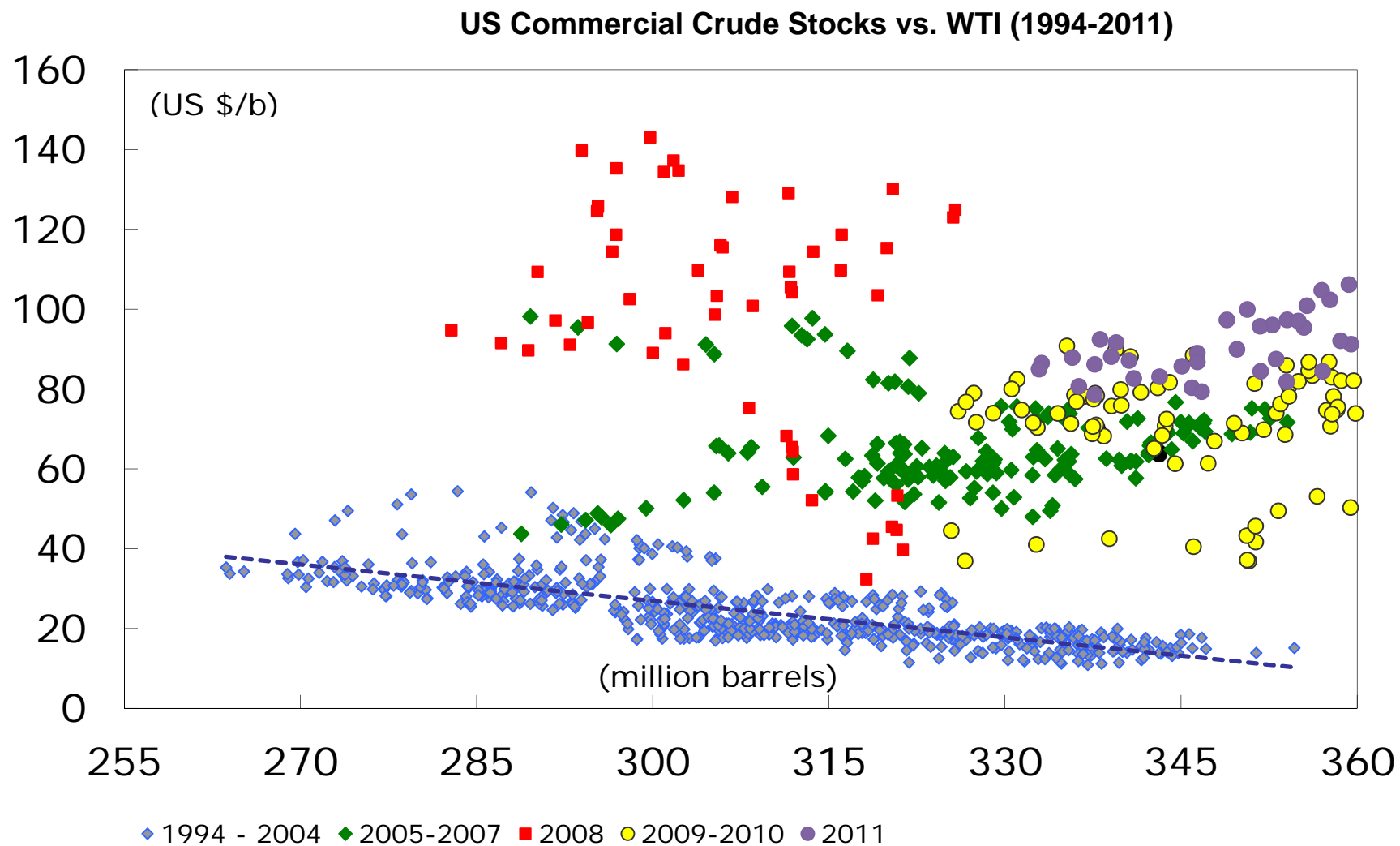
Irwin and Sanders (2011):

- WTI crude oil futures positions using Masters algorithm over-estimates size of index investors
- Correlation between Index Investment Data and Masters series close to zero at quarterly horizon
- Empirical studies that use Masters Algorithm are flawed
- No statistically significant relationship between growth in contracts on one hand and returns, realised volatility and implied volatility on other hand; When relationship found, it is negative

Interpretation of Result

- Even if such an evidence holds it is not necessarily supportive of speculation
 - Consistent with existence of frictions that limit participation of non-commercial traders in futures markets (Hirshleifer , 1988; 1989)
- Buying a futures contract involves risk that is compensated for in equilibrium by a risk premium paid to the speculator
- Risk premium depends both on systematic factor and residual risk linked to hedging pressure
- Increased hedging pressures  Increase risk premium
- Increased hedging pressures  Attract more speculative positions
- De Roon et al (2000):
 - Market producers hedging positions correlated with commodity futures price changes
 - Consistent with evidence of frictions in futures markets

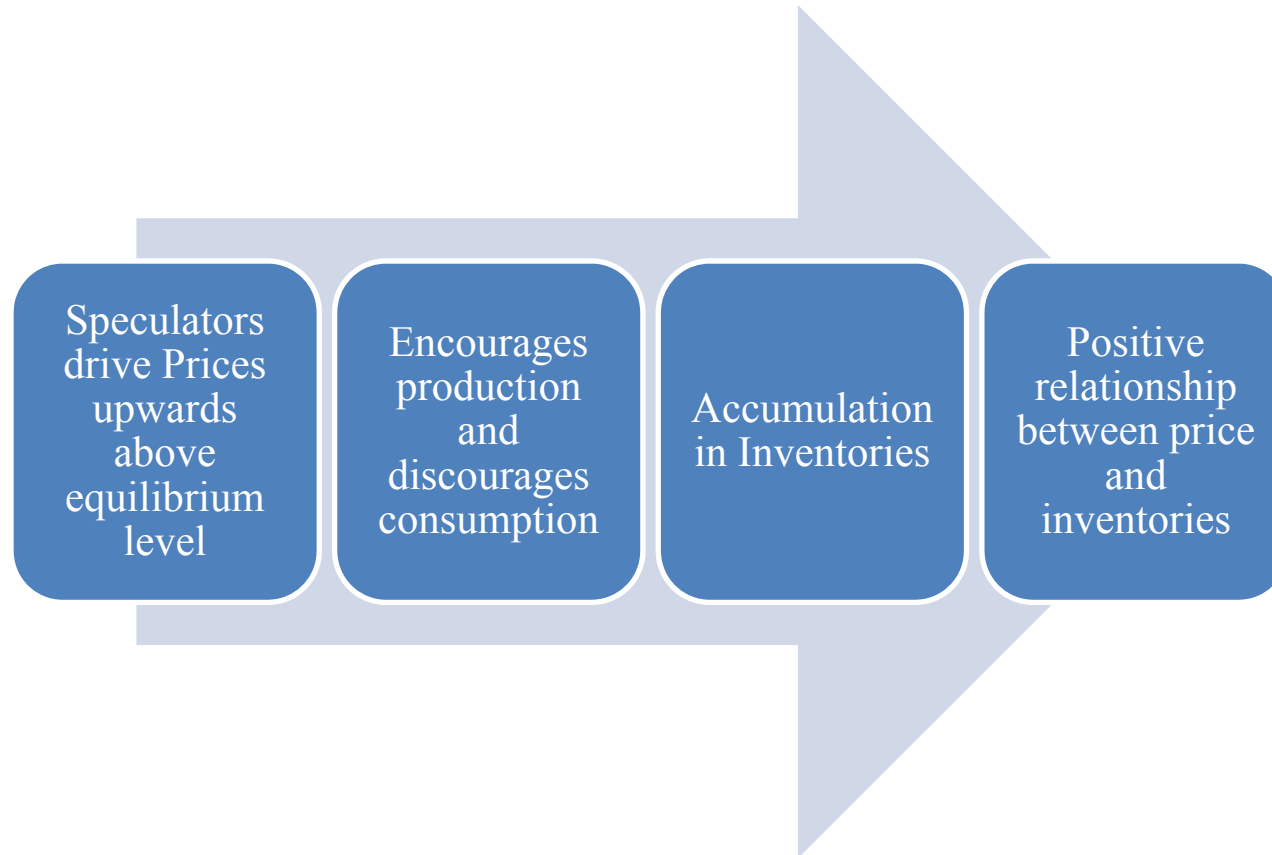
3.5 The Inventory-Price Relationship



Source: OPEC

Broken Relationship

- Often claimed that relationship broken due to entry of speculators/ index investors
- Underlying static framework

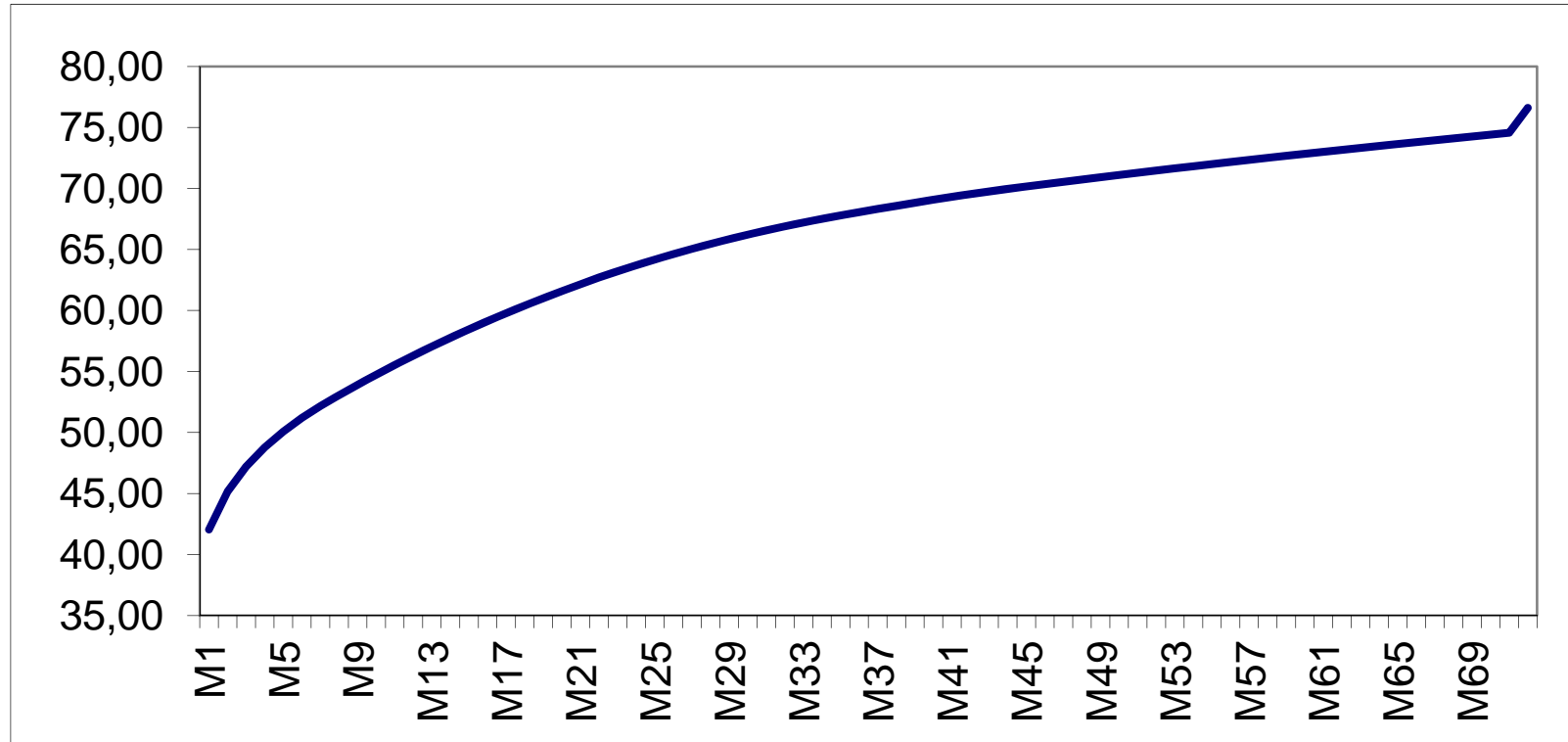


Inventory-Price Relationship Much More Complex

- Relationship between two endogenous problems could be shifting in response to structural changes or changes in expectations
- Pirrong (2008): Commodity storage problem dynamic & should be analysed in dynamic rational expectation model
 - Forward looking agents respond to increase in variance of demand by increasing inventory holdings which requires prices to increase
 - If variance shocks are volatile enough, relationship between inventories and prices becomes unstable
- Dvir and Rogoff (2009):
 - Agents will increase optimal storage in expectation of higher prices in next period
 - Will lead to higher equilibrium price today when storage is positive
 - Impact of growth shock is magnified: increasing demand when it is high in preparation of higher demand in the future
 - Price volatility higher in presence of storage (contrary to the view that storage lean against the wind)
- *“Those searching for evidence of speculative excess need look elsewhere than the price-inventory relation.” (Pirrong, 2008); same conclusion reached by Singleton (2011)*

Dislocation of Forward Curve

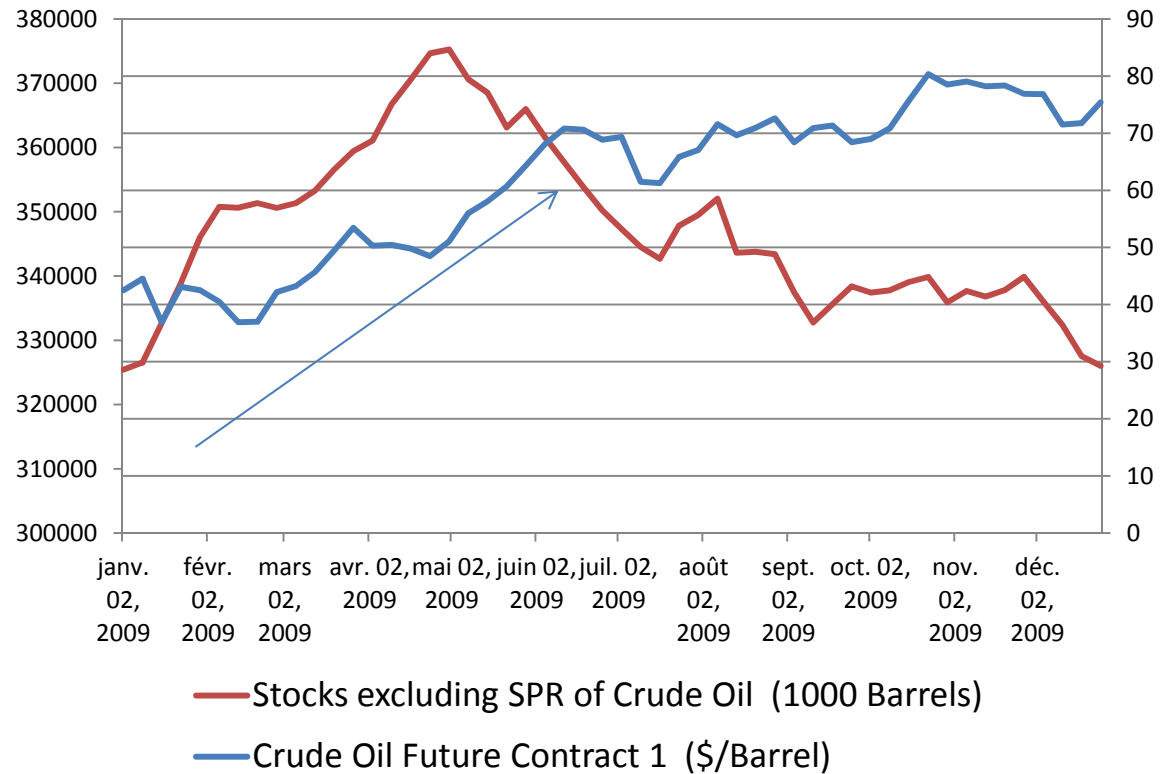
WTI Term Price Structure (December 2008, Monthly Average)



Source: Bloomberg

Crude Oil Inventories can play a stabilizing role

Weekly U.S. Ending Stocks excluding SPR of Crude Oil (1000 Barrels) and the WTI Oil Price



Source: EIA

3.6 Shocks in a VAR Framework

- Distinguish between various types of shocks (Kilian and Murphy, 2010) in VAR framework:
 - Shock to the flow of crude oil production (flow supply shock)
 - Shock to the demand for crude oil driven by the global business cycle (flow demand shock)
 - Shock to the demand for above-ground oil inventories arising from forward-looking behaviour (“speculative demand shock”)
 - Anticipation of a booming world economy;
 - Speculative demand for oil manifests itself as demand for oil inventories;
 - By including changes in oil inventories in an econometric model able to identify the effects of expectations shifts without explicit measures of expectations
 - Residual shock that captures all structural shocks not otherwise accounted for and has no direct economic interpretation (e.g., weather shocks, shocks to inventory technology or preferences, changes in SPR, technical constraints in refining).

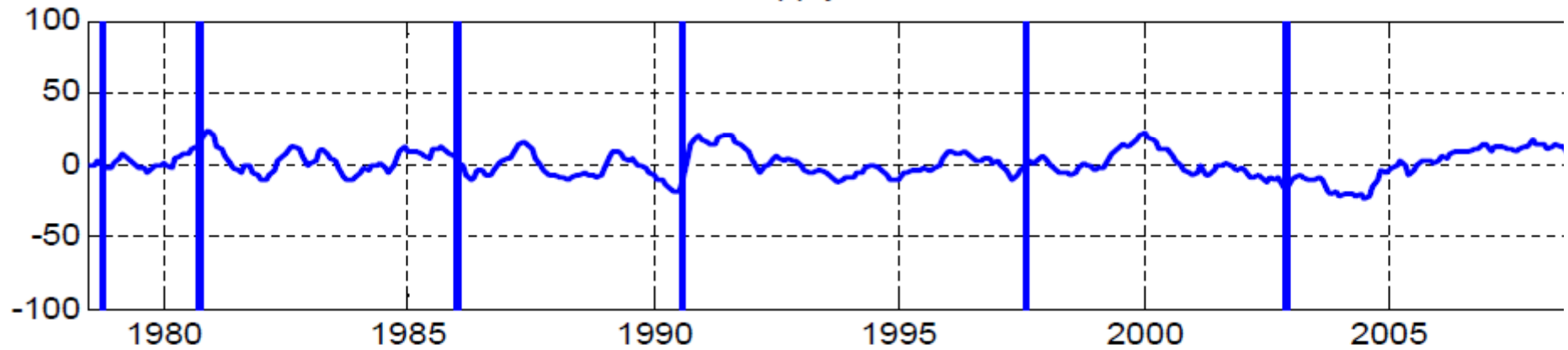
Structural Model of Oil Market

- Monthly data for 1973.2-2009.8
- Four variables all endogenous
 - Percent change in global crude oil production
 - Index of global real activity in deviations from trend
 - Real price of oil
 - Change in above-ground global crude oil inventories

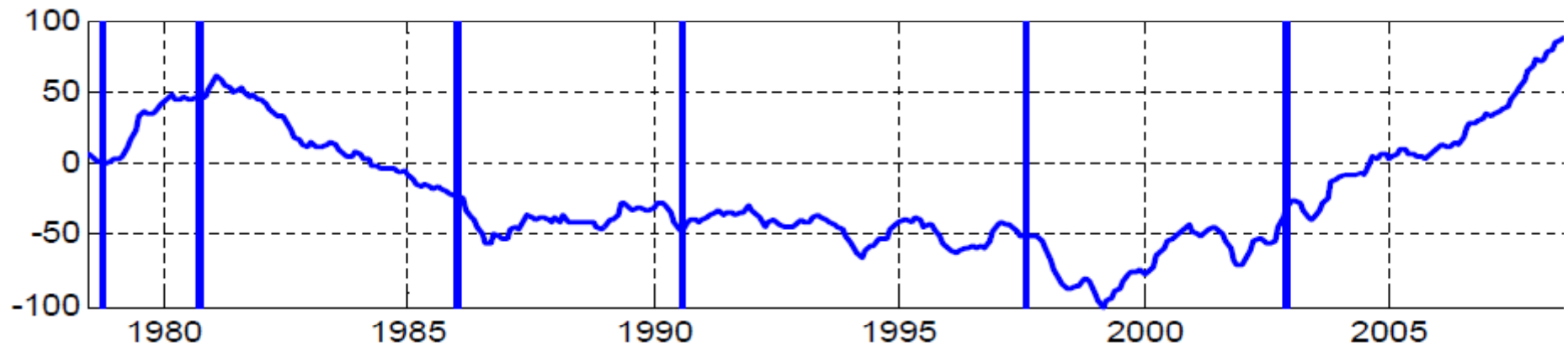
	Flow Supply	Flow Demand	Speculative
	Shock	Shock	Demand Shock
Oil Production	-	+	+
Real Activity	-	+	-
Real Oil Price	+	+	+
Inventories			+

Historical Decompositions for 1978.6-2009.8

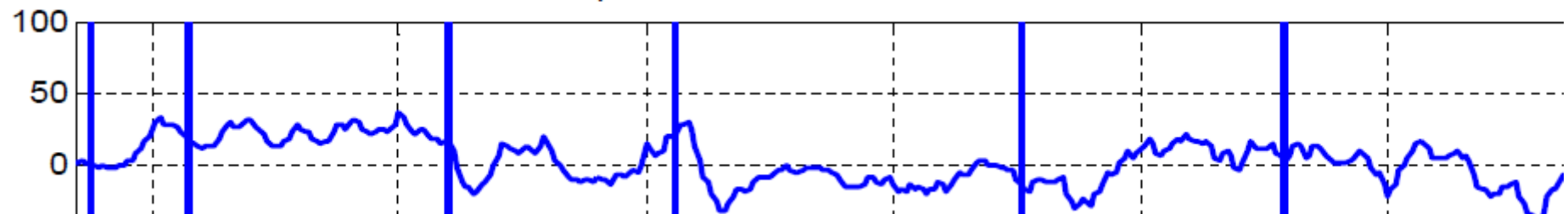
Cumulative Effect of Flow Supply Shock on Real Price of Crude Oil



Cumulative Effect of Flow Demand Shock on Real Price of Crude Oil



Cumulative Effect of Speculative Demand Shock on Real Price of Crude Oil



Other VAR Studies

- Juvenal and Patrella (2011) introduce an additional shock but with questionable identifying restrictions:
 - Financial speculative demand shock reflecting traders' activity in financial markets
 - Financial speculation shocks second most important driver of oil prices after oil demand shocks
 - Also accounts for increased correlation between oil & other commodities
- Lombardi and Van Robyas (2011) introduce a financial speculation shock
 - Identification based on oil futures spread and futures price
 - Find that destabilizing financial activity can have an impact in the short run but limited in the long run
 - Fundamentals (and expected fundamentals) explain about 90% of oil price movements in the short run
- Lechthaler and Leinert (2012): Include an explicit proxy for precautionary demand
 - Use media sentiment to model expectation driven demand activities; considers news/ information to be at the heart of the expectation formation process
 - Expectations have been a major driver of the price of crude oil after 2003. Fundamentals have played a much smaller role

3.7 'Financialization' and Risk Aversion

- Acharya et al (2010): Capital constraints
 - Pressure for hedging demand from producers and/or if speculators face capital constraints which limit their ability to take risk results in an increase in cost of hedging and affect optimal inventory decisions
 - Decision to hold/release inventories affects spot prices
 - Find evidence that changes in default risk (proxy for risk aversion) predict oil futures returns
- Etula (2009): Risk aversion
 - Risk premium depends both on systematic risk and non-marketable risk increasing in the level of effective risk aversion
 - Risk-bearing capacity of brokers and dealers
 - Empirical findings: Change in risk bearing capacity of traders predicts quarterly crude oil returns
- Pirrong (2011)
 - Greater financial market integration reduces market price for risk and increases the level of inventories by reducing cost of hedging
 - Induces an increase in the spot price
 - But stabilizing: higher level for inventories reduces the risk of future price spikes

Policy Implications

- Regulatory measures matter:
 - Regulatory measures aimed at increasing cost of hedging or reduce the risk bearing capacity of ‘speculators’ have adverse consequences and should be avoided
 - Etula (2009) concludes: ‘result is central to understanding why restrictions on speculation by market makers may adversely impact the functioning of many derivatives markets’

2.8 Structural Calibrated Model

- Fattouh and Mahadeva (2012) build a calibrated finance-macro model to test implications of financialization
- Define financialization in precise manner
 - Lower risk aversion by financial speculators
 - More wealth at their disposable.
- Competing explanations
 - Lower real rates (search for yield)
 - Looser net supply
 - More volatile supply
- Test the financialization hypothesis and competing explanations in one model

Spreads and Players

P_t

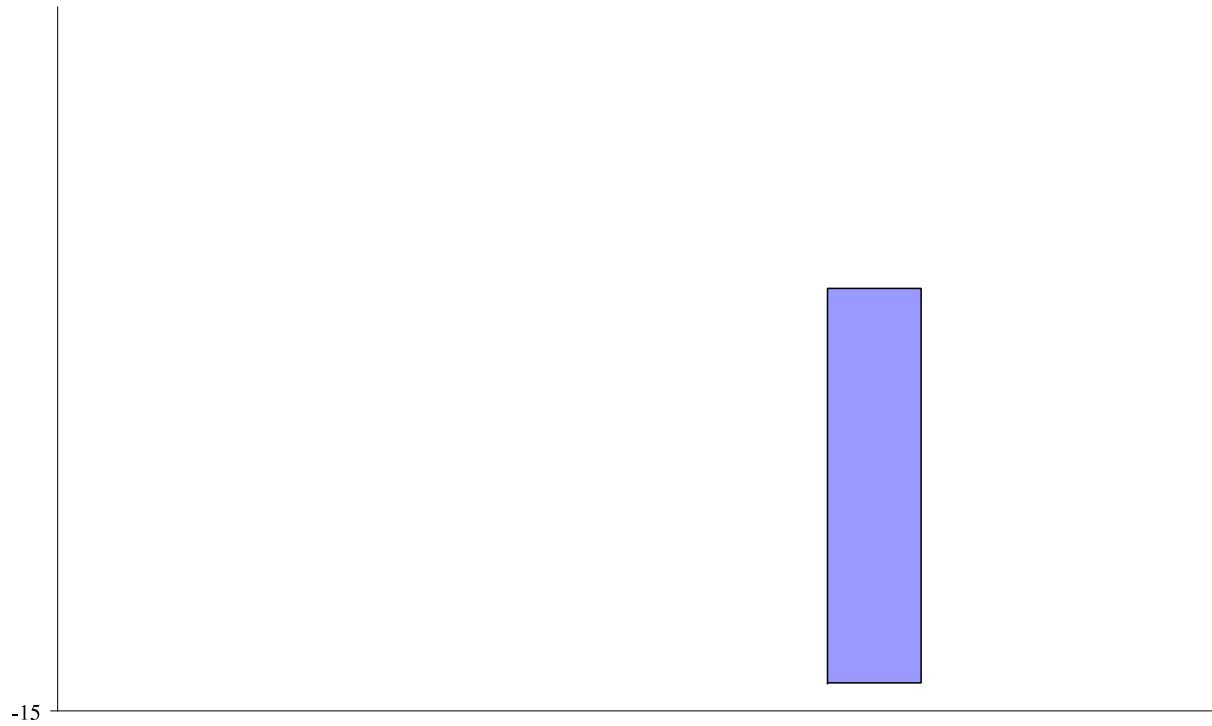
Physical Speculators (hedged)

$[F^{t+1}]$

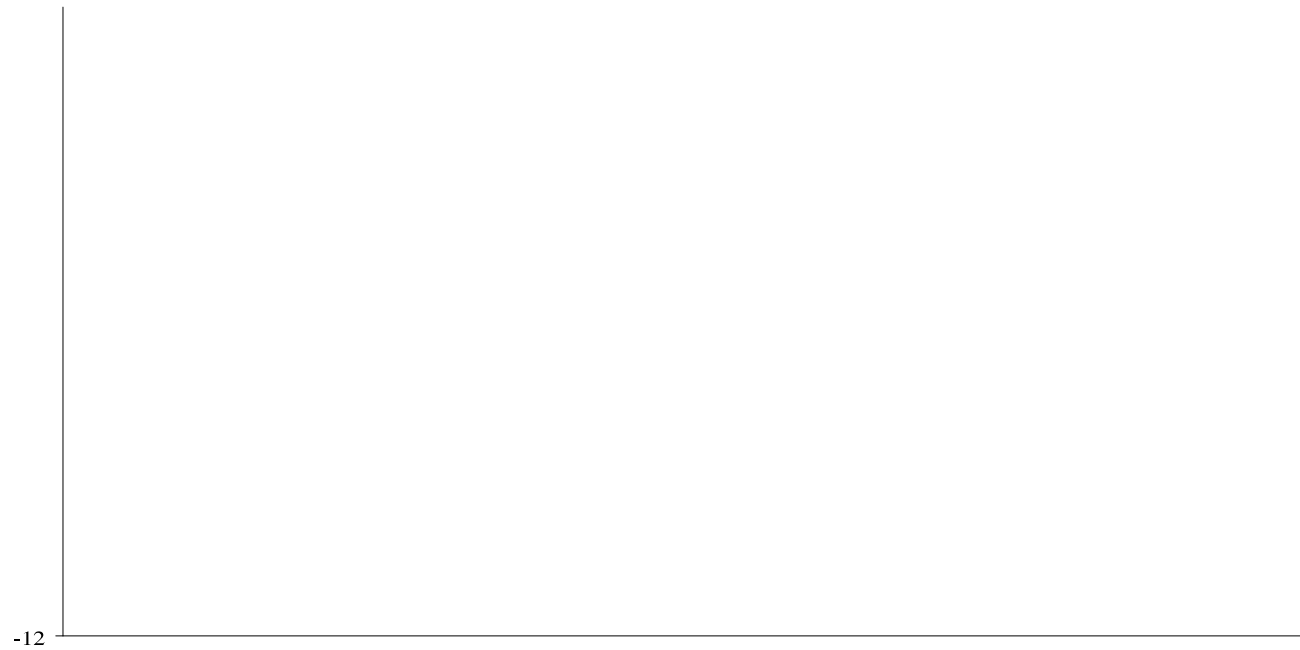
Methodology

- We match the model to the data before 2003
 - It matches the spreads reasonably well
- We experiment with
 - Financialization changes
 - Other changes to the financial layer
 - The physical layer
- We see if the financialization hypotheses predictions are borne out

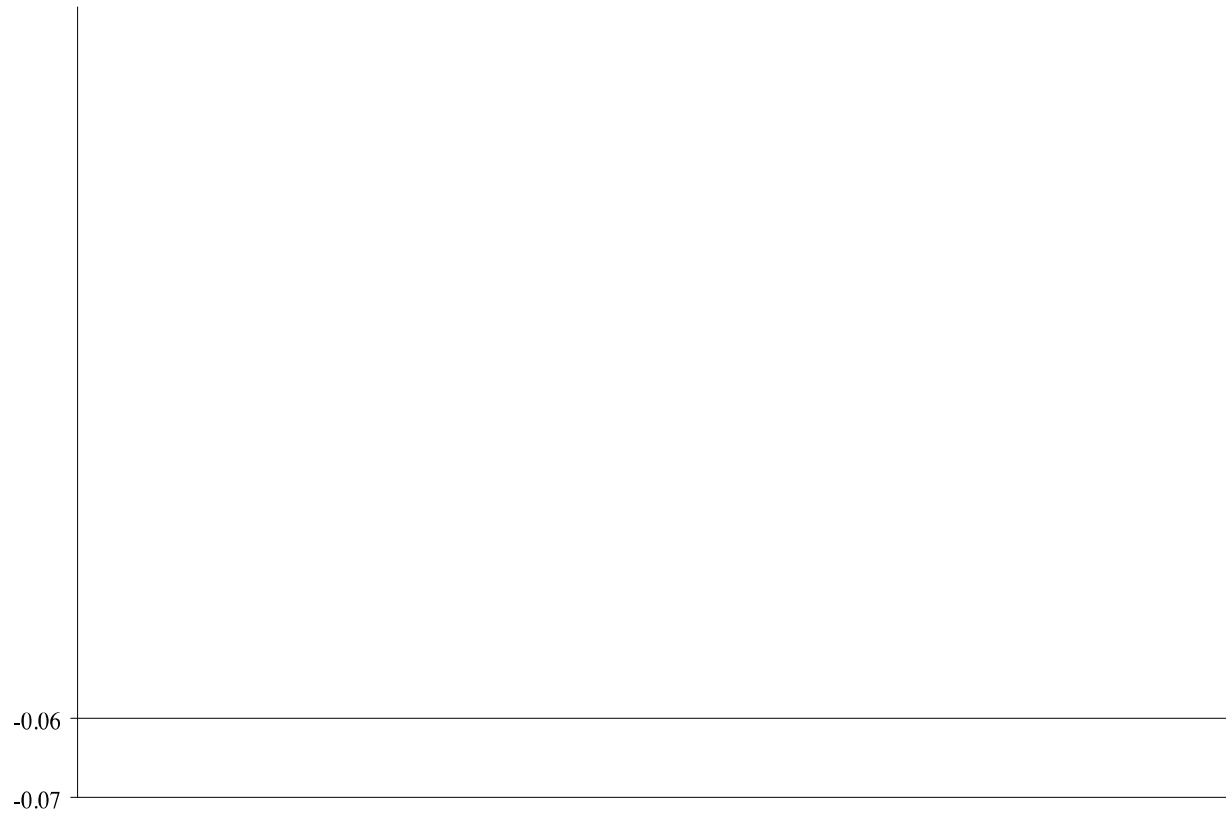
Financial Participation



Price Levels



Consumer Welfare



Regulation

- No support for the view that greater financialization had an important effect on oil market variables and harmed final consumers
- Anticipations of net supply shifts have important impacts on prices, spreads, welfare, and even on financial market participation
- Model did not allow for frictions displayed in real world financial markets
 - For instance, financial speculators not leveraged
- Fundamental market failures would elicit own specific policy solutions
 - If entrance of highly leveraged financial speculators disrupts oil markets then prudential regulation should be employed on leveraged investors
 - Many types of regulation: micro-prudential, market prudential or systemic
- Before oil financial market policies are contemplated crucial in first instance to identify channels through which financialization can result in market failure

4. What Has been Learnt So Far?

- Price co-movement analysis adds little to our understanding of drivers of oil prices
 - What drives this co-movement?
 - Why does it matter?
 - Correlation does not imply causation
- Evidence of Granger causality mixed at best and do not say much about ‘causality’
- Evidence of predictability of futures returns based on inflows is mixed at best and is consistent with other explanations based on market frictions
- The inventory-price relationship should not be used to test for speculation
- Most evidence from VAR analysis suggests that speculation played a limited role in explaining oil price movements during the 2002-2008 oil price cycle; oil demand shocks (current and expected) can account for the oil price rise
- Structural calibrated models suggest that financialization has no impact on key variables including consumer welfare; fundamental factors have much bigger role

Does not imply that entry of financial players has had no impact on oil price formation

- Change in risk aversion of financial players can have an impact on the spot price
- Entry of financial players affects risk premia (Hamilton and Wu, 2011)
 - Significant changes as financial investors (index funds) have become natural counterparts to hedgers
 - Risk premia declined post 2005 and become more volatile (even negative in many instances like in 2009)
- Change in term structure of commodity futures markets (Mou, 2010)
- Increase in herding activity in commodities futures (Buyuksahin et al, 2009)
 - Herding in futures markets driven in part by mimicking behaviour and common trading strategies specifically by hedge funds and floor brokers/traders
 - But have stabilising effect on prices
 - Evidence has been limited so far to this study: An area in need of further research
- Increased correlation across various maturities but different explanations
 - Buyuksahin et al (2008): More efficient pricing methods
 - Fattouh and Scaramozzino (2011): Shift in the probability distribution of the mean reversion parameter due to change in expectations

Financial Players and Expectations

- How does the entry of financial players affect the formation of expectations?
- Beauty contest games can arise in difference of opinion framework and heterogeneity of traders (Singleton, 2011; Allen, Morison and Shin, 2006)
 - Market participants form expectations not only in terms of expected fundamentals but also on basis of anticipations of other players' expectations
- Impact of public information or signals amplified even if do not necessarily reflect large changes in underlying fundamentals
 - Can affect my guess about other players' guesses
- Market participants tend to focus only on few signals while ignoring others as not possible to coordinate on a large number of signals
 - Inventories, weak dollar, shortages of supply, peak oil
- To what extent these features play out in commodities markets is yet not clear and is need of further research