The Financialization of Commodity Markets

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Society of Quantitative Analysts
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The Financialization of Commodity Markets

• This lecture builds on my recent review article with Ing-haw Cheng (Dartmouth)

• Large inflow of investment capital
  – according to CFTC Report (2008), commodity index investments in total $200B on June 30, 2008

• Commodity futures has become a new asset class for portfolio investors

• Economic mechanisms that affect financial markets and financial investors may also be relevant for commodity markets
Synchronized Boom and Bust of Commodity Prices

Source: Tang and Xiong (2012)
The Debate

• Polarized views on whether financial investors have affected commodity prices
  – The bubble view: commodity index investors had caused a gigantic bubble in energy and agricultural commodities in 2007-2008
    • e.g., Masters (2008), US Senate Report (2009), Kennedy (2012)
  – The business-as-usual view: there was no bubble and thus no problem
    • e.g., Krugman (2008), Stoll and Whaley (2010), Irwin and Sanders (2012), Fattouh, Kilian and Mahadeva (2012)

• Rejecting one extreme view does not justify the other
  – The truth might be more nuanced---financialization has transformed commodity markets in subtle ways, some good, some bad
  – Need to analyze specific mechanisms
  – Caution against blank generalization of results from a specific test
Road Map

- Basic facts about changes in commodity futures markets in recent years

- Economic mechanisms
  - Theory of storage
  - Information discovery
  - Risk sharing

- A few focal issues
  1. Speculation and commodity inventory
  2. Excessive speculation

- The ongoing issue with the Fed’s evaluation of banks’ trading of physical commodities
Basic Facts
Expansion of Open Interest and Volume

- Source: Irwin and Sanders (2012)
Evolution of Market Participation
Cheng, Kirilenko, and Xiong (2012)

Net Commodity Exposure

Exposure defined as Net Position(t) x Front Month Price(t), Real Dec2006 $
Evolution of Market Participation
Cheng, Kirilenko, and Xiong (2012)

Net Commodity Exposure

Exposure defined as Net Position(t) x Front Month Price (15Dec2006)

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Commodity Price Volatility

Source: Tang and Xiong (2012)
Comovement between Commodities

- **Source:** Tang and Xiong (2012)

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Comovement between Commodities and Stocks


Source: Tang and Xiong (2012)
Economic Mechanisms

– Theory of storage

– Information discovery

– Risk sharing
Theory of Storage

• The balance between physical supply and demand is the economic fundamental of commodity markets

• A large strand of the literature focuses on storage
  – Storage saves excess supply and acts as buffer stock for future supply-demand imbalances
  – A non-negativity constraint on inventory
  – Storage leads to positive auto-correlations in price

• Futures markets in theory of storage
  – e.g., Routledge, Seppi and Spatt (2001), Alquist and Kilian (2010)
  – Futures are sideshows
  – Futures-spot price spread as incentive for storage
Speculation by Storage

• Many economists posit that inventory has to rise if speculation distorts prices.
  – The premise is that consumers disagree with the traded prices and respond by reducing demand

• Speculation is often defined by anyone buying crude oil not for current consumption, but for future sale or use.

  • Based on this definition, Kilian and Murphy (2013), Juvenal and Petrella (2012), Knittel and Pindyck (2013) find that the WTI price boom in recent years was not accompanied by inventory spike (i.e., intensified speculative activity)

  • This is a specific form of speculation, which ignores informational frictions in reality.
Economic Mechanisms

– Theory of storage

– Information discovery

– Risk sharing
Understanding Commodity Price Boom in 2008

• Hamilton (2009), Kilian (2009), G20 Report
  – Largely increased demand propelled by rapid growth of emerging economies and stagnant supply

• Commodity prices continued to rise in early 2008!
  – WTI rose 40% in 2008 before it peaked in July 2008
  – U.S. were falling into recession in late 2007; S&P 500, FTSE 100, DAX, and Nikkei indices had peaked by October 2007
  – Bear Stearns collapsed in March 2008
  – Growth rate of China was also slowing, it peaked in mid-2007
  – Most emerging economies were driven by exports

• Confusion about emerging economies
  – ECB increased its key interest rate in early 2008, quoting high commodity prices as a key reason
  – Singleton (2012): high dispersion in 1-year ahead oil price forecasts of professional economists
Informational Frictions in Commodity Markets

• Participants of commodity markets face incomplete information regarding global supply, demand, and inventory of commodities.
  – Regular reports available from OECD countries, but can be delayed and revised over time
  – Little is available from emerging economies

• Centralized futures markets serve an important platform for information aggregation and price discovery
  – Roll (1984): orange juice futures effectively capture Florida temperature fluctuation
  – Garbade and Silber (1983): commodity futures prices often lead spot prices
  – Hu and Xiong (2013): after mid-2000s, overnight U.S. commodity futures prices positively lead East Asian stock prices
East Asian Market Reactions to Copper Return in 2005-2012

\[
R_{Asian\_Stock,t} = b_0 + b_1 R_{US\_Commodity,t-1}^{NonOverlap} + b_2 R_{S&P500,t-1}^{NonOverlap} + b_3 R_{Asian\_Stock,t-1} + \varepsilon_t
\]

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<thead>
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<tr>
<td>(b_1)</td>
<td>0.265***</td>
<td>0.0919***</td>
<td>0.280***</td>
<td>0.0675***</td>
<td>0.169***</td>
<td>0.0185</td>
<td>0.202***</td>
<td>0.059***</td>
<td>0.155***</td>
<td>0.083***</td>
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<tr>
<td></td>
<td>(10.53)</td>
<td>(3.99)</td>
<td>(8.28)</td>
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<td>(6.71)</td>
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<td>(6.24)</td>
<td>(2.20)</td>
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<tr>
<td>(b_2)</td>
<td>0.613***</td>
<td>0.702***</td>
<td>0.505***</td>
<td>0.466***</td>
<td>0.234***</td>
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<td></td>
<td>(17.54)</td>
<td>(15.66)</td>
<td>(13.33)</td>
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<td>(b_3)</td>
<td>0.018</td>
<td>0.0304</td>
<td>-0.052</td>
<td>-0.070</td>
<td>0.028</td>
<td>0.043</td>
<td>0.086*</td>
<td>0.088**</td>
<td>-0.0005</td>
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<td></td>
<td>(0.45)</td>
<td>(0.80)</td>
<td>(-1.09)</td>
<td>(-1.43)</td>
<td>(0.98)</td>
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<td>(1.86)</td>
<td>(1.97)</td>
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<tr>
<td>Obs</td>
<td>1,692</td>
<td>1,690</td>
<td>1,715</td>
<td>1,715</td>
<td>1,731</td>
<td>1,728</td>
<td>1,711</td>
<td>1,709</td>
<td>1,720</td>
<td>1,718</td>
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<tr>
<td>Adj R^2</td>
<td>0.123</td>
<td>0.377</td>
<td>0.095</td>
<td>0.323</td>
<td>0.057</td>
<td>0.243</td>
<td>0.069</td>
<td>0.196</td>
<td>0.023</td>
<td>0.044</td>
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### Panel B: Soybeans

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<td>$b_1$</td>
<td>0.180***</td>
<td>0.0502*</td>
<td>0.240***</td>
<td>0.0832**</td>
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<td>(4.98)</td>
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<td>$b_2$</td>
<td>0.655***</td>
<td>0.719***</td>
<td>0.504***</td>
<td>0.487***</td>
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<td>(19.18)</td>
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<td>(14.03)</td>
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<td>$b_3$</td>
<td>0.00909</td>
<td>0.0285</td>
<td>0.0345</td>
<td>0.0465*</td>
<td>0.0941**</td>
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<td>(0.20)</td>
<td>(0.73)</td>
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<td>Obs</td>
<td>1,688</td>
<td>1,688</td>
<td>1,714</td>
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<td>Adj $R^2$</td>
<td>0.037</td>
<td>0.368</td>
<td>0.325</td>
<td>0.028</td>
<td>0.246</td>
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**East Asian Market Reactions to Crude Oil Return in 2005-2012**

\[ R_{\text{Asian Stock},t} = b_0 + b_1 R_{\text{US Commodity},t-1}^{\text{NonOverlap}} + b_2 R_{\text{S&P500},t-1}^{\text{NonOverlap}} + b_3 R_{\text{Asian Stock},t-1} + \epsilon_t \]

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<td>Shanghai</td>
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<tr>
<td>( b_1 )</td>
<td>0.165***</td>
<td>0.0216</td>
<td>0.180***</td>
<td>0.00392</td>
<td>0.120***</td>
<td>0.00754</td>
<td>0.116***</td>
<td>-0.00289</td>
<td>0.0609**</td>
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<tr>
<td>(7.47)</td>
<td>(1.23)</td>
<td>(6.72)</td>
<td>(0.18)</td>
<td>(6.03)</td>
<td>(0.43)</td>
<td>(4.64)</td>
<td>(-0.14)</td>
<td>(2.50)</td>
<td>(-0.20)</td>
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<tr>
<td>( b_2 )</td>
<td>0.656***</td>
<td>0.741***</td>
<td>0.512***</td>
<td>0.504***</td>
<td>0.290***</td>
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<td>(19.34)</td>
<td>(16.55)</td>
<td>(14.22)</td>
<td>(10.61)</td>
<td>(5.56)</td>
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<td>( b_3 )</td>
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<td>0.0261</td>
<td>-0.0601</td>
<td>-0.0701</td>
<td>0.0191</td>
<td>0.0427</td>
<td>0.0818*</td>
<td>0.0887**</td>
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<td>(0.04)</td>
<td>(0.67)</td>
<td>(-1.18)</td>
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<td>(0.68)</td>
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<td>(1.76)</td>
<td>(1.99)</td>
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<td><strong>Obs</strong></td>
<td>1,692</td>
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<td>1,715</td>
<td>1,715</td>
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<td>1,728</td>
<td>1,711</td>
<td>1,709</td>
<td>1,720</td>
</tr>
<tr>
<td><strong>Adj R^2</strong></td>
<td>0.061</td>
<td>0.366</td>
<td>0.052</td>
<td>0.319</td>
<td>0.038</td>
<td>0.243</td>
<td>0.035</td>
<td>0.192</td>
<td>0.005</td>
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Does Inventory Have to Rise with Speculation?

- In the presence of information frictions, consumers’ expectations may be affected by futures prices.
  - A speculative effect does not have to show up in high inventory
Informational Frictions and Commodity Demand

Sockin and Xiong (2012):

- Basic premise:
  - Both supply and demand shocks are unobservable to market participants.
  - Demand is driven by people’s expectation of global economic strength
  - Commodity prices are useful signals

Without informational frictions:
- A higher price leads to lower demand
- A supply shock reduces price and boosts demand
- Futures price is a shadow of spot price

With informational frictions
- A higher price is not just a higher cost of production, but also a signal for a stronger economy
  - In net, price elasticity of demand is reduced and can be even positive
- Supply shock has an amplified price effect and an undetermined effect on demand
- Noise from trading in futures market can boost demand and spot price
- Differentiate two types of demand
  - Genuine demand vs confused demand
Economic Mechanisms

– Theory of storage
– Information discovery
– Risk sharing
Inefficient sharing of commodity price risks

• Keynes (1923) and Hicks (1939)
  – Hedgers are willing to offer premia in futures prices to attract speculators to the long side

• Gorton and Rouwenhorst (2006) --- commodity indices as an alternative investment vehicle
  – Analyze futures returns of commodities in GSCI in 1959-2004
  – Average return comparable to equity, not from spot returns but rather from the structure of futures markets
  – Great benefit of diversification: negative correlation with equity and bond and positive correlation with inflation

Table 2. Risk Premiums for Annualized Monthly Returns, July 1959–December 2004

<table>
<thead>
<tr>
<th></th>
<th>Commodity Futures</th>
<th>Stocks</th>
<th>Bonds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>5.23</td>
<td>5.65</td>
<td>2.22</td>
</tr>
<tr>
<td>Standard deviation (%)</td>
<td>12.10</td>
<td>14.65</td>
<td>8.47</td>
</tr>
<tr>
<td>t-Statistic</td>
<td>2.92</td>
<td>2.57</td>
<td>1.77</td>
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<tr>
<td>Sharpe ratio</td>
<td>0.43</td>
<td>0.38</td>
<td>0.26</td>
</tr>
<tr>
<td>Percent returns &gt; 0</td>
<td>55</td>
<td>57</td>
<td>54</td>
</tr>
</tbody>
</table>

Table 4. Correlations of Commodity Futures Returns with Stocks, Bonds, and Inflation, July 1959–December 2004

<table>
<thead>
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<th>Holding Period</th>
<th>Stocks</th>
<th>Bonds</th>
<th>Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly</td>
<td>0.05</td>
<td>-0.14*</td>
<td>0.01</td>
</tr>
<tr>
<td>Quarterly</td>
<td>-0.06</td>
<td>-0.27*</td>
<td>0.14</td>
</tr>
<tr>
<td>One year</td>
<td>-0.10</td>
<td>-0.30*</td>
<td>0.29</td>
</tr>
<tr>
<td>Five years</td>
<td>-0.42*</td>
<td>-0.25*</td>
<td>0.45*</td>
</tr>
</tbody>
</table>

Note: Overlapping return data.
Segmentation and Integration of Commodity Markets

• Several observations suggest that before mid-2000s commodity market were previously segmented from outside
  – Largely uncorrelated returns between different commodity futures
  – Lack of correlation between commodities and stocks
  – Large risk premium in commodity futures unrelated to market risk
    • High roll returns in historical data indicate strong backwardation and thus consistent with hedging pressure theory

• The large inflow of financial capital after mid-2000s integrates commodity futures markets
  – Correlation between commodity prices largely increased, e.g., Tang and Xiong (2012)
  – Correlation between commodities and stocks largely increased, e.g., Tang and Xiong (2012), Büyükşahin and Robe (2011, 2012), Silvennoinen and Thorp (2011)
  – Commodity futures risk premia reduced, e.g., Hamilton and Wu (2012)
  – Basak and Pavlova (2012) provide a general equilibrium model to capture these features
Risk Sharing bw Hedgers and Financial Traders

• The two sides have to accommodate each other’s need

• Emerging literature on limited financial intermediary capital as a key asset pricing factor

• Financial traders on the long side have limited capacity
  – Etula (2010): commodity risk premium decreases in leverage of the broker-dealer sector
  – Acharya, Lochstoer, and Ramadorai (2012): fraction of futures risk premium attributable to producers’ default risk is higher when broker-dealer balance-sheets are shrinking

• When financial traders suffer distresses, risk may be reallocated back to hedgers
  – Cheng, Kirilenko and Xiong (2012)
  – During the recent crisis, VIX shocks hammer financial traders’ risk bearing capacity and cause risk to flow back from financial traders to hedgers.
Evolution of Different Groups

- Source: Cheng, Kirilenko and Xiong (2012)

Exposure defined as Net Position(t) x Front Month Price(15Dec2006)
Convective Risk Flows

Summary of findings of Cheng, Kirilenko and Xiong (2012)

1. After the crisis, financial institutions typically sold when the VIX rose and bought when the VIX fell, just as prices started to exhibit a negative sensitivity to the VIX, consistent with the distressed financial institution theory.

2. Within certain types of financials, “commodity index traders,” institutions that have particularly high CDS spreads are those who exhibit the strongest negative sensitivity to the VIX.

3. Commercial hedgers bought as the VIX rose and sold as the VIX fell. Looking at both long and short hedgers reveals that this was not driven by reductions in hedges.

Upshot: Risk flowed back to commercials during this period as financials were more distressed, a risk convection.
Summary

It is important to understand the financialization of commodity markets in junction with various frictions

- Commodity futures prices serve as important price signals

- Risk sharing between hedgers and financial traders is subtle and complex
Banks’ Trading of Physical Commodities

- Federal Reserve Board is currently evaluating banks’ trading of physical commodities
  - In summer 2013, Goldman Sachs was accused of manipulating prices of aluminum by delaying delivery of aluminum through its LME warehouses in Detroit
  - Systemic risk concern
  - JPMorgan and several other banks have sold their physical commodity units

- Why do banks want to own physical facilities in the first place?
  - Profitable
  - Important to access information flow

- Who will gain from banks’ exit?
  - Commodity trading firms, e.g., Glencore, Vitol, Trafigura
  - Opaque and largely unregulated
  - Any systemic risk?