

# COMMODITY TRADING



# Commodity Transformations

- All commodities undergo transformations through the value chain
- Transformation in space (transportation)
- Transformation in time (storage)
- Transformation in form (processing)



# Some Examples

- Power plants transform fuel into power
- Pipelines transform gas in one location to gas in another
- Storage terminals convert oil today to oil tomorrow



# Complexity

- Most commodities go through numerous transformations of all 3 types
- Think of the process of transforming oil at the wellhead to gasoline at the pump
- Multiple spatial transformations (VLCC, pipeline, truck)
- Multiple physical transformations (at refinery)
- Storage at “break points”



# Bottlenecks

- Every transformation process has bottlenecks
- Bottlenecks constrain the transformation process
- The tightness of these constraints can vary over time



# Some Examples

- Pipeline capacity
- Transmission capacity (e.g., thermal, voltage limits)
- Refinery capacity
- Limits on rate of flow into and out of gas storage facilities (which can vary depending on type of facility)



# Regulatory Bottlenecks

- Regulatory factors are an increasingly important source of bottlenecks.
- Gasoline formula regulations that vary by geographic region (e.g., Midwest)
- NOX or SOX limits (again may be geographic variation in these constraints)
- Export bans



# Pricing

- Understanding energy pricing requires an understanding of the transformation process and the role of bottlenecks
- It also requires an understanding of the role of the price system





# The Role of the Price System

- A competitive price system aggregates the information held by millions of economic actors
- Competitive prices adjust to direct resources to their highest value uses
- In particular, they adjust to reflect relative scarcity and the importance of constraints/bottlenecks



# Pricing “Regimes”

- Prices may behave very differently over time, depending on how tightly constraints bind
- In general, prices are more volatile when constraints bind tightly than when they do not



# The Economics of Pricing Regimes

- Very straightforward supply and demand economics explains this
- Supply is “inelastic” when constraints bind
- Binding constraints mean that it’s very costly to adjust production or consumption in response to demand and supply shocks
- In these circumstances, prices must bear the burden of adjustment



# Example: Midwest Gas Pricing

- Midwest gasoline (petrol) pricing has been very controversial recently (since late-1990s)
- Several FTC investigations
- Simple supply and demand analysis can shed light on why pricing behavior has changed
- Role of environmental regulations—supply less elastic



# Example: NOX Permits

- CA enacted restrictions on NOX emissions from power plants
- Due to heavy operations in summer of 2000, many plants had come close to reaching their allowed emissions
- NOX permits became a bottleneck



# Derived Demand

- Demand for products further back in the marketing chain “derived from” demand for final products— e.g., demand for oil is derived from demand for gasoline, heating oil, plastics, etc.
- Bottlenecks determine how shocks upstream and downstream impact prices along the chain



# Implication of Derived Demand

- The same shock (e.g., an increase in the demand for gasoline) can have a different impact on the demand for (and hence pricing of) crude oil depending on the amount of slack in refining



# Spreads Price Bottlenecks

- Transmission/congestion charges price transmission bottlenecks (example: PJM)
- Price of NG transportation and storage prices pipeline and storage bottlenecks
- Crack spread
- Spark spread
- Basis





# Spreads Provide Signals on Resource Allocation

- Basis prices quality/location value differences
- Locational basis will adjust to reflect changes in spatial supply and demand patterns and transportation constraints
- Example: CL basis. Basis relations in WTI (and between WTI and other crudes) have changed dramatically in recent years



# WTI Basis Example

- See the Purvin Gertz report for a detailed analysis
- Example: late-2008; reduced demand, increased Canadian supply, lack of direct route from Midcontinent to Gulf resulted in sharp rise in LLS-WTI basis
- Marginal barrel determines price: where the marginal barrel comes from depends on shifting supply and demand conditions
- Seasonal and secular shifts



# Light-Heavy Differential Example

- At the height of the oil price spike in summer, 2008, light-heavy price differentials were very wide and inventories of heavy crude were accumulating (e.g., Iran storing heavy crude in VLCCs)
- Combination of regulation-induced demand (low sulfur diesel), restrictions on supply of light sweet crude due to Nigerian disruptions, and limitations on capacity to process heavier crudes to satisfy demand for low sulfur diesel caused the differential to blow out

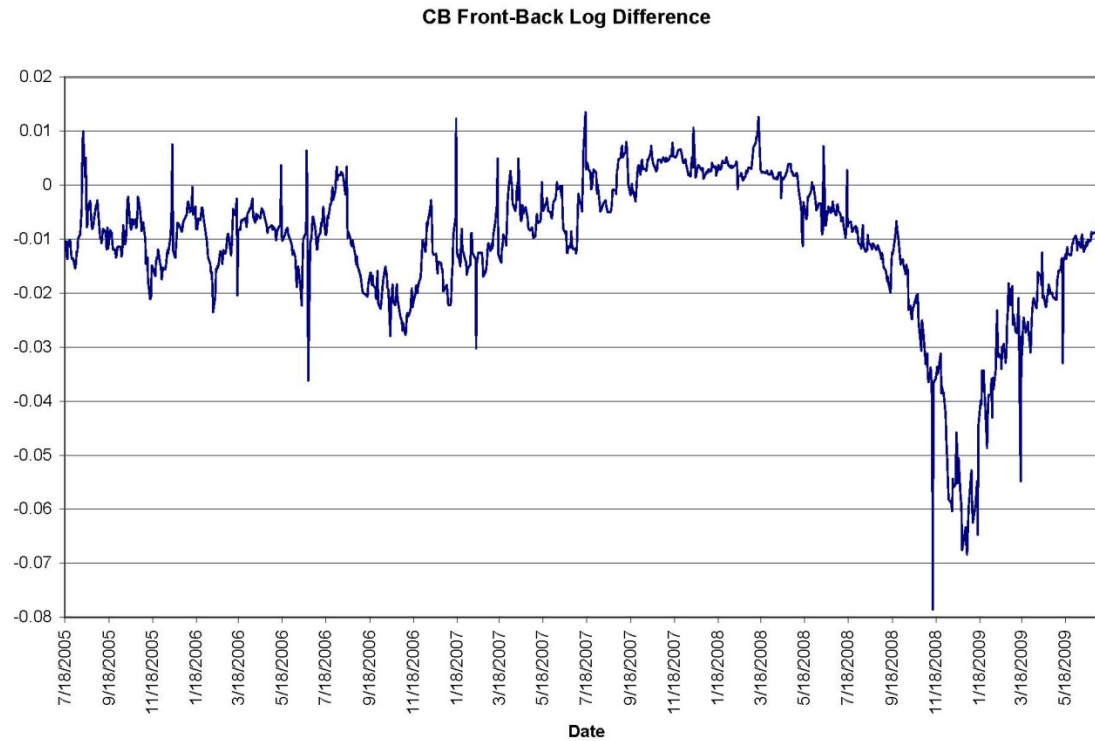


# Contango Example

- Demand collapse in aftermath of financial crisis and inflexibility of supply response in the short run caused huge crude inventory builds, including in US Midcontinent, especially Cushing
- Storage space effectively constrained
- Contango (the implicit price of storage) on WTI blew out
- Also blew out on WTS—so it was a storage capacity issue, not a WTI/futures issue



# Supercontango



# Trading

- Spreads and pricing relationships are the essence of much commodity trading
- Trading and managing the risk of such price exposures requires an understanding of the value chain
- There is a big potential payoff to understanding the intricacies of the value chain



# US Oil Markets: An Extended Example

- Major changes in North American oil markets in the past decades
- Major supply and demand shocks have affected pricing relationships
- Marginal barrel determines price: where the marginal barrel comes from depends on shifting supply and demand conditions
- Seasonal and secular shifts



# An Overview

- 1990s-early 2000s: US Midcontinent became a deficit supply region: marginal barrel was from imports. Oil flow mainly south-to-north. Midwest supplied from Canada
- 2008: Financial crisis led to a substantial decline in demand
- Post-2008: huge increases in output in Midcon, S. TX and W. TX.
- Complete shift in pricing relationships due to bottlenecks



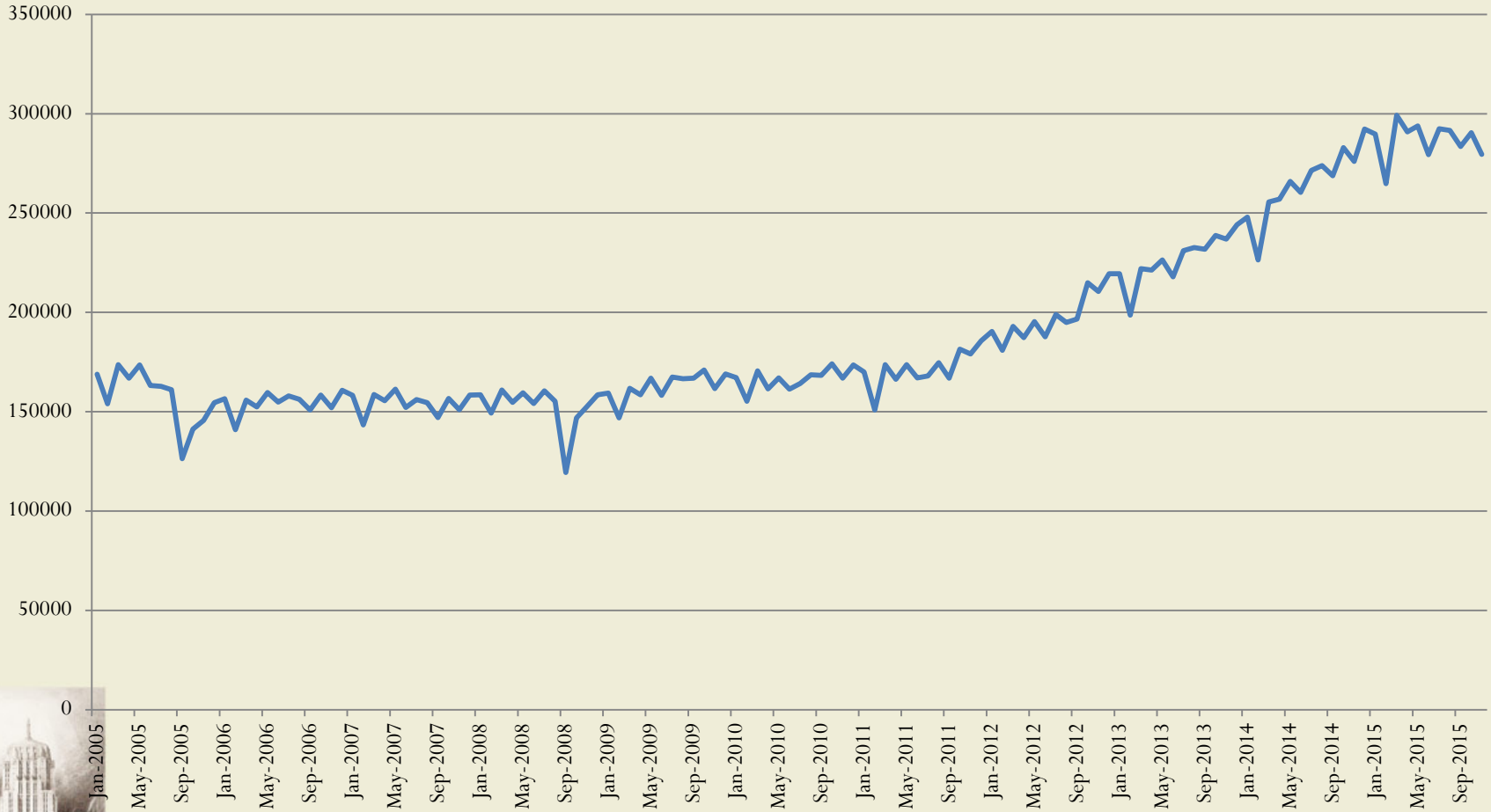


# Cash Basis Relationships

- Midcon prices above prices at GOM by cost of transportation prior to shale boom
- Shale boom created huge bottlenecks: excess supply in Midcon and parts of TX, no way to get it to Gulf, and Midcon refineries operating at full capacity
- Pricing relationships flipped: Midcon at a huge discount to GOM until bottleneck alleviated by reversal of pipelines, addition of rail and barge capacity
- Now the bottlenecks is legal:  $GOM - Midcon = \text{cost of transportation}$ , but GOM at a discount to foreign crude due to export ban

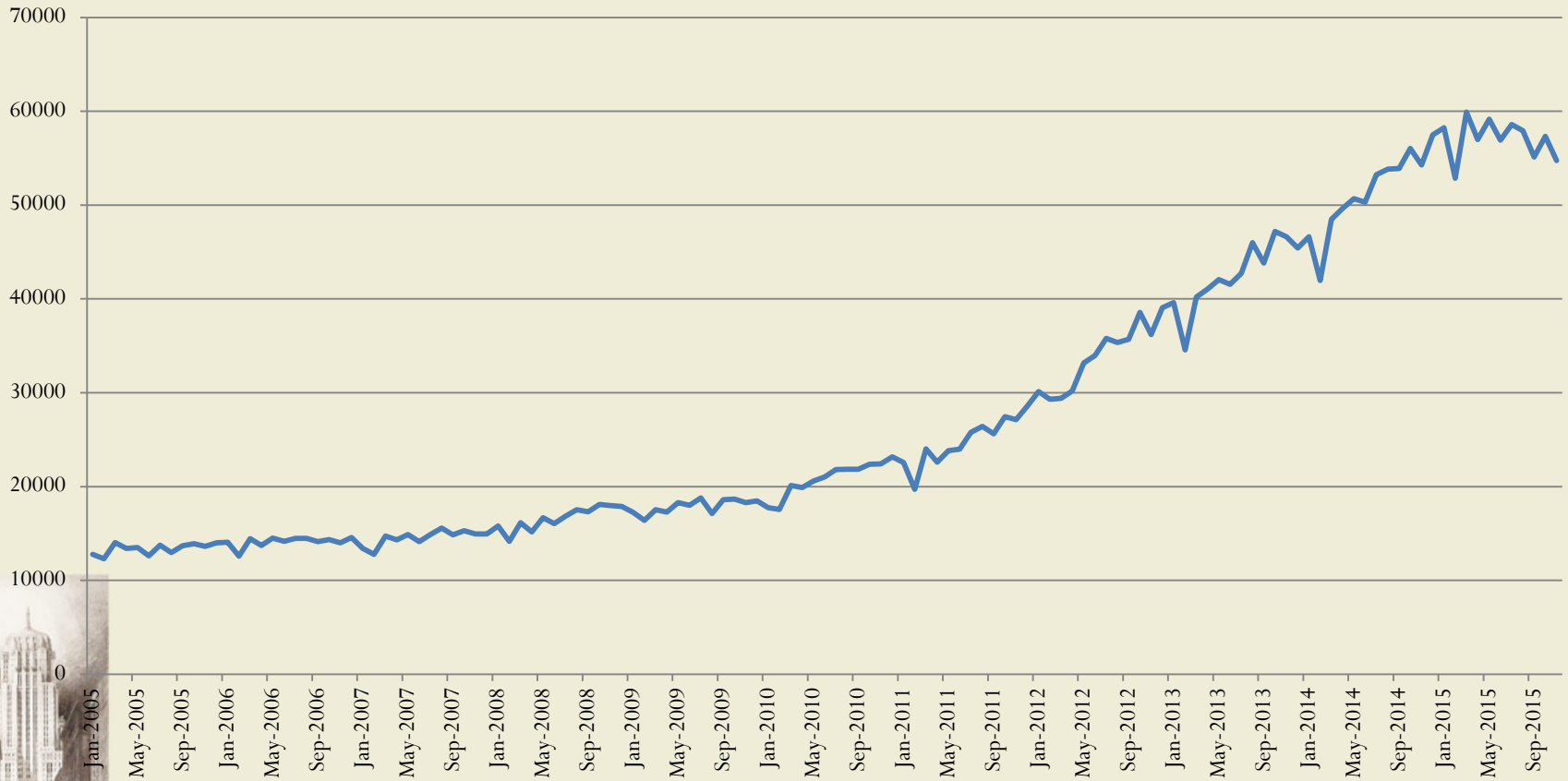


# US Oil Output



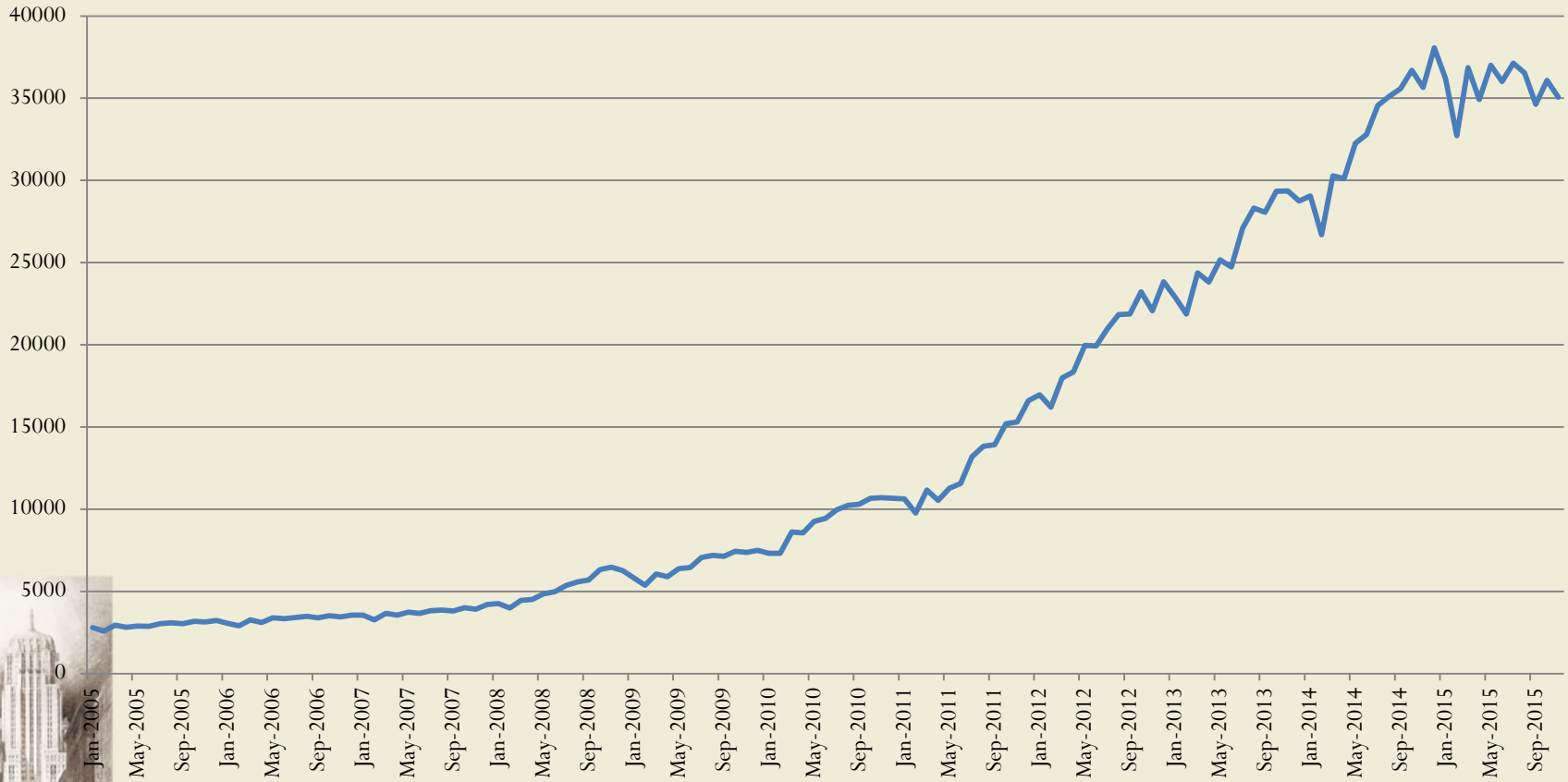
# PADD 2 Output

## PADD 2 Crude Production



# North Dakota Output

## North Dakota Crude Production



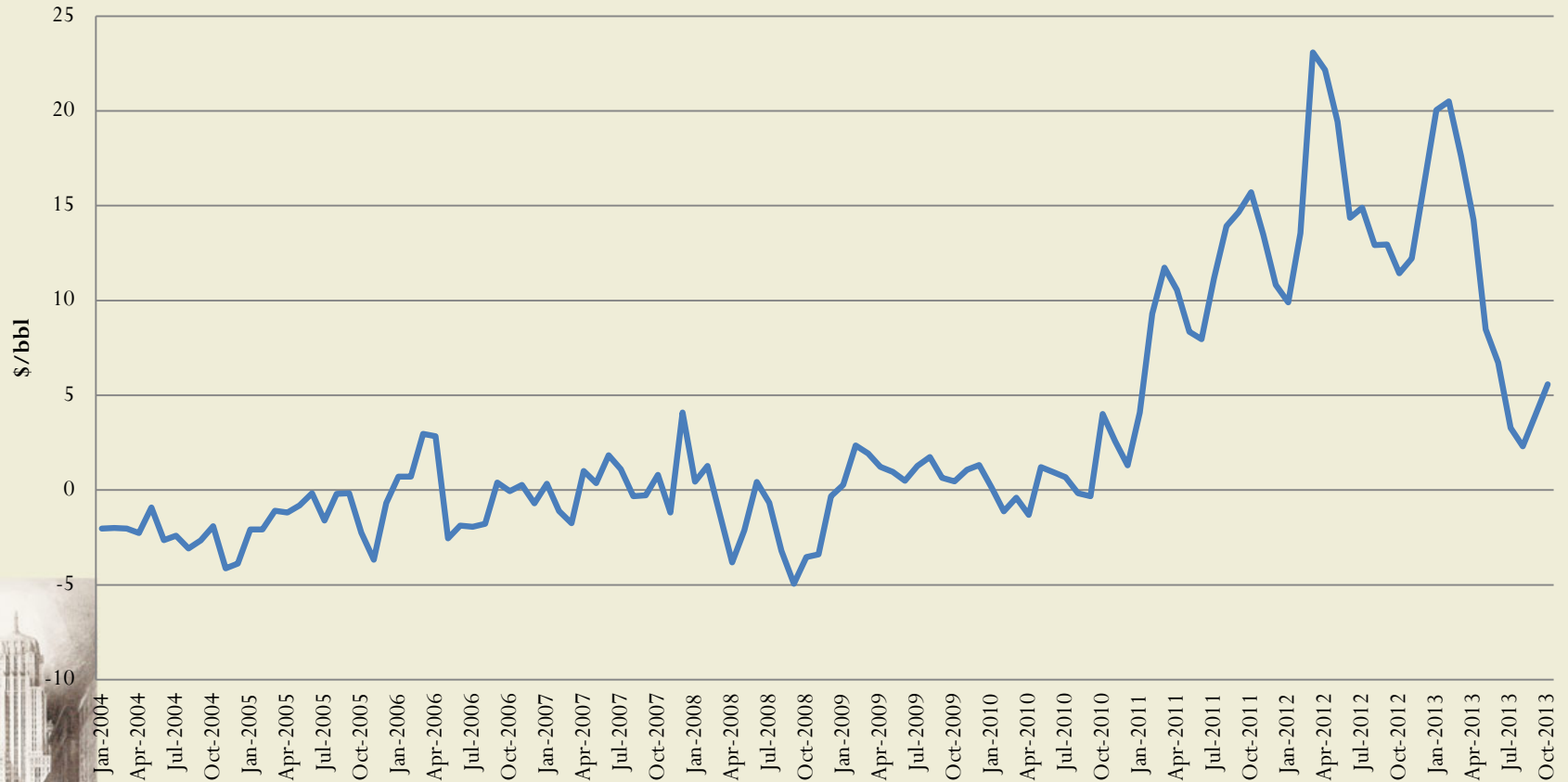
# PADD 3 Output

## PADD 3 Crude Output



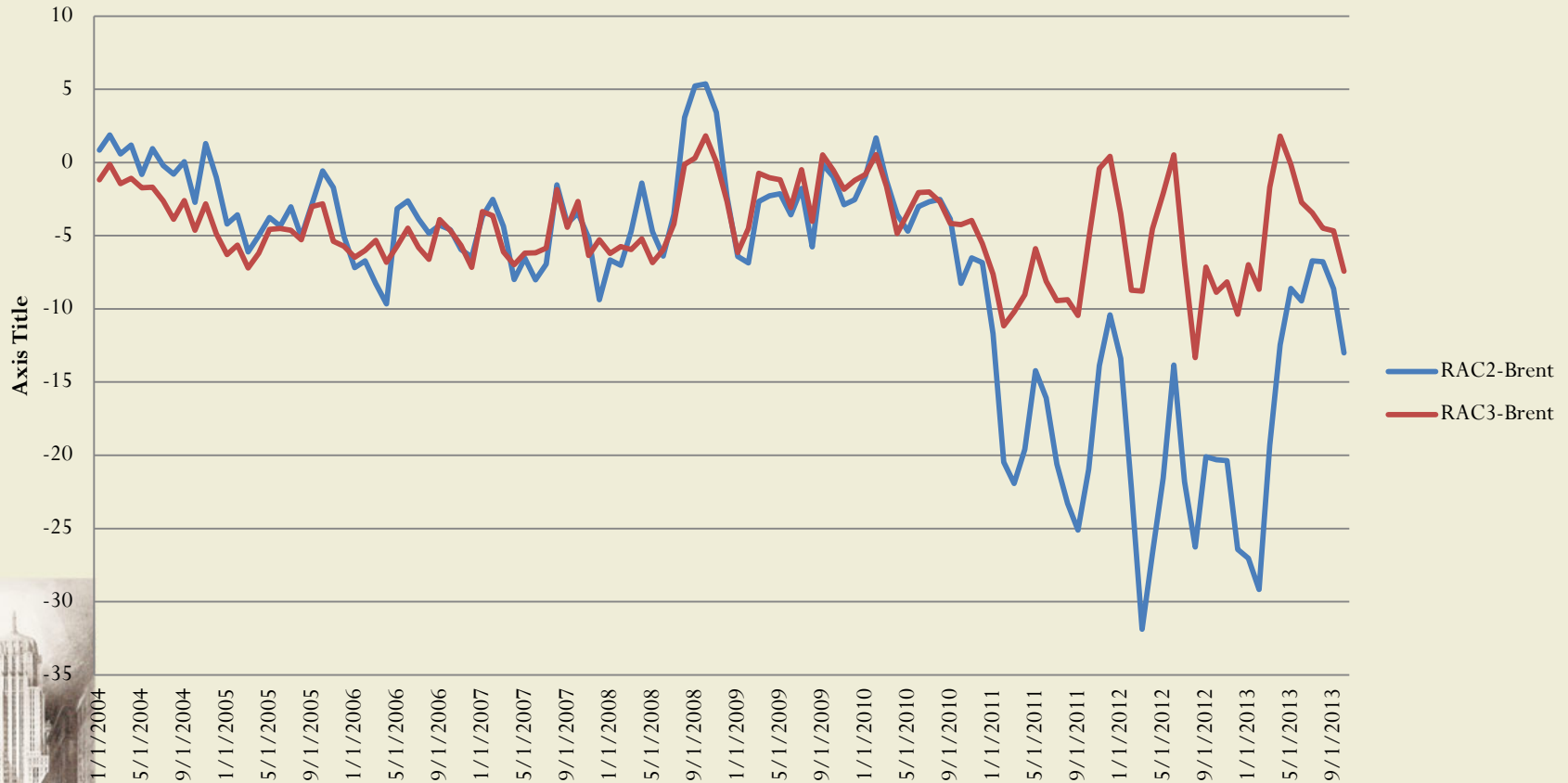
# Crude Price Differential

## PADD 3-PADD2 RAC Differential



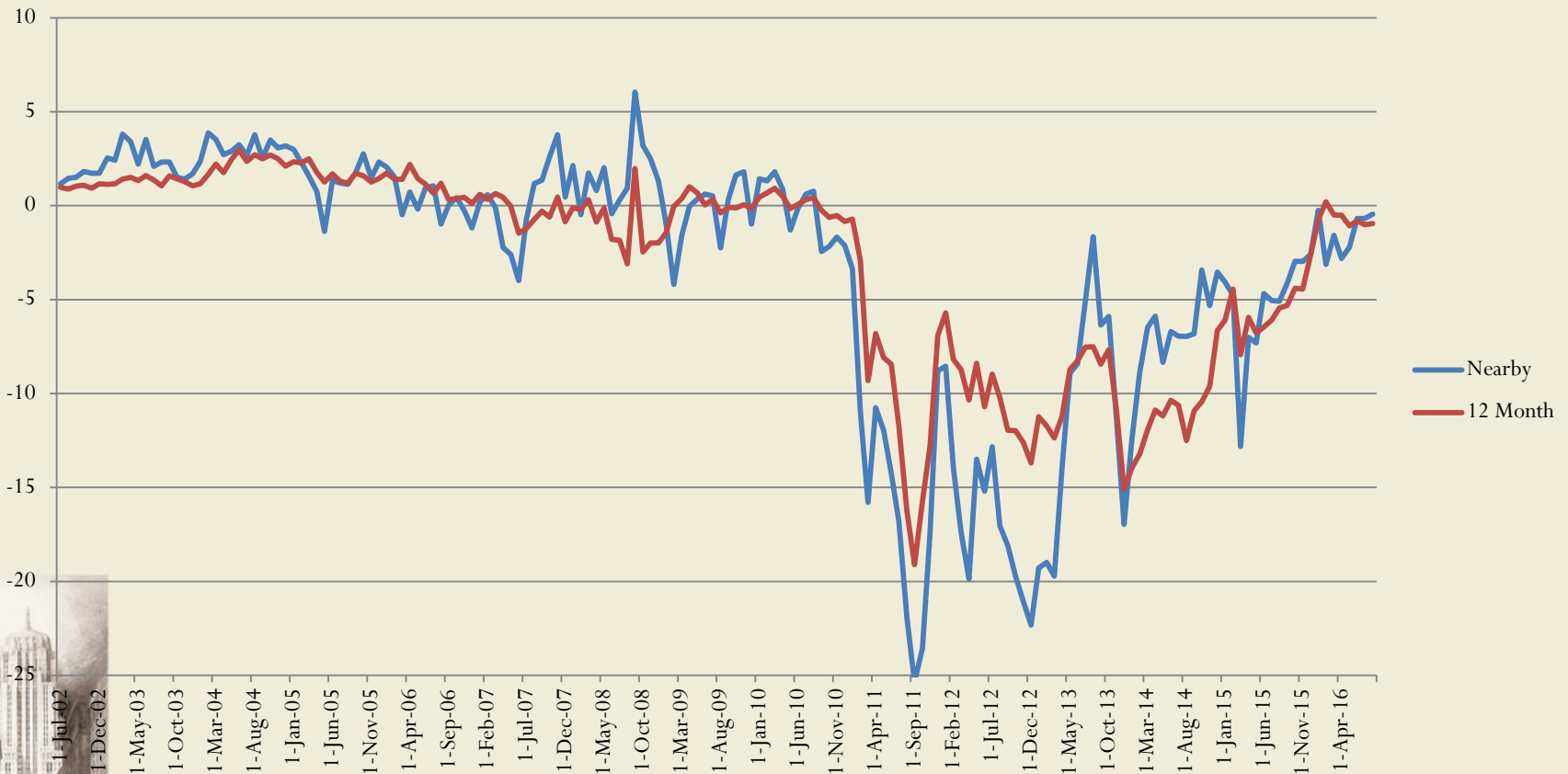
# US Prices vs. Brent

## PADD II and PADD III RAC Minus Brent



# WTI-Brent Futures Spreads

## CL-CB Spread (Nearby & 12 Month)





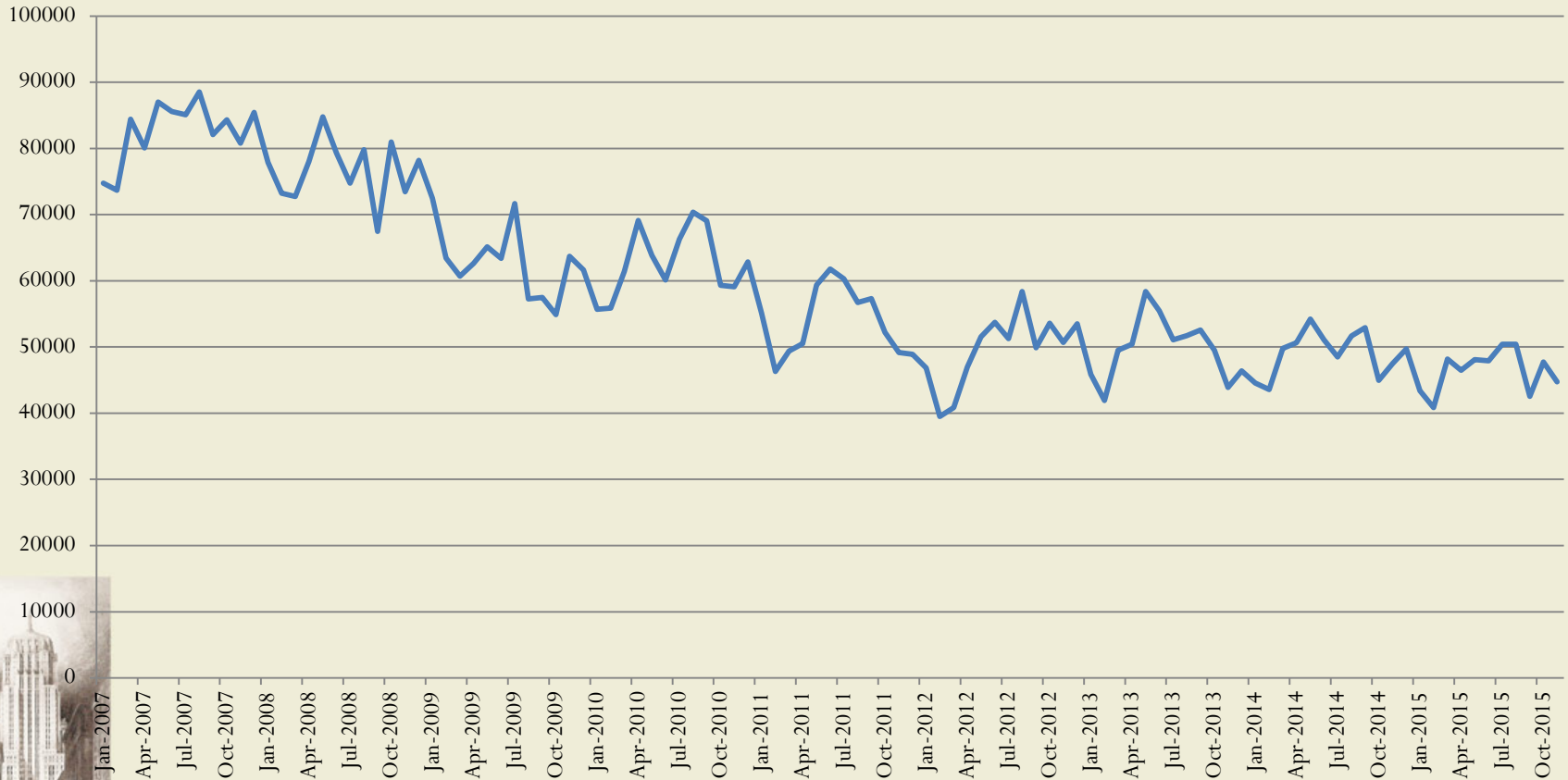
# Commodity Flows & New Infrastructure

- Dramatic reversal in direction of oil flows
- Utilization of rail, barge and even truck to circumvent bottlenecks
- Displacement of imports, especially from Nigeria (shale oil light and sweet)
- Reversal of pipelines, construction of new pipelines
- Increased product exports to circumvent ban on crude exports, increased investment in refining capacity
- Building of “splitters” (“mini-refineries”) to circumvent ban on crude exports



# Crude Shipments

## PADD 3 to PADD 2 Crude Shipments



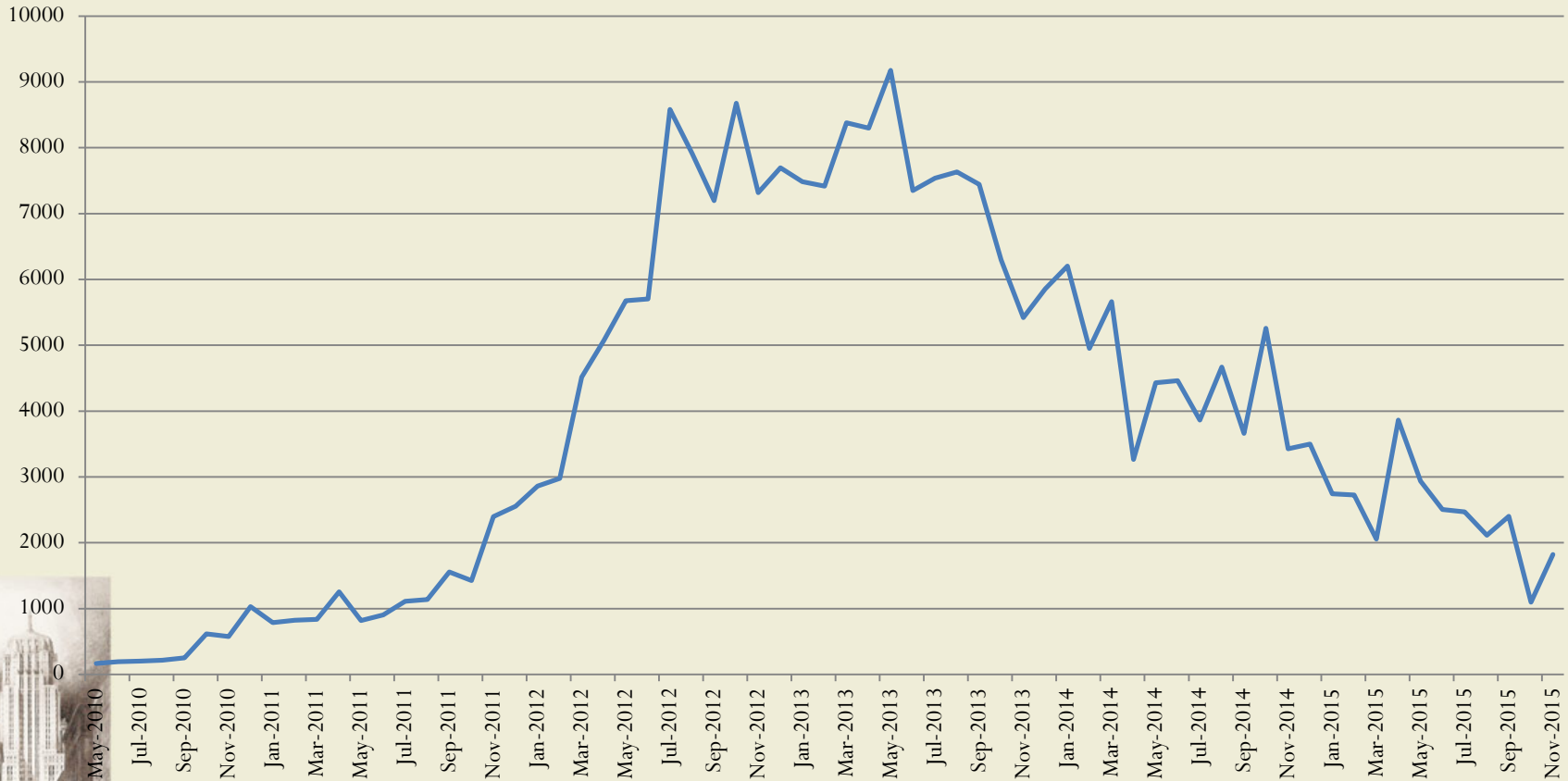
# Crude Shipments

## PADD 2 to PADD 3 Crude Shipments



# Rail Shipments

## PADD 2 to PADD 3 Crude Oil by Rail

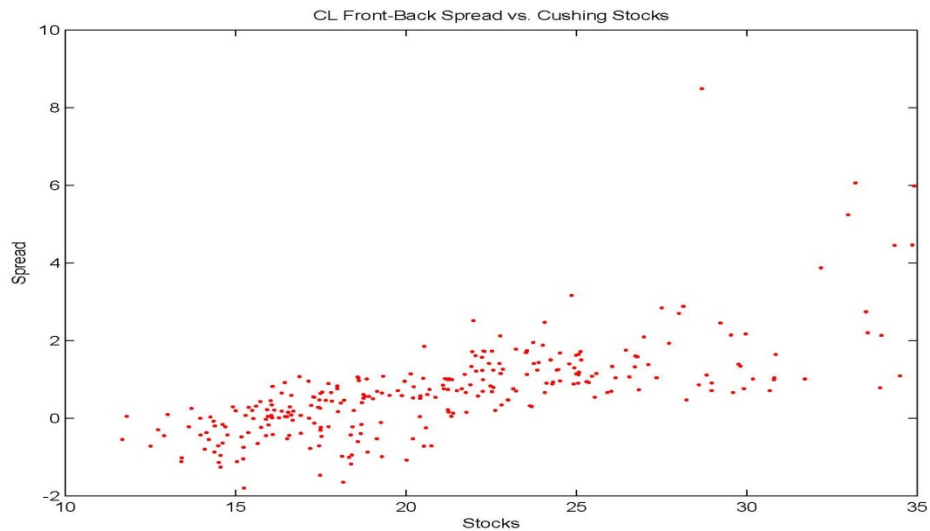


# Time Spreads and the Crisis

- Demand collapse in aftermath of financial crisis and inflexibility of supply response in the short run caused huge crude inventory builds, including in US Midcontinent, especially Cushing: Low demand plus inability to move oil out of Cushing to Gulf
- Storage space effectively constrained
- Contango (the implicit price of storage) on WTI blew out
- Also blew out on WTS—so it was a storage capacity issue, not a WTI/futures issue



# CL Supply of Storage



# Market Responses

- Substantial increase in storage capacity at Cushing
- Using VLCCs to store oil



# Grains in the US

- In 2006-2008, spreads between the grain futures prices (and the prices of shipping certificates) and cash grain prices in the country (e.g., elevator bids) reached historically high levels
- This differential should reflect the cost of transforming stored grain to grain on a barge
- What is the bottleneck?
- Huge inventory build (driven in part by impending renewable fuel mandates)
- Anything else?





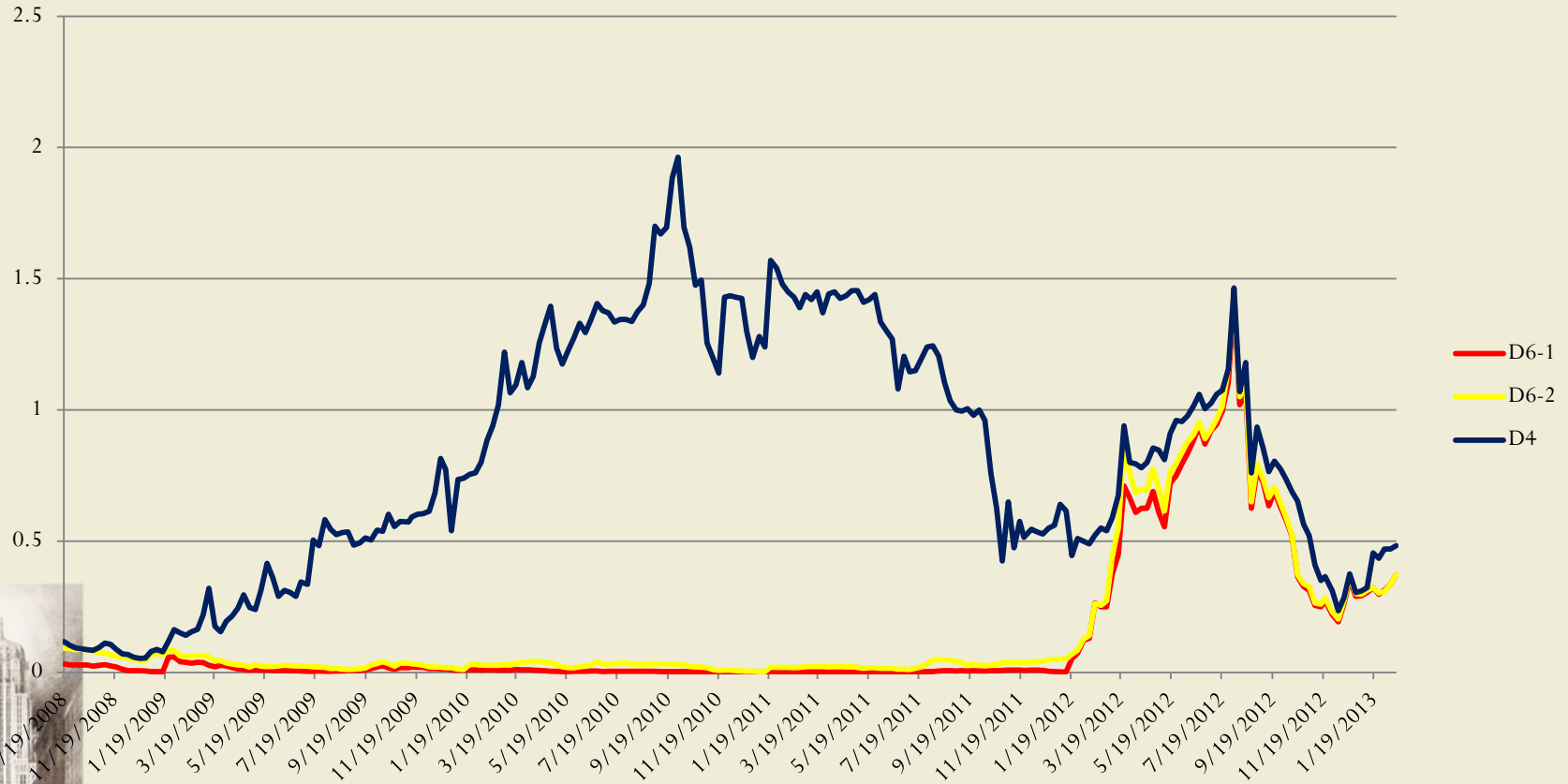
# RINs

- Renewable ID Numbers (“RINs”) provide an example of how a regulatory bottleneck can affect pricing
- Congress mandated increasing use of biofuels (e.g., ethanol) but decline in gasoline usage and technical limitations on the amount of ethanol standard engines can use (“the blend wall”) caused dramatic increase in the demand for unused certificates issued in prior years
- Huge price spike



# Hitting the (Blend-) Wall

## RINS Prices



# Suppression of Markets and Price Signals

- Sometimes (particularly in power markets, it seems) markets are missing (by accident or design) or price signals are suppressed
- Zonal pricing in power markets
- Price caps (electricity, gasoline in the bad old days)
- Absence of markets means that some bottlenecks are “free”
- People expend resources to get “free lunches”(California Power Crisis)



# Market Power

- The foregoing analysis has presumed that everybody is a price taker—competitive markets
- Some players may be “price makers”
- These players can influence prices—that is, they can exercise market power—by withholding output from the market



# The Effects of Market Power

- Prices can spike in competitive markets
- Market power can lead to higher prices, but prices can be high without market power
- Market power sometimes hard to diagnose—not so hard at other times
- Policies that make no sense when there is no market power (e.g., price caps) may be sensible when market power exists



# Market Power and Bottlenecks

- Bottlenecks can create or enhance market power
- Less competition behind bottleneck
- Midwestern gasoline redux
- Market power per se is not illegal
- Collusion
- Manipulation



# Aluminum

- Premiums between aluminum delivered to users and in-store (LME) prices increased dramatically in mid-2009
- Stocks of aluminum rose dramatically during the crisis
- Operator of the largest LME storage facility exploited LME rules, and engaged in “queue jamming” tactics to constrain loadouts of aluminum when demand started to rebound



# COMMODITY TRADING FIRMS





# Fundamental Facts About CTFs

- CTFs transform physical commodities
- CTFs buy and sell commodities, so are focused on margins (price differentials) not on flat price levels
- Physical business, with profitability driven by volumes and margins
- Extensive users of derivatives but as hedgers of flat price risk
- Main exposure is to basis risk



# Commodity Transformations

- CTFs perform commodity transformations at all levels of the value chain
- Transformation in space (transportation)
- Transformation in time (storage)
- Transformation in form (processing)
- Different firms focus on different transformations and different commodities: substantial diversity among firms



# Trading

- Spreads and pricing relationships, not flat prices, are the essence of physical commodity trading
- Trading and managing the risk of such price exposures requires an understanding of the value chain
- CTFs specialize in understanding the value chain and enhancing value by identifying physical “arbitrages” and managing the associated risks



# Commodity Trading Firms: Agents of Transformation

- Commodity trading firms specialize in making transformations in space, time, and form
- As such, they are focused on price relationships (spreads) rather than flat prices
- Flat prices matter primarily to the the extent that they affect (a) volumes/margins, and (b) financing constraints



# Flat Prices & Volumes/Margins

- Relationships between flat prices and volumes/margins depends on whether supply or demand shocks are driving flat prices
- High prices due to high demand: good for margins and volumes
- High prices due to low supply: bad for margins and volumes
- Margins/volumes *much* more stable over the cycle than prices



# Paper Trading by CTFs

- CTFs are extensive users of listed and OTC derivatives, but primarily as hedgers
- Use derivatives to exchange flat price risk for basis (spread) risk
- Typically major sellers of futures/swaps to hedge their inventory holdings
- Speculative trading focuses on spread trades, rather than directional trades



# Asset Ownership By Commodity Trading Firms

- Commodity trading firms can transform commodities without owning assets (charter a ship; rent storage space)
- Commodity trading firms quite diverse in their asset ownership patterns
- Asset light firms
- Asset heavy firms



# Trends in Asset Ownership

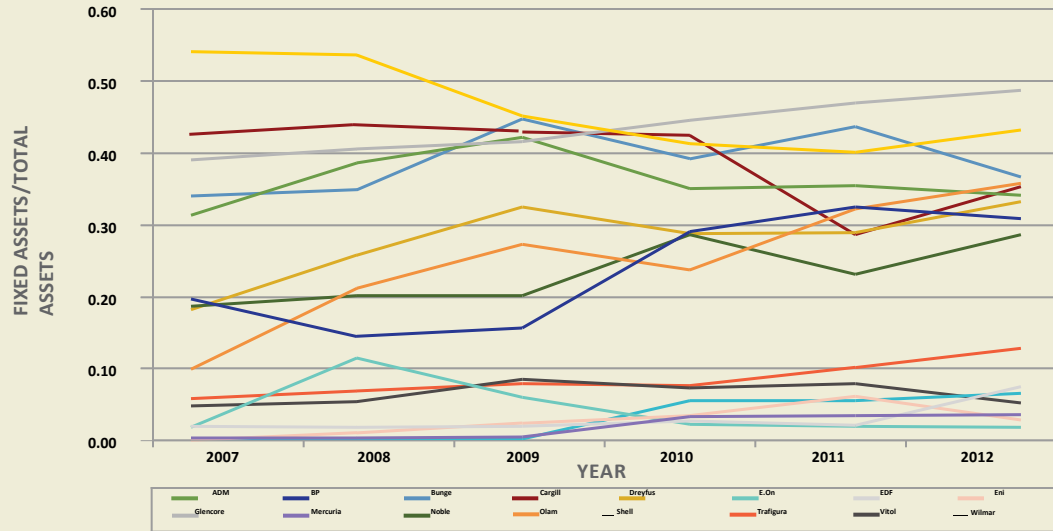
- Widely believed that commodity trading firms becoming more asset heavy
- In reality, considerable diversity in trends across commodity trading firms





FIGURE 1

FIXED ASSETS DIVIDED BY TOTAL ASSETS AT COMMODITY TRADING FIRMS



# APPENDIX B

## TRADING ACTIVITY AND PHYSICAL ASSET OWNERSHIP FOR LEADING COMMODITY TRADING FIRMS

FIGURE 1

ADM

	Corn	Wheat	Oilseeds	Cotton	Sugar	Cocoa	Coffee	Industrial Metals	Iron Ore	Petroleum	Coal	Natural Gas	Power
Trading	x		x			x							
Upstream													
Midstream	x		x			x							
Downstream	x		x			x							

FIGURE 2

BUNGE

	Corn	Wheat	Oilseeds	Cotton	Sugar	Cocoa	Coffee	Industrial Metals	Iron Ore	Petroleum	Coal	Natural Gas	Power
Trading	x	x	x		x								
Upstream													
Midstream	x	x	x		x								
Downstream		x	x		x								

FIGURE 3

CARGILL

	Corn	Wheat	Oilseeds	Cotton	Sugar	Cocoa	Coffee	Industrial Metals	Iron Ore	Petroleum	Coal	Natural Gas	Power
Trading	x	x	x	x	x	x		x	x	x	x	x	x
Upstream	x	x	x										
Midstream	x	x	x	x	x	x							
Downstream	x	x	x		x	x							

FIGURE 4

LOUIS DREYFUS

	Corn	Wheat	Oilseeds	Cotton	Sugar	Cocoa	Coffee	Industrial Metals	Iron Ore	Petroleum	Coal	Natural Gas	Power
Trading	x	x	x	x	x		x	x					
Upstream	x	x	x										
Midstream	x	x	x	x	x		x	x					
Downstream	x	x	x		x		x						

FIGURE 5

GLENCORE

	Corn	Wheat	Oilseeds	Cotton	Sugar	Cocoa	Coffee	Industrial Metals	Iron Ore	Petroleum	Coal	Natural Gas	Power
Trading	x	x	x	x	x			x	x	x	x		
Upstream								x	x	x	x		
Midstream	x	x	x		x			x		x	x		
Downstream			x		x			x	x				

FIGURE 6

GUNVOR

	Corn	Wheat	Oilseeds	Cotton	Sugar	Cocoa	Coffee	Industrial Metals	Iron Ore	Petroleum	Coal	Natural Gas	Power
Trading												x	
Upstream										x	x		
Midstream										x			
Downstream										x			



FIGURE 7

MERCURIA

	Corn	Wheat	Soybeans	Cotton	Sugar	Cocoa	Coffee	Industrial Metals	Iron Ore	Petroleum	Coal	Natural Gas	Power
Trading	x	x	x					x	x	x	x	x	x
Upstream										x	x		
Midstream										x	x	x	
Downstream													

FIGURE 8

TRAFIGURA

	Corn	Wheat	Soybeans	Cotton	Sugar	Cocoa	Coffee	Industrial Metals	Iron Ore	Petroleum	Coal	Natural Gas	Power
Trading								x	x	x	x	x	
Upstream								x					
Midstream								x	x	x	x		
Downstream										x			

FIGURE 9

VITOL

	Corn	Wheat	Soybeans	Cotton	Sugar	Cocoa	Coffee	Industrial Metals	Iron Ore	Petroleum	Coal	Natural Gas	Power
Trading										x	x	x	x
Upstream										x	x		
Midstream										x	x	x	
Downstream										x			

FIGURE 10

OLAM

	Corn	Wheat	Soybeans	Cotton	Sugar	Cocoa	Coffee	Industrial Metals	Iron Ore	Petroleum	Coal	Natural Gas	Power
Trading		x	x	x	x	x	x						
Upstream			x	x	x		x						
Midstream		x		x	x	x							
Downstream		x	x	x	x	x							

FIGURE 11

NOBLE

	Corn	Wheat	Soybeans	Cotton	Sugar	Cocoa	Coffee	Industrial Metals	Iron Ore	Petroleum	Coal	Natural Gas	Power
Trading	x	x	x	x	x	x	x	x	x	x			x
Upstream			x							x			
Midstream	x	x	x	x	x	x	x	x	x	x			
Downstream			x		x		x						

FIGURE 12

WILMAR

	Corn	Wheat	Soybeans	Cotton	Sugar	Cocoa	Coffee	Industrial Metals	Iron Ore	Petroleum	Coal	Natural Gas	Power
Trading		x	x		x								
Upstream					x								
Midstream		x	x										
Downstream		x	x		x								



# Why Own Assets?

- Common to say asset ownership provides optionality, but you can have optionality without ownership (shipping is a great example, or offtake agreements)
- Asset ownership can mitigate “transactions costs”, notably costs associated with “holdups”
- Holdups can occur when an asset is specialized and there are few available substitutes



# Example: Storage Facilities

- Efficient utilization of storage rapid response to supply and demand shocks
- The owner of a storage facility can attempt to extract concessions from a firm using the facility by threatening to delay access to the stored commodity (look at aluminum, cocoa)
- “Temporal specificity”
- The storer can avoid this problem by owning the asset



# Logistics Assets

- Similar considerations pertain for other “midstream” assets, like terminals: rapid access to asset on an unpredictable basis necessary to execute arbitrage transactions
- Many midstream assets are also large scale, site specific, with few close substitutes, and users often move volumes sufficient to utilize a large fraction of capacity



# Upstream Assets

- Some ownership of upstream assets by commodity traders (e.g., palm oil plantations)
- In some cases, transactions costs considerations seem to explain this: in the case of palm oil, desirable to locate processing plants on plantations, so holdups are avoided by having the same firm own both
- In other cases, notably mines, this seems less clear



# Downstream Assets

- Considerable integration recently into downstream assets (e.g., fuel marketing)
- Transactions costs considerations seem important here:
- Flipside of disintegration by oil majors
- The development of robust spot markets for fuel means that majors don't need to own downstream assets to market their products





# The Ownership of Commodity Traders

- Diversity here as well: some firms private, others public
- Trade off: better incentives under private ownership, but it limits ability to raise capital and limits ability of owners to diversify
- Relationship between asset intensity and ownership
- Uses of hybrid financing strategies to finesse trade off (perpetual debt; selling equity in asset-heavy subsidiaries)



# Do Commodity Trading Firms Pose Systemic Risks?

- Post-crisis, it has been asserted that commodity trading firms pose systemic risk like banks do
- “Too big to fail”
- Commodity trading firms very different from banks, and hence do not pose even remotely similar systemic risks



# Why Commodity Traders Aren't Systemically Risky

- Not really that big
- Balance sheets not “fragile” (no maturity transformation)
- Don't supply credit like banks do: mainly conduits of credit from banks to customers/suppliers
- Little concentration
- Assets redeployable
- Less vulnerability to major economic downturns



# Why Commodity Traders Aren't Systemically Risky (con't)

- Historically, large disruptions to logistics networks have not had systemic effects (e.g., Japanese tsunami)
- Failures of commodity firms have not had systemic spillover effects: indeed, entire sectors (e.g., US merchant energy in 2002-2003) have suffered financial distress without major effects on the broader economy

