

# Energy and Financial Markets Overview: Crude Oil Price Formation



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# EIA's Energy and Financial Markets Initiative

- Collection of critical energy information to improve market transparency
  - improved petroleum storage capacity data
  - other improvements to data quality and coverage
- Analysis of energy and financial market dynamics to improve understanding of what drives energy prices
  - internal analysis and sponsorship of external research
- Outreach with other Federal agencies, experts, and the public
  - expert workshops
  - public sessions at EIA's energy conferences
  - solicitation of public comment on EIA's data collections

# Synthesis of current perspectives on oil price formation

# Who's who in global oil markets

- Producers
  - international oil companies (private)
  - national oil companies (government-controlled)
- Consumers
  - individuals (autos and space-heating)
  - transportation fleets (trucking, shipping, air)
  - industrials (chemicals and plastics manufacturers) and power generation
- Traders, hedgers, speculators, and investors
  - merchants: firms facilitating physical trade
  - financial market participants
    - index investment by pensions, endowments, and others
    - commodity trading advisors, hedge funds, and individuals
    - swap dealers: typically banks and merchants serving customers
- Policymakers
  - demand-side (subsidies); supply-side (OPEC quotas); market regulation (position limits)

# Many factors influence the formation of oil prices and other energy prices

## Supply

Affected by current conditions and future expectations for:

- energy prices
- OPEC supply capacity
- usable spare capacity
- non-OPEC capacity
- geopolitics
- weather
- E&P costs
- E&P investments
- E&P innovations

## Physical balancing

- Inventories

### Markets & market behavior

- Energy prices
  - spot
  - futures
  - options
  - spreads
  - swaps
- Other financial markets
  - other commodity prices
  - commodity investment
  - currency exchange rates
  - stocks and other assets
  - interest rates

## Demand

Affected by current conditions and future expectations for:

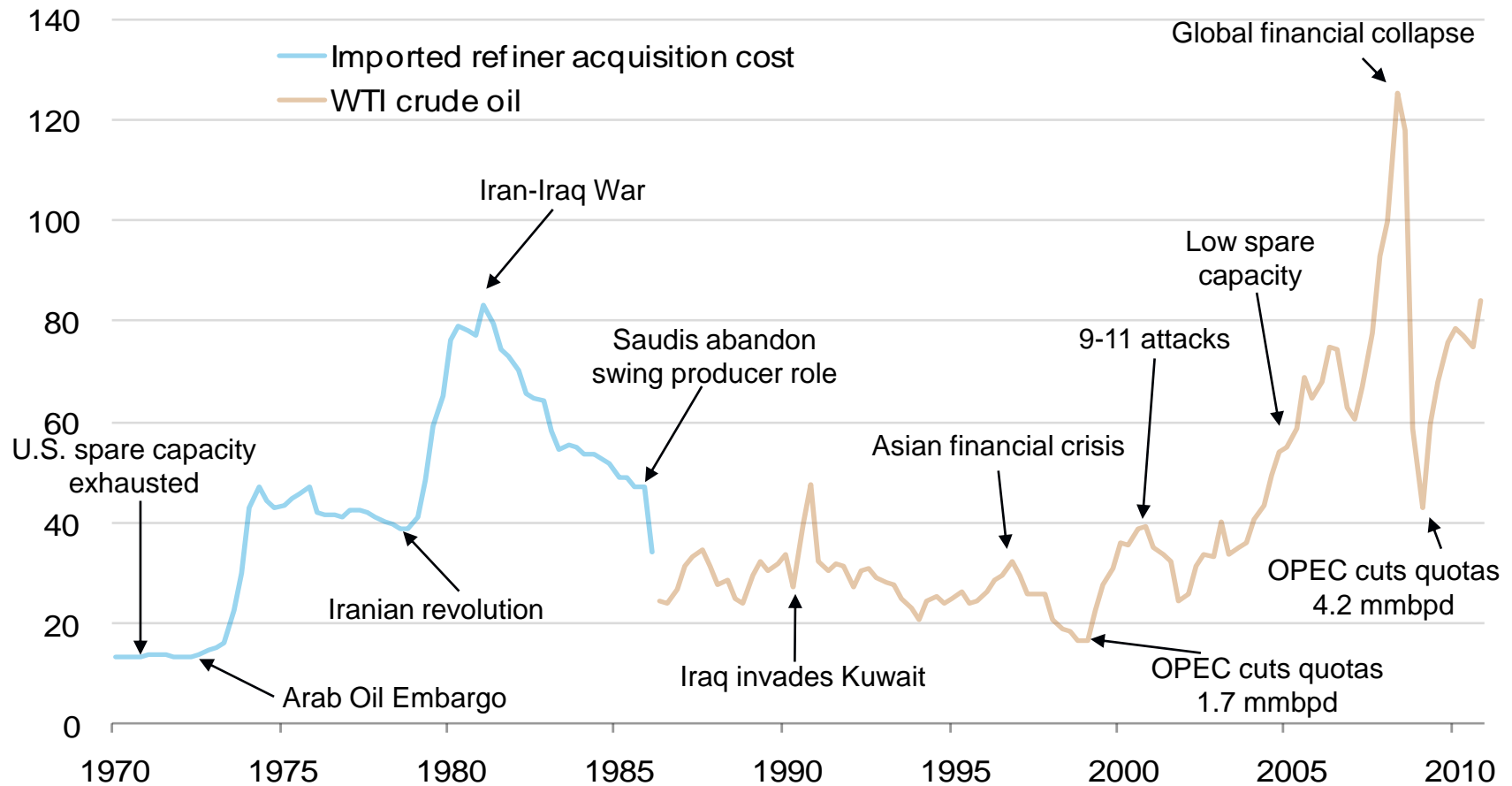
- energy prices
- economic growth
- industrial production
- goods transport
- personal transport
- weather
- innovation in energy-using equipment

## EIA is actively examining the role of both supply-demand fundamentals and other factors in oil price formation

- EIA has asked several academic partners to conduct thorough reviews of economic literature regarding supply-demand fundamentals and the role of financial market speculation and investment in the oil-price formation process
  - the work is ongoing, but still at an early stage
- Some researchers are finding evidence that factors including unexpectedly strong economic growth in China and stagnant supply were at least associated with, and may have contributed to, the sharp oil price run-up and subsequent decline during the 2007-2008 period
- The researchers are also finding some evidence suggesting that the price run-up and decline may have been exacerbated by the formation and collapse of an oil price bubble, perhaps triggered by fundamental factors in both the oil market and the broader global economy
- As discussed later in the presentation, both internal EIA and academic research is also addressing the major increase in oil derivatives trading, significant change in the composition of derivatives traders (such as the growth of swap dealers, hedge funds, and commodity index funds), and increased correlation of oil and other markets over the past several years

# Crude oil prices react to a variety of economic and geopolitical events

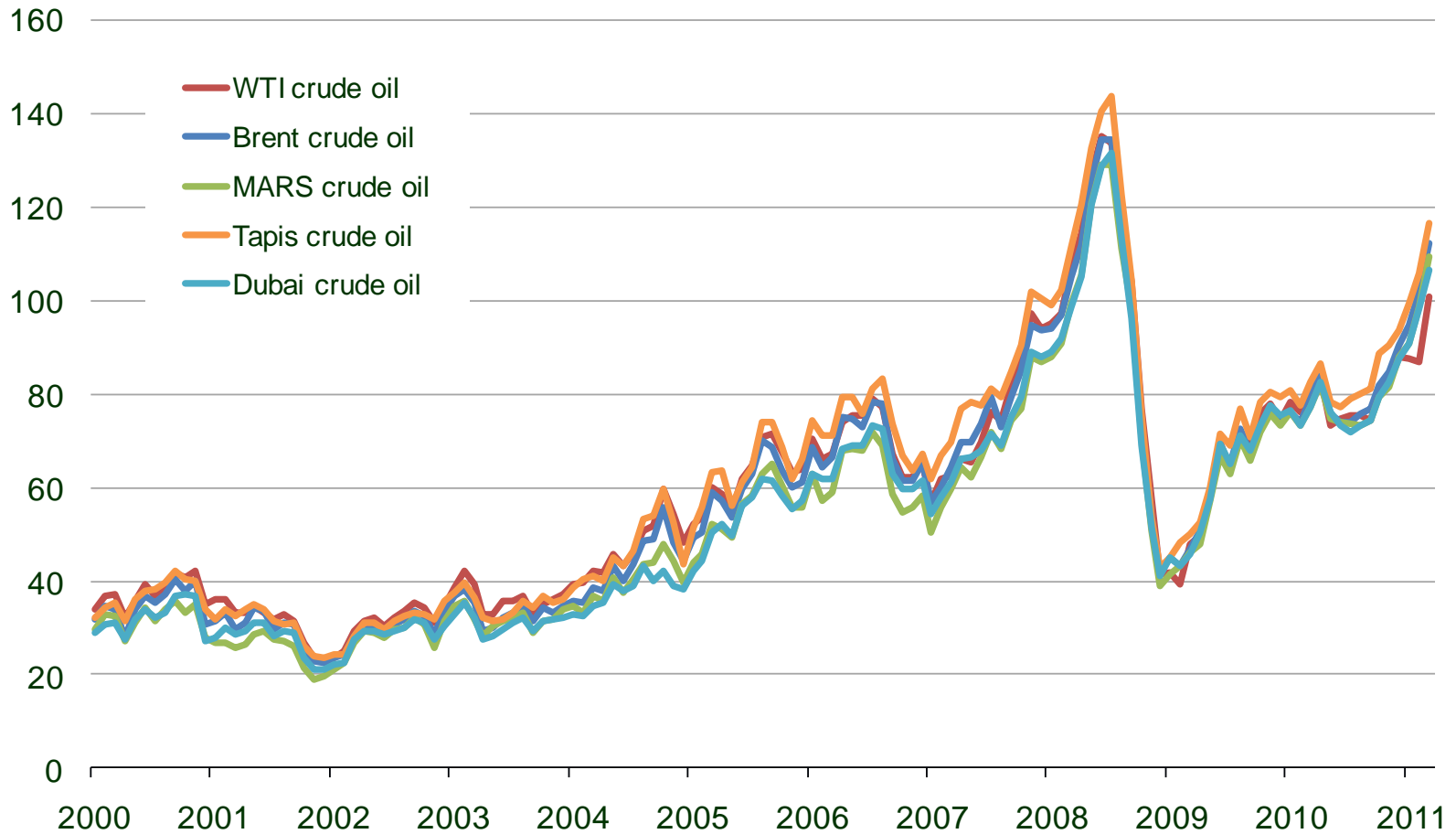
price per barrel (real 2009 dollars, quarterly average)



Sources: EIA, Thomson Reuters

# World oil prices move together due to arbitrage

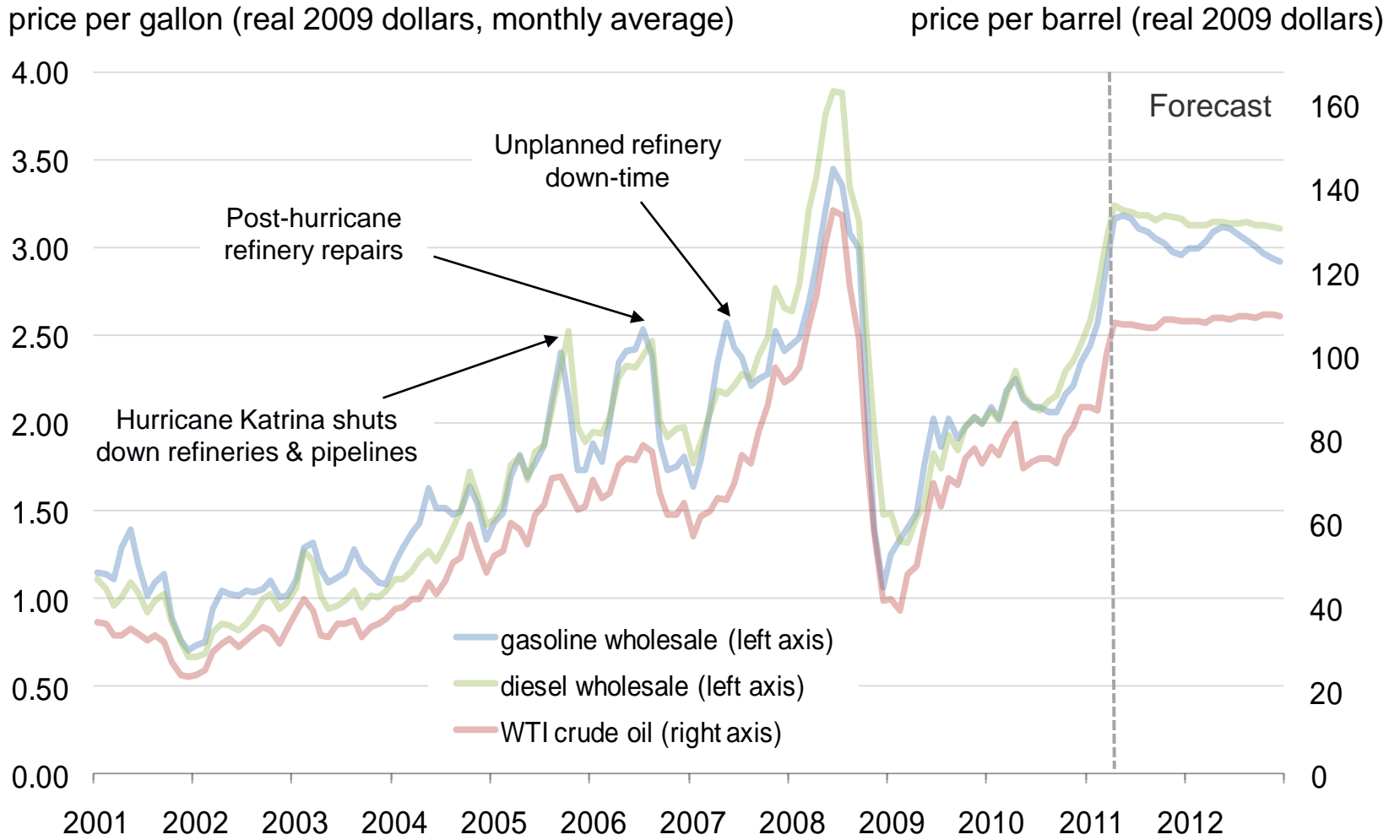
price per barrel (real 2009 dollars, monthly average)



Sources: Bloomberg, Thomson Reuters



# Crude oil prices are the primary driver of petroleum product prices



Sources: EIA, Thomson Reuters

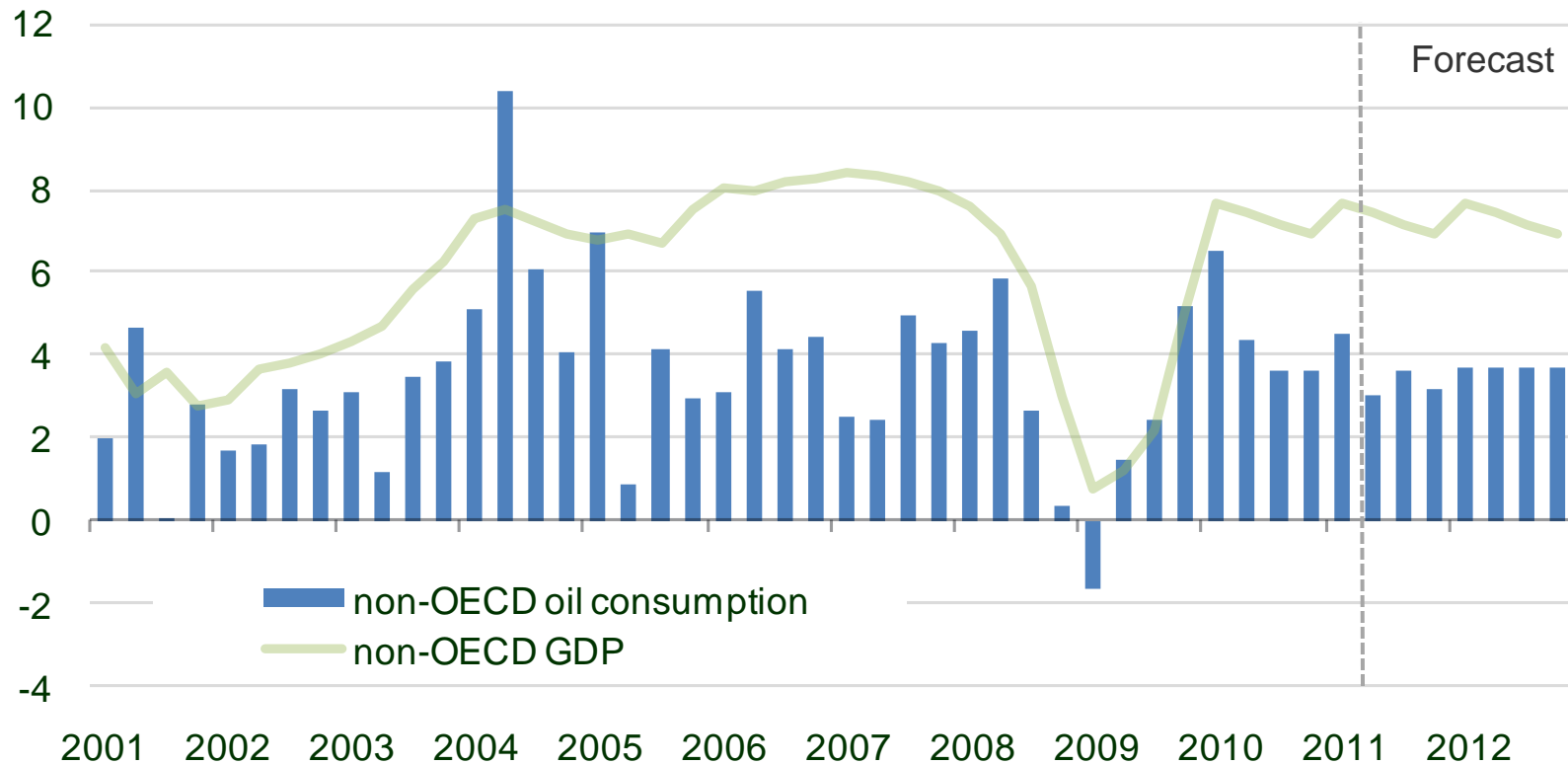
# Oil demand

# Oil demand and consumption: What matters?

- Oil consumption is determined by demand drivers and price
- Demand is closely related to the state of the global economy
  - oil is an input into industrial production and the transport of goods
  - household income and employment drive personal transport demand
- Demand in recent years has come increasingly from non-OECD countries, led by China
  - growth expectations for Asia ex-Japan approached 10% by 2010
- Price increases tamp-down fundamental demand drivers
  - the net effect on consumption depends on the relative strength of price impacts and economic growth

# In non-OECD countries, economic growth has a strong impact on oil consumption

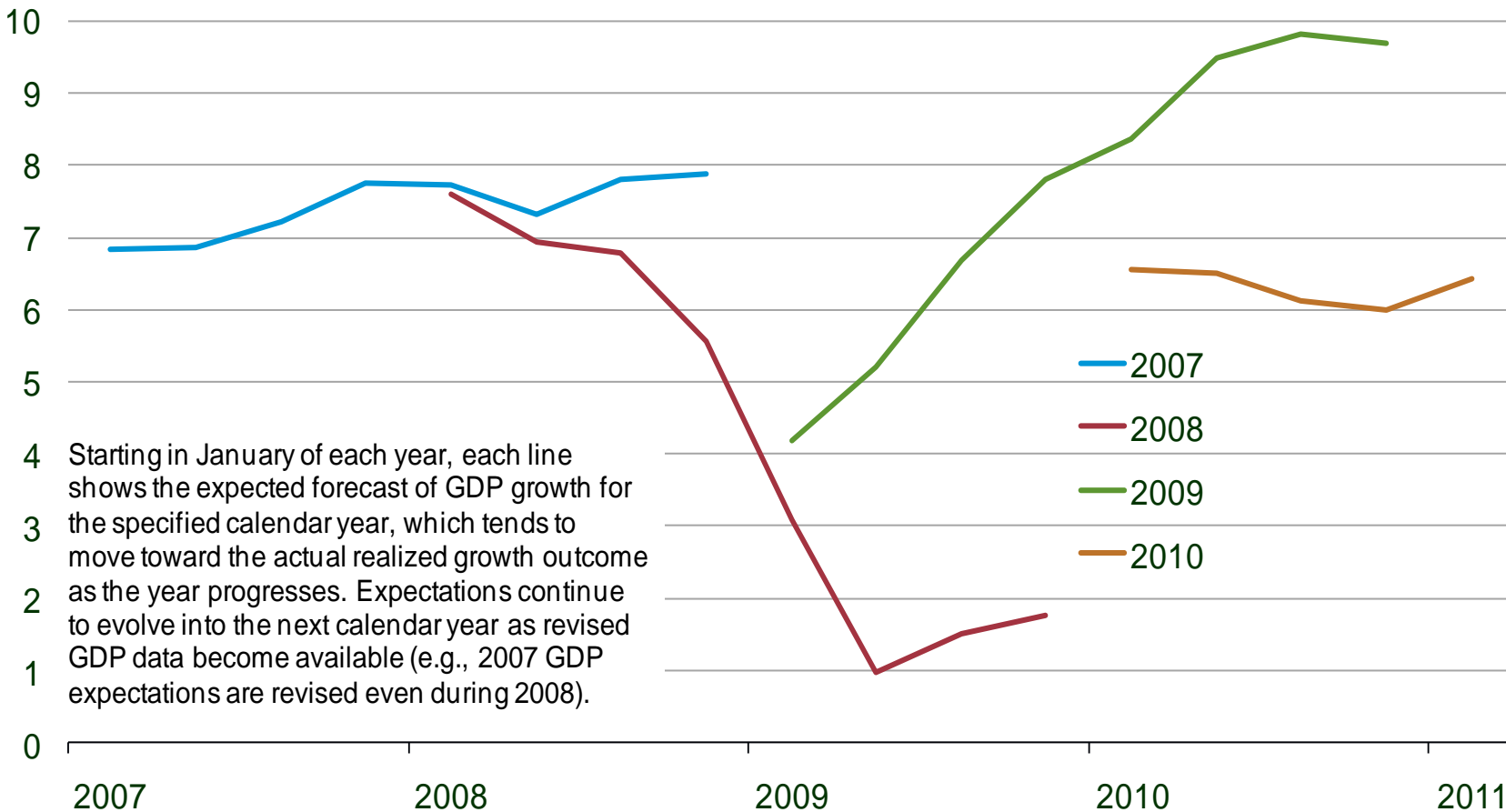
percent change (year-on-year)



Sources: EIA, IHS Global Insight

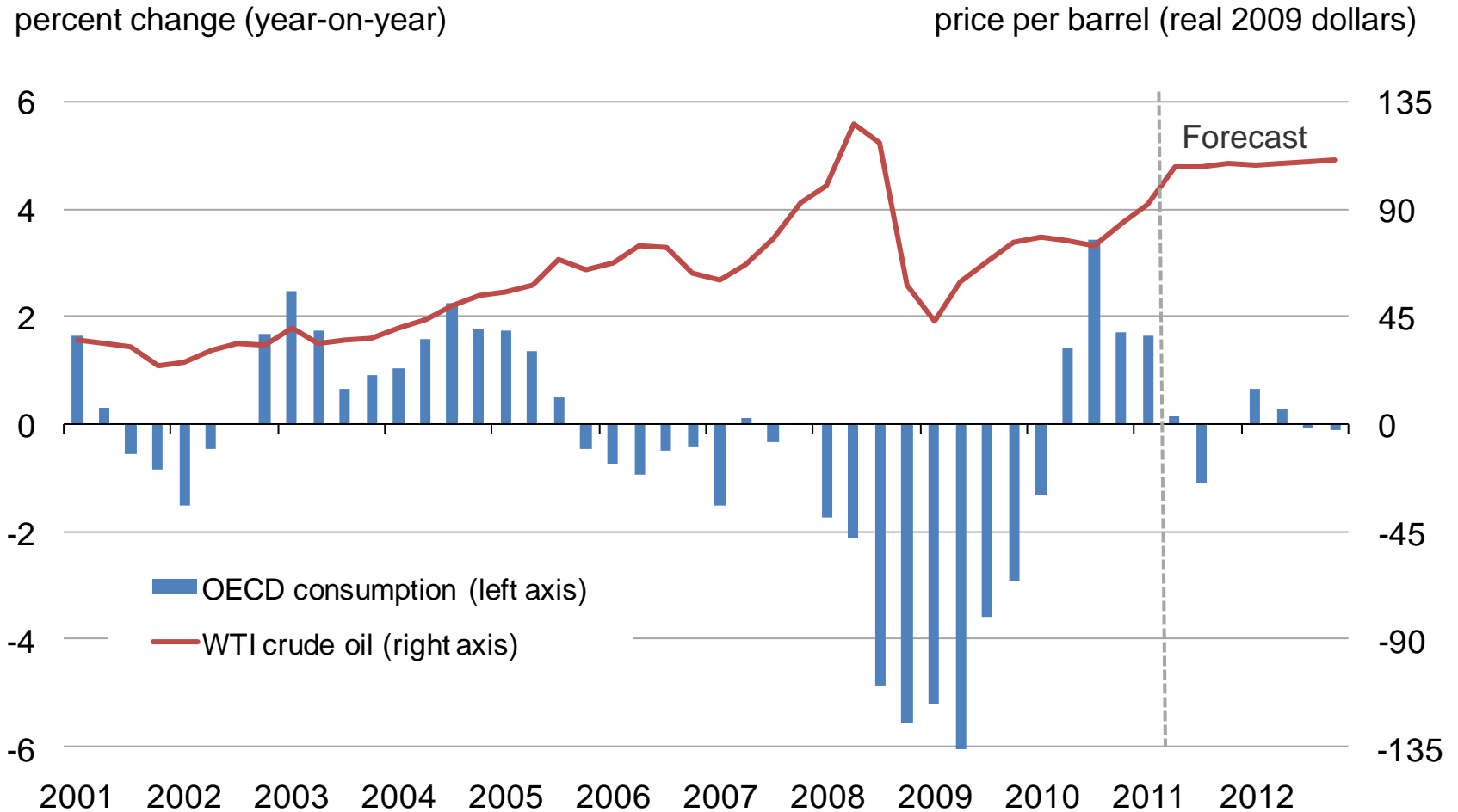
# Economic growth in Asian economies surprised to the upside in 2007 and 2009 and to the downside in 2008

percent GDP growth in Asia-ex Japan (annual expectations)



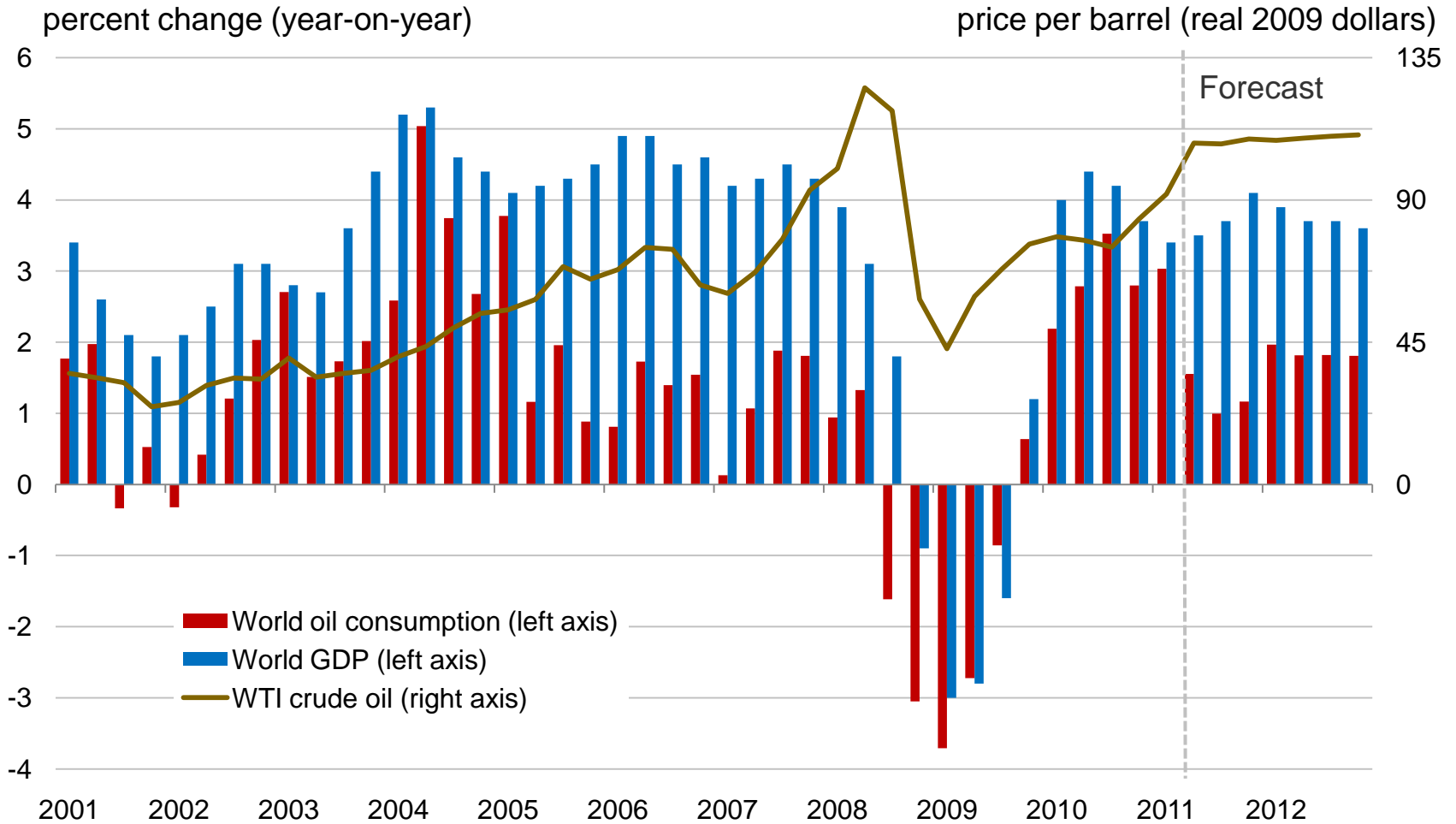
Source: IHS Global Insight

# In OECD countries, price increases have coincided with lower consumption



Sources: EIA, Thomson Reuters

# Rising oil prices held down global oil consumption growth from 2005-2008, despite high economic growth



Sources: EIA, Thomson Reuters

# Oil supply



# Oil supply and production: What matters?

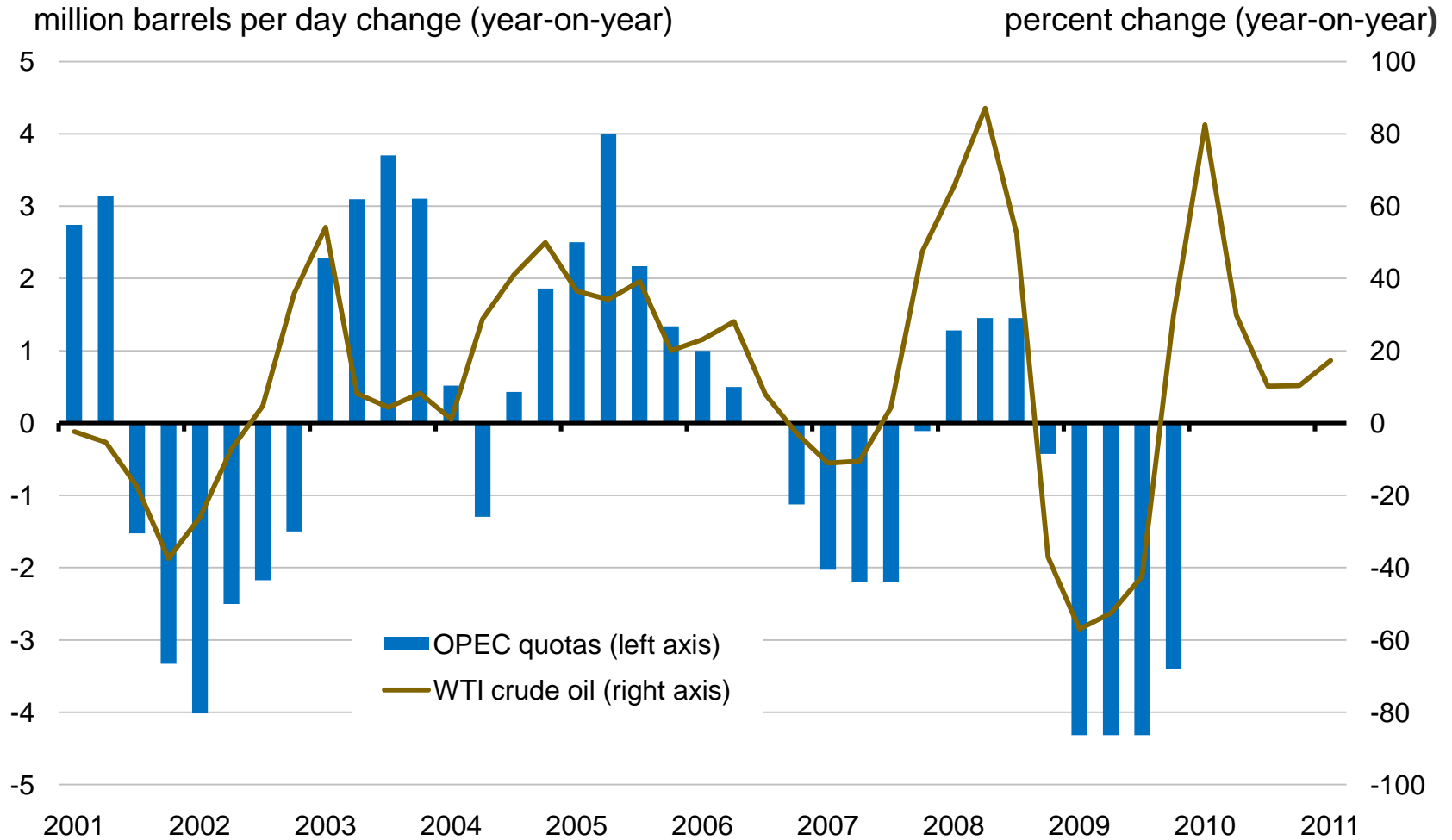
- OPEC

- actively sets production quotas for members (compliance varies)
- can influence prices with announced price targets and quotas
- maintenance of spare capacity by Saudi Arabia gives it the option to pursue price objectives
- in times of low spare capacity, OPEC's ability to respond to supply shocks or rising demand is reduced
- this reduced ability coincided with 2004-2008 oil price increases

- Non-OPEC

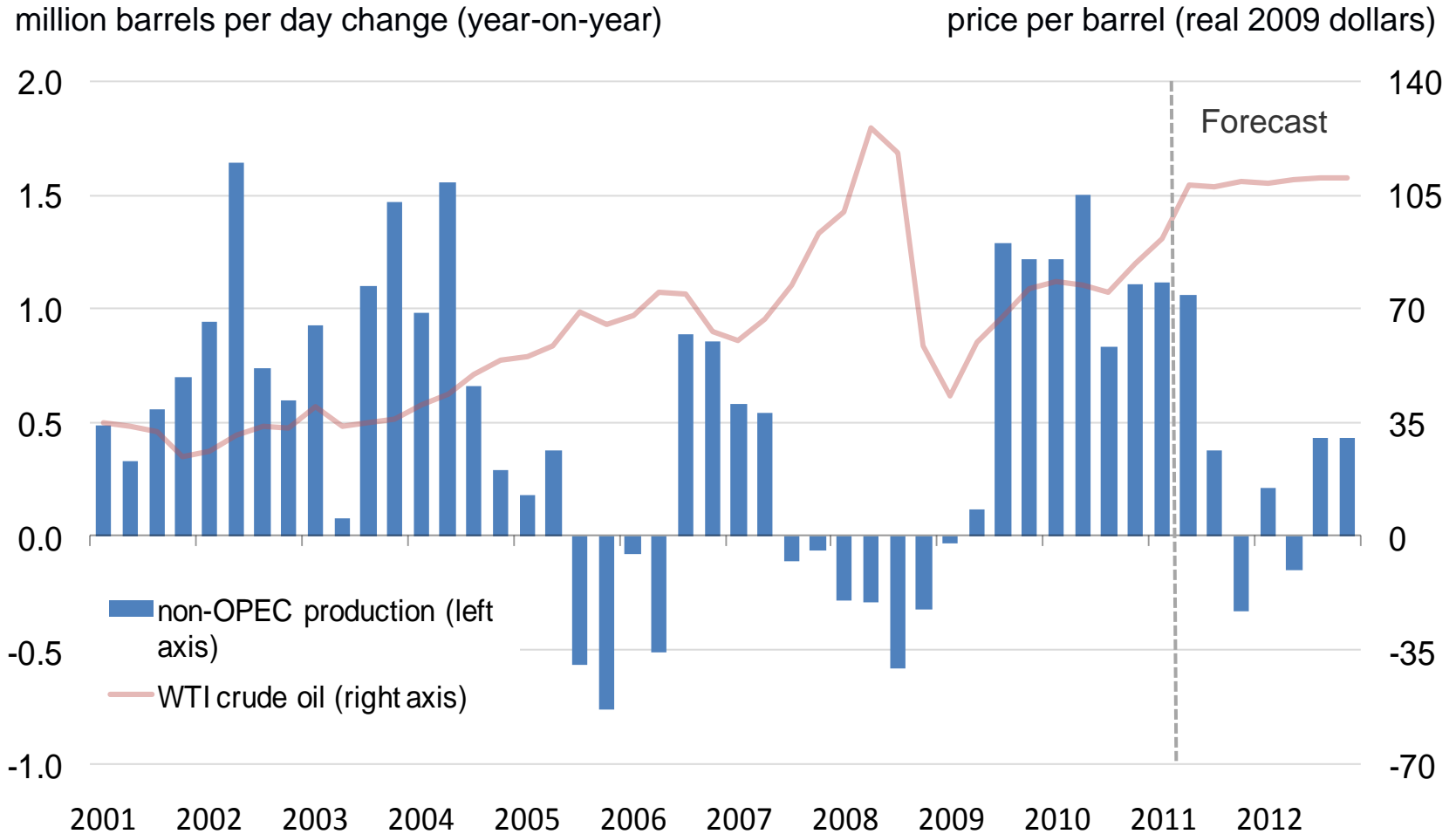
- production is typically at or close to full capacity
- unlike OPEC producers, almost no near-term price-driven variation in production levels
- even with rising prices, there was almost no net annual production increase during 2005-2008

# OPEC production often acts to balance the oil market; OPEC quota cuts tend to lead to price increases



Sources: EIA , Thomson Reuters

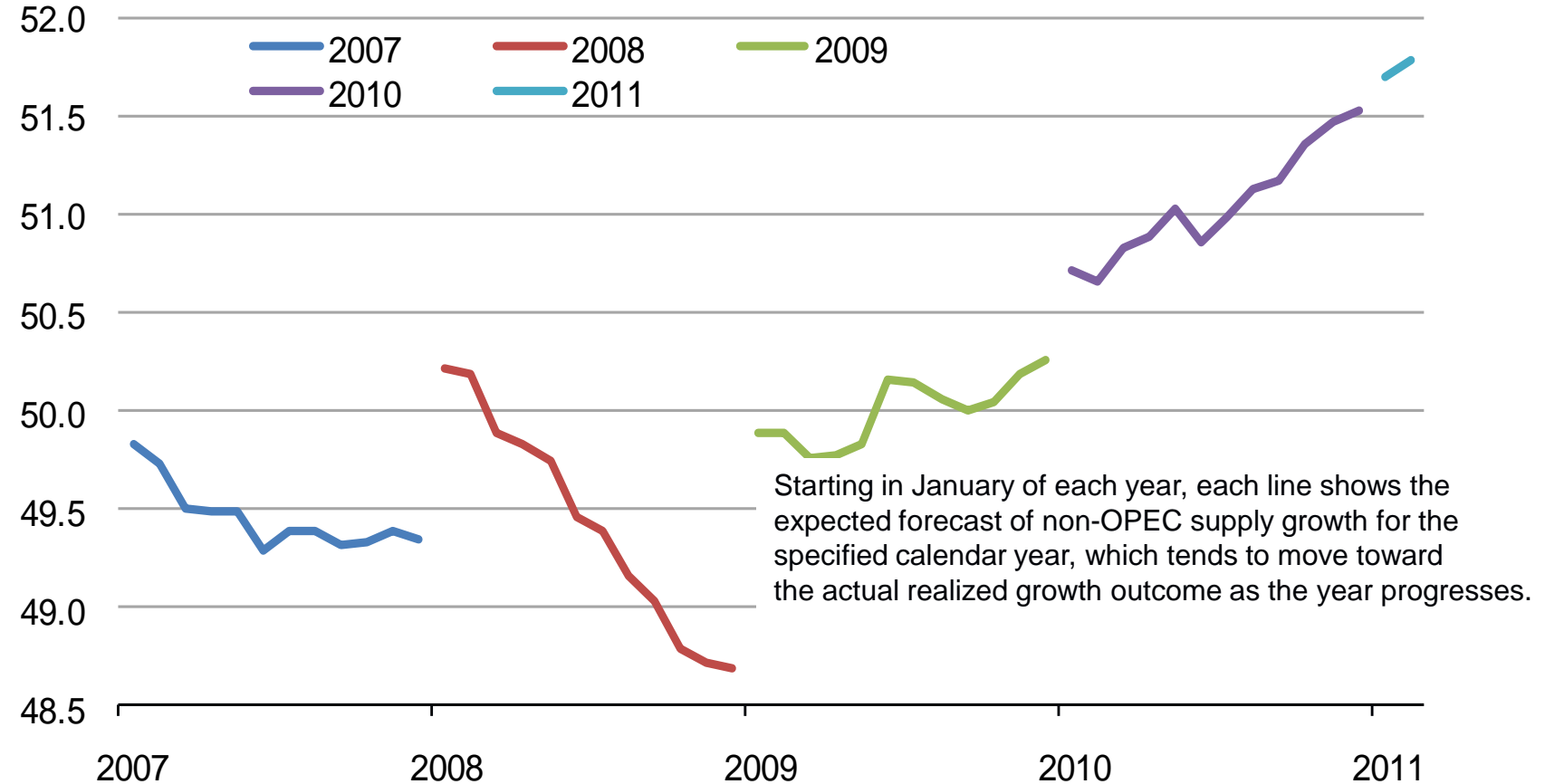
# Non-OPEC production saw strong growth in 2009-2010. EIA expects these increases to slow in 2011-2012



Sources: EIA, Thomson Reuters

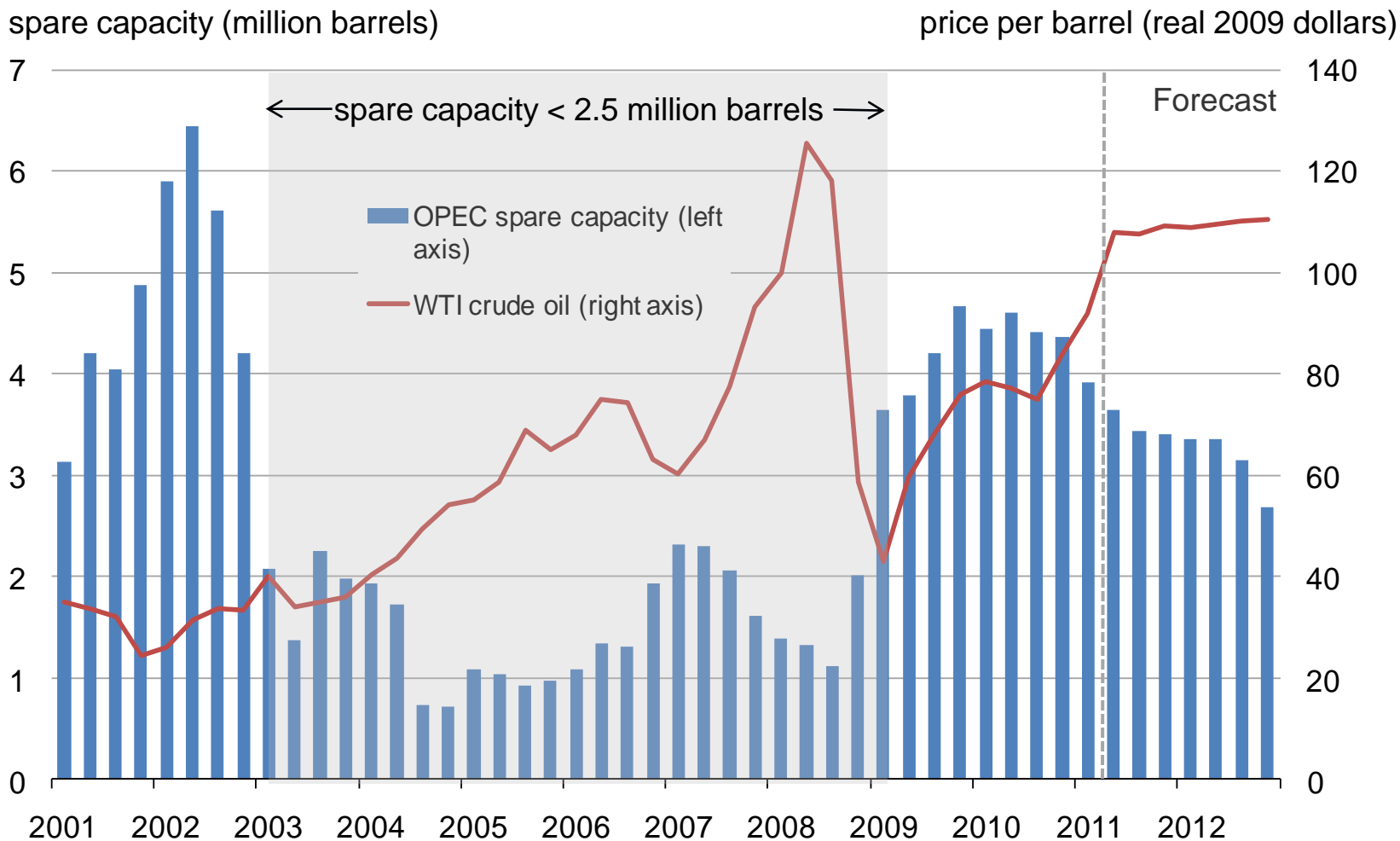
# Non-OPEC supply expectations were adjusted upward in 2009-2010 after production decreases during downturn

million barrels per day (annual average expectations)



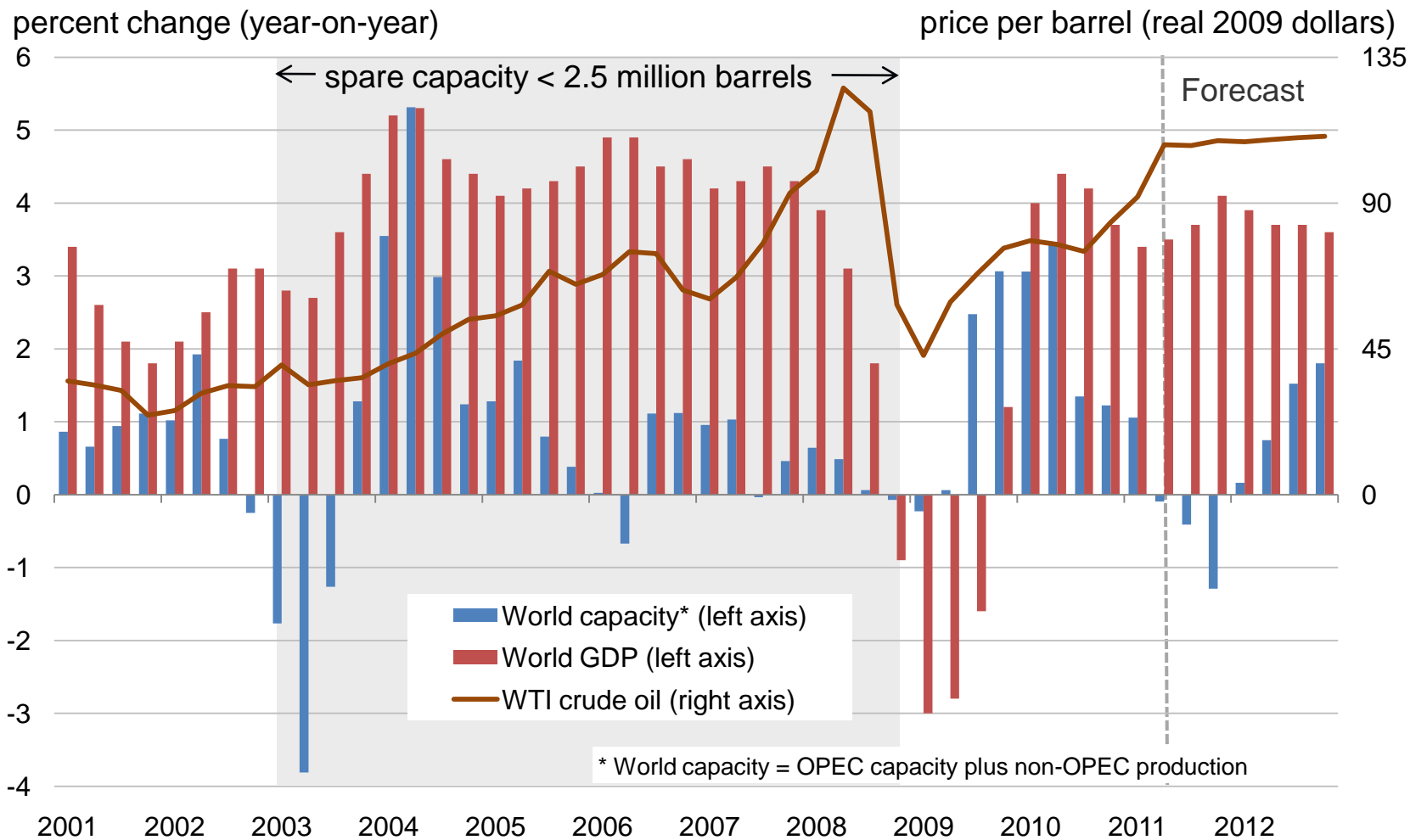
Source: EIA, Short Term Energy Outlook

# During 2003-2008, OPEC's spare production levels were low, limiting its ability to respond to demand and price increases



Source: EIA, Thomson Reuters

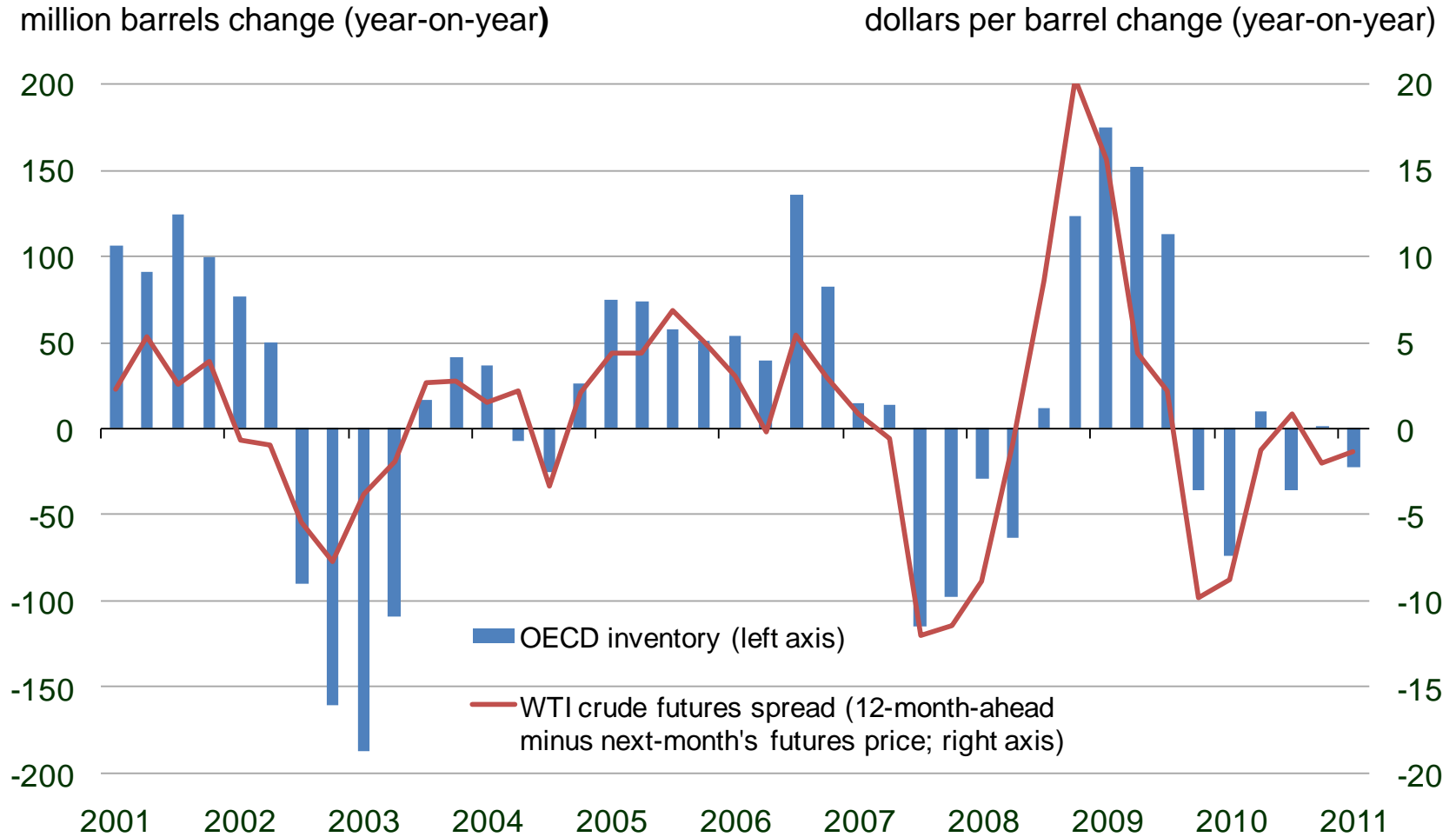
# In summary, 2003-2008 saw periods of very strong economic and oil demand growth, slow supply growth and tight spare capacity



Sources: EIA, Thomson Reuters

# Inventories: The balancing point

# Inventory builds go hand-in-hand with increases in future oil prices *relative to current prices* (and vice versa)



Sources: EIA, Thomson Reuters



# Financial market activity

## EIA is reviewing information that bears on several proposed linkages between physical and financial markets

- Our academic partners are looking at the growth of swap dealers, hedge funds, and commodity index funds in oil derivatives trading
  - to date, they have not identified any rigorous research that either proves or disproves that speculation caused or contributed to 2007-2008 oil price volatility
  - some evidence suggests that the price run-up and decline may have been exacerbated by the formation and collapse of an oil price bubble, perhaps triggered by fundamental factors in the oil market and the global economy
- Internal work is looking at several relationships
  - the relationship between levels of index investment, both for crude and commodities more generally, and oil price changes
  - movement in the correlation of daily returns between energy and other assets, as one indicator of changing linkages among markets
  - the relationship between changing information in the marketplace and changing expectations, building on our recent use of futures and options prices to measure the uncertainty surrounding future price expectations

# Commodity derivatives have multiple roles in the market

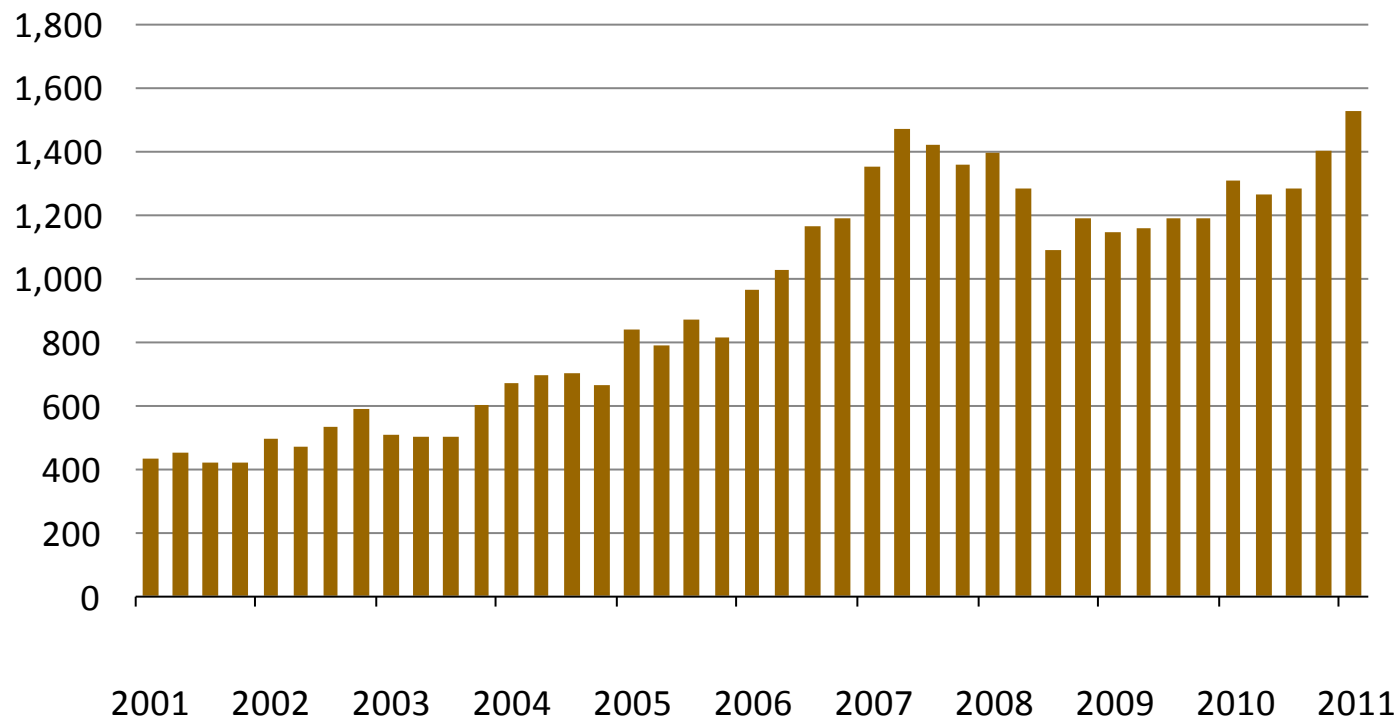
- Successful futures and derivatives markets can help improve market efficiency
  - provide transparent price discovery
  - tools for managing and hedging price risk
  - serve as a vehicle for investors to diversify their portfolios
- Derivative trading can also influence the degree of price fluctuations
  - moderation (arbitrage can reduce price discrepancies and smooth them over time)
  - amplification (if herding behavior and/or bubbles occur)
- Prices could diverge from what physical factors alone may warrant, particularly if current conditions and expectations about the future are uncertain
  - identifying the magnitude of such episodes is extremely challenging

## The attraction of commodity diversification brought increased institutional investment during the oil price rise

- Crude oil and other commodities were an attractive investment
  - expectations for crude oil demand were high in 2007 and the first half of 2008
  - crude oil price had historically been slightly negatively correlated or uncorrelated with other investments up until 2008
- There were increased risks to traditional asset classes, as evidenced by unfavorable trends in indicators linked to these assets over the period July 2007-July 2008
  - equities: unemployment rose from 4.6% to 5.8% (Bureau of Labor Statistics)
  - bonds: annual inflation expectations rose from 2.6% to 3.1% (Cleveland Federal Reserve Bank)
  - real estate: S&P/Case Shiller Home Price Index fell 14.9%

# Open interest in crude oil futures grew over the last decade as more participants entered the market

average daily open interest in crude oil futures  
(thousands of contracts)

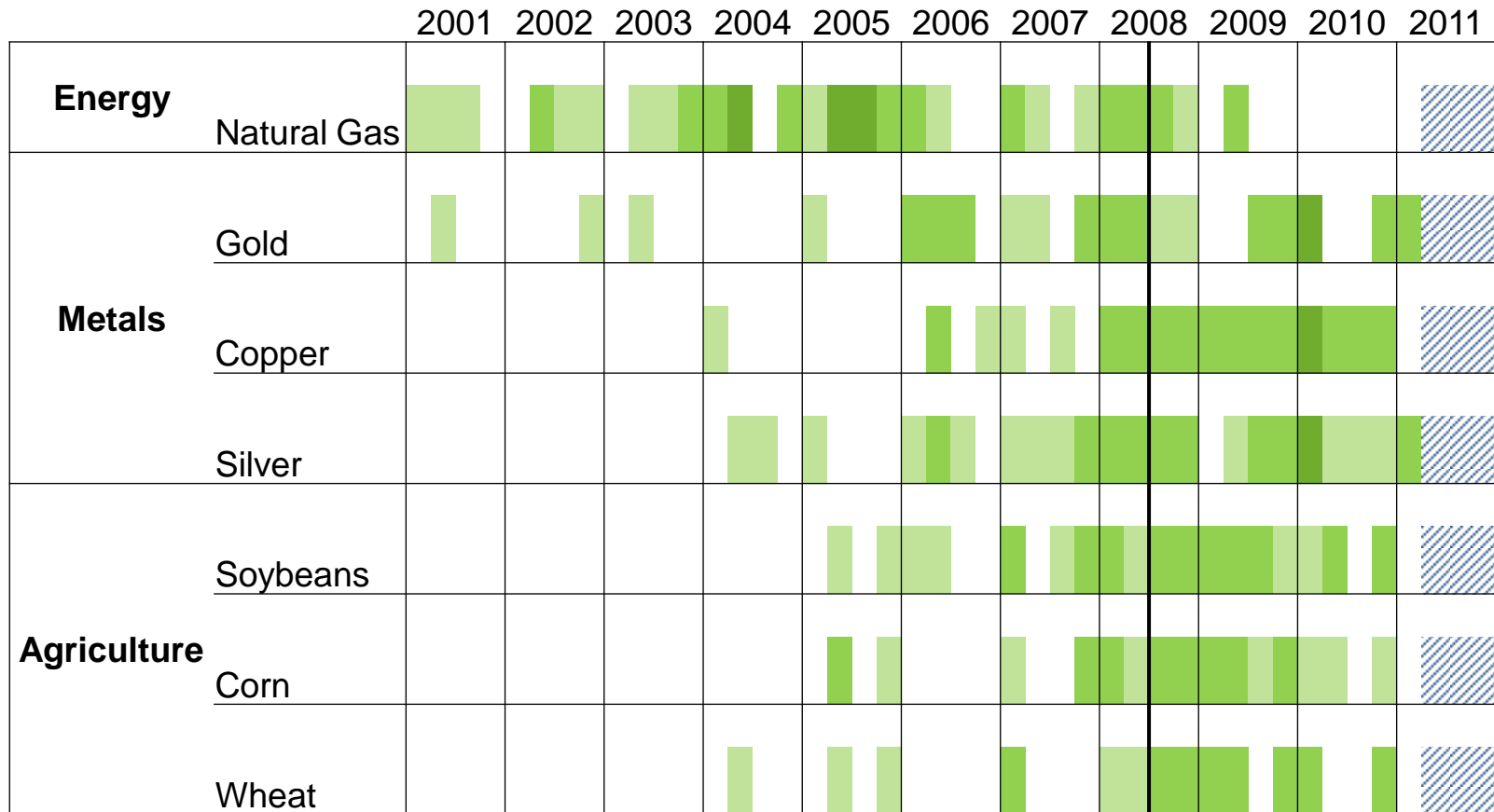


Source: Bloomberg

## Daily return correlations between oil prices and other asset classes have generally strengthened in recent years

- The correlation between daily returns on crude oil and other globally-traded commodities has strengthened over the past few years
- Crude oil also began showing stronger absolute correlations in 2008 with the S&P 500 and U.S. Treasury bonds
- The correlation between crude oil and the dollar has varied over the past decade, with a strong negative correlation in recent years
- In contrast, crude oil and natural gas returns have been correlated over the past decade, but the relationship has recently weakened

# Correlations between daily price changes of crude oil and other commodities generally rose in recent years

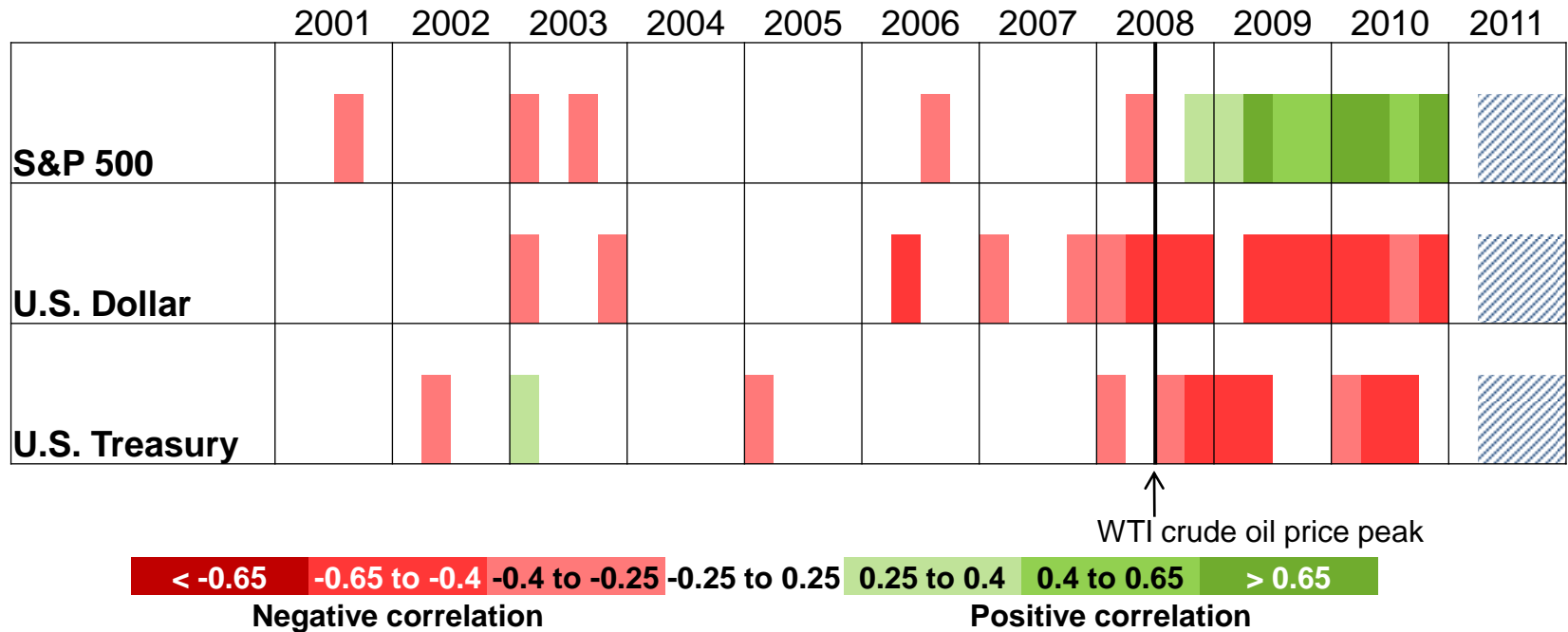


↑  
WTI crude oil price peak



Note: Correlations computed quarterly

# Correlations (+ or -) between daily returns on crude oil and financial investments have also strengthened



\* U.S. Dollar Index (DXY), which is a weighted index of a basket of currencies, per U.S. dollar. As the dollar strengthens against other currencies, the value of the index rises.

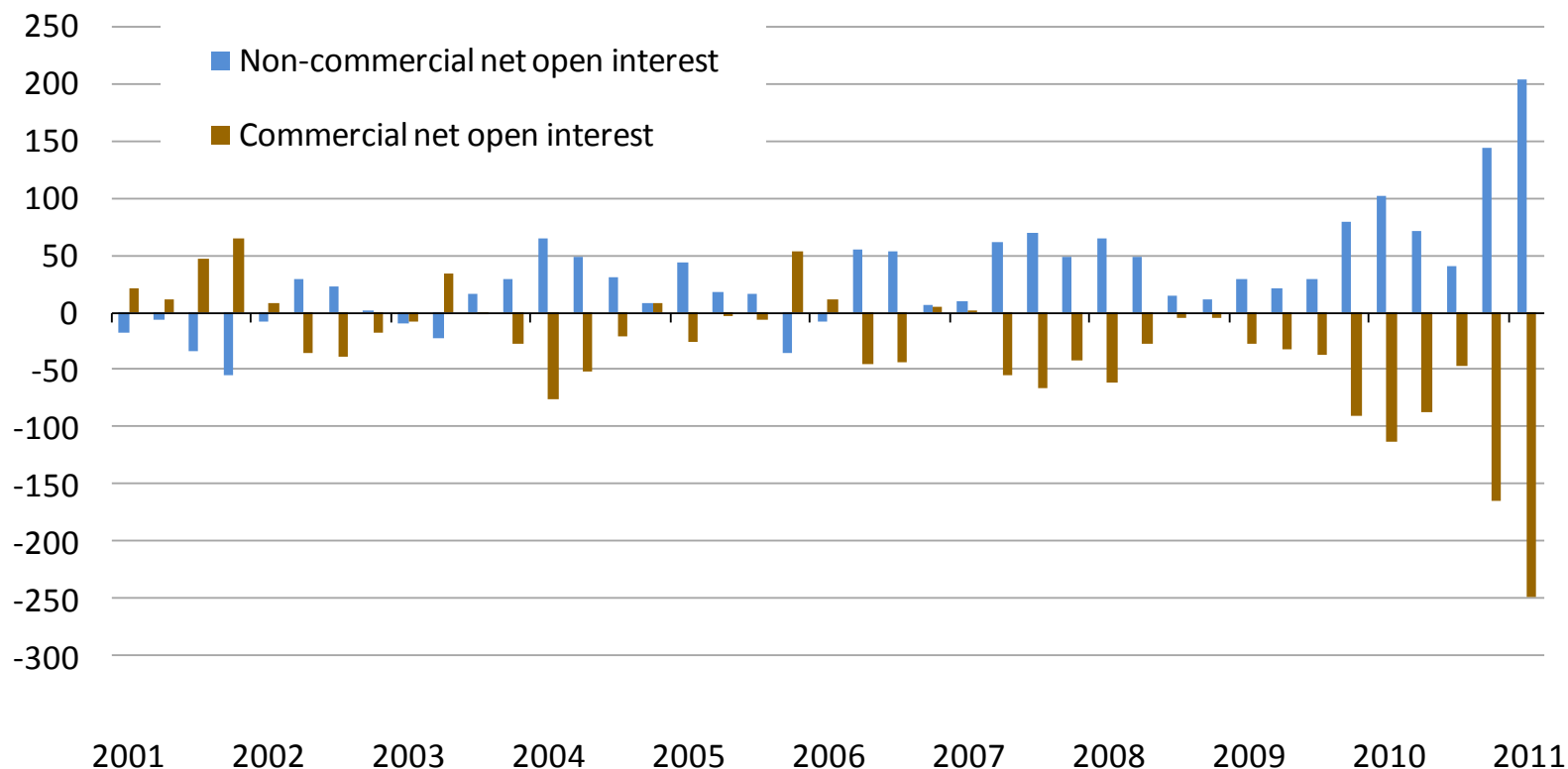
\*\* U.S. Treasury is based on the negative of the change in yield on 30-year U.S. government bonds because as yields rise, bond prices fall.

Note: Correlations computed quarterly



# Non-commercial participation in commodity derivative markets has been increasingly on the buy-side (net long)

number of contracts (thousands)



*Note: Non-commercial consists of managed money and other market participants. Commercial consists of producers, merchants, processors, end users and swap dealers.*

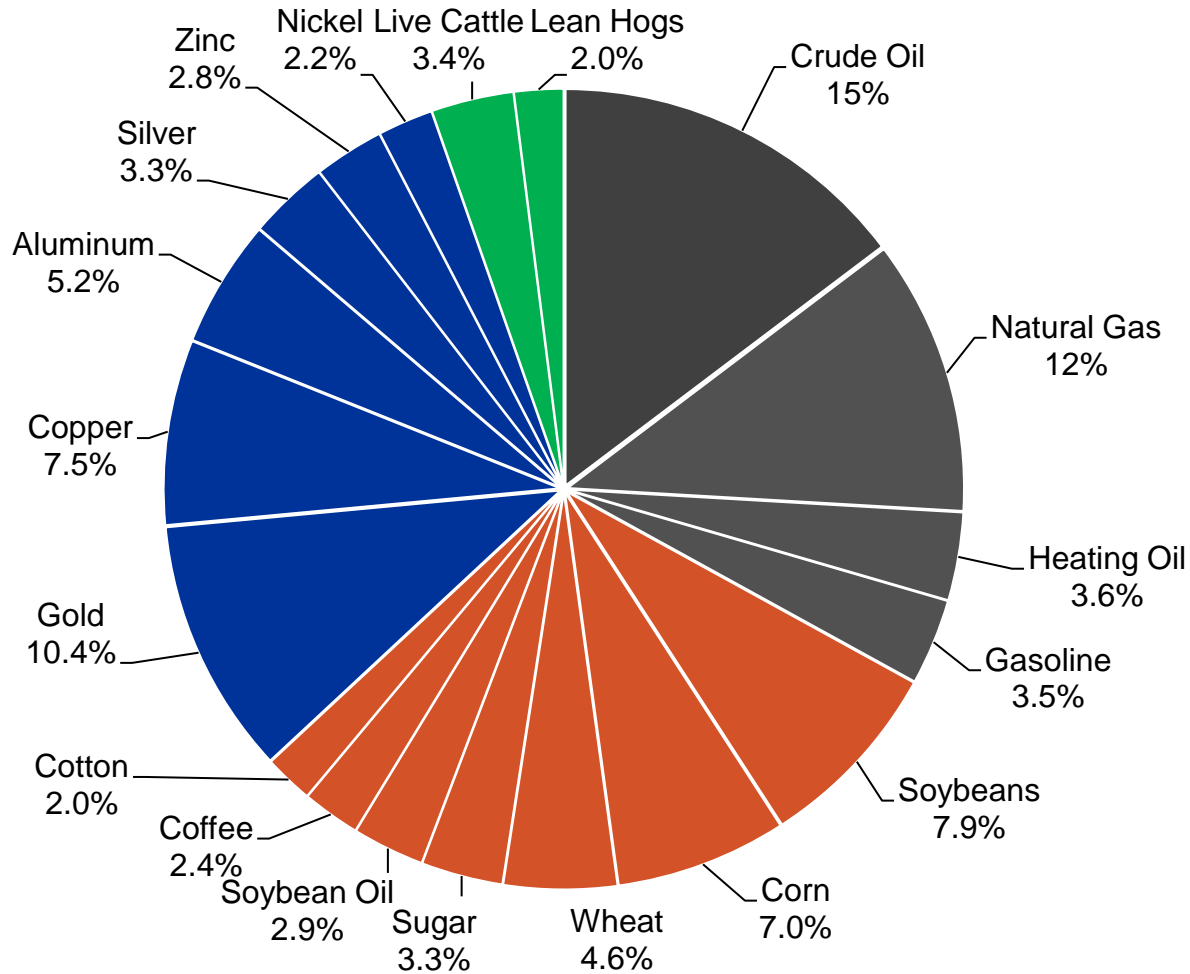
*Source: CFTC Commitment of Traders*

## Did the level of commodity index investment move with or counter to movement in oil prices? More evidence is needed

- CFTC “special call data” on commodity investment is an important source of information, but it is only available post-December 2007
  - suggests that investment positions in oil futures and derivatives moved counter to oil prices during 2008 and early 2009
  - the use of supplemental CFTC commitment-of-traders data to look back further for oil (by backing out other commodities) is methodologically difficult
- We are also looking at other measures of index investment in all commodities
  - constructing a measure of index investment that aggregates across commodities is even more challenging, even if we limit attention to the post-December 2007 period
  - preliminary evidence suggests that a broader commodity measure may have a different relationship to oil price movements than one that considers only the level of oil index investment

# Crude oil plays a major role in commodity investment

2011 Target Weights of the Dow Jones - UBS Commodity Index

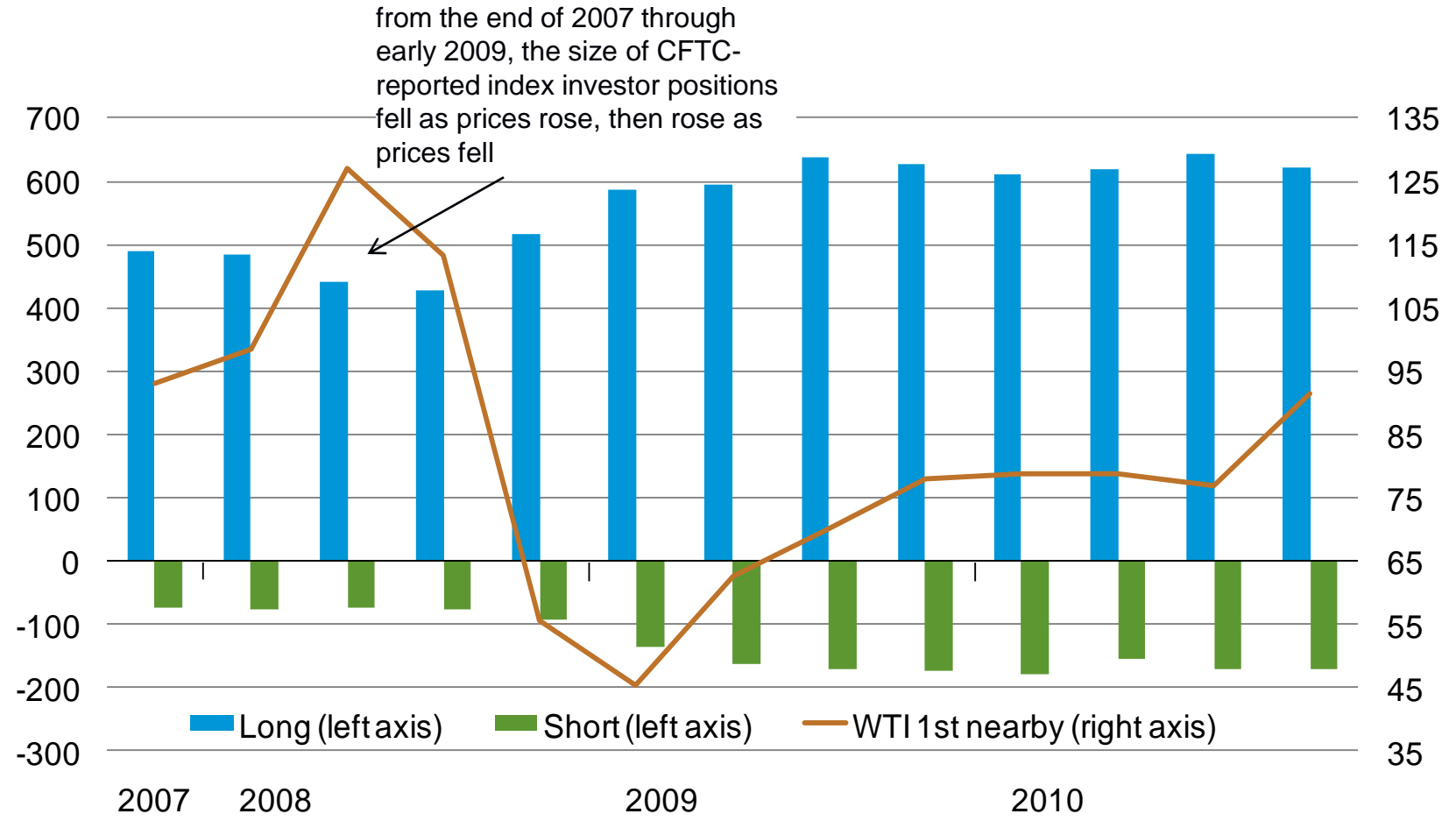


Source: Dow Jones Indexes, CME Group

# Index investors' CFTC futures-equivalent positions may have actually run counter to movements in oil prices

index investor future-equivalent positions  
(thousands of contracts)

price per barrel (real 2009 dollars)

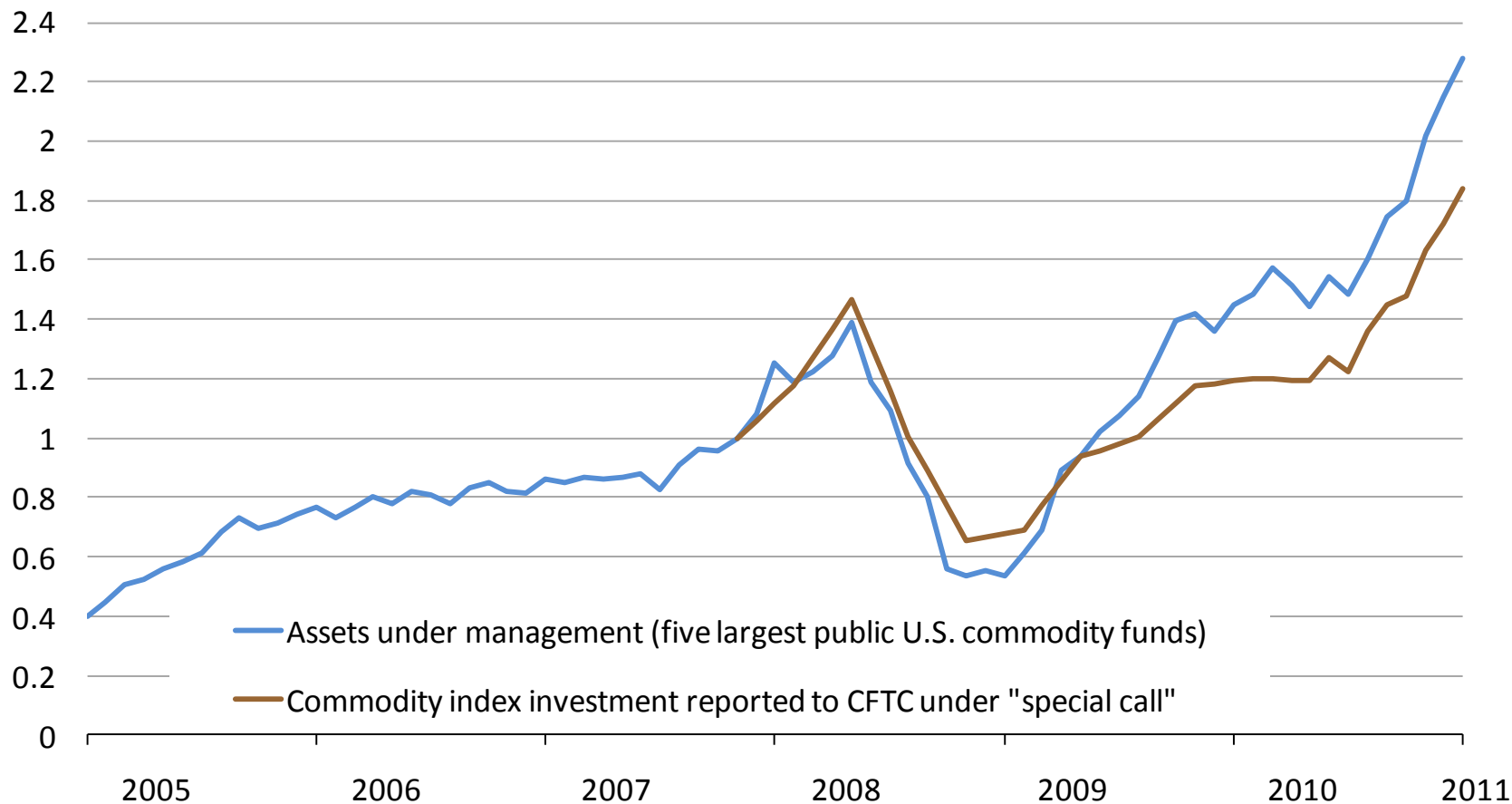


Sources: CFTC Special Call Report, Bloomberg

# Assets under management by largest U.S. commodity funds compared to CFTC's total index notional investment

asset value

ratios relative to December 2007 (normalized dollars)



Source: CFTC, Bloomberg

# Oil price formation: both physical and financial markets matter

- Supply and demand fundamentals remain a key underlying driver of oil prices
  - the low near-term responsiveness of both oil consumption and production to price changes is an essential factor underpinning oil price volatility
- Financial market conditions in the past few years have, however, increased interest in oil as an asset class
- Activity in markets for other commodities, equities, bonds, and foreign exchange has become more highly correlated with oil, and should be considered in analysis of oil price formation
- Additional research is needed to better understand the linkages among these markets

# For more information

U.S. Energy Information Administration home page | [www.eia.gov](http://www.eia.gov)

Short-Term Energy Outlook | [www.eia.gov/steo](http://www.eia.gov/steo)

Annual Energy Outlook | [www.eia.gov/aeo](http://www.eia.gov/aeo)

International Energy Outlook | [www.eia.gov/ieo](http://www.eia.gov/ieo)

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