Is the World Oil Market Unified? Regions in Quality, Risk, & Space

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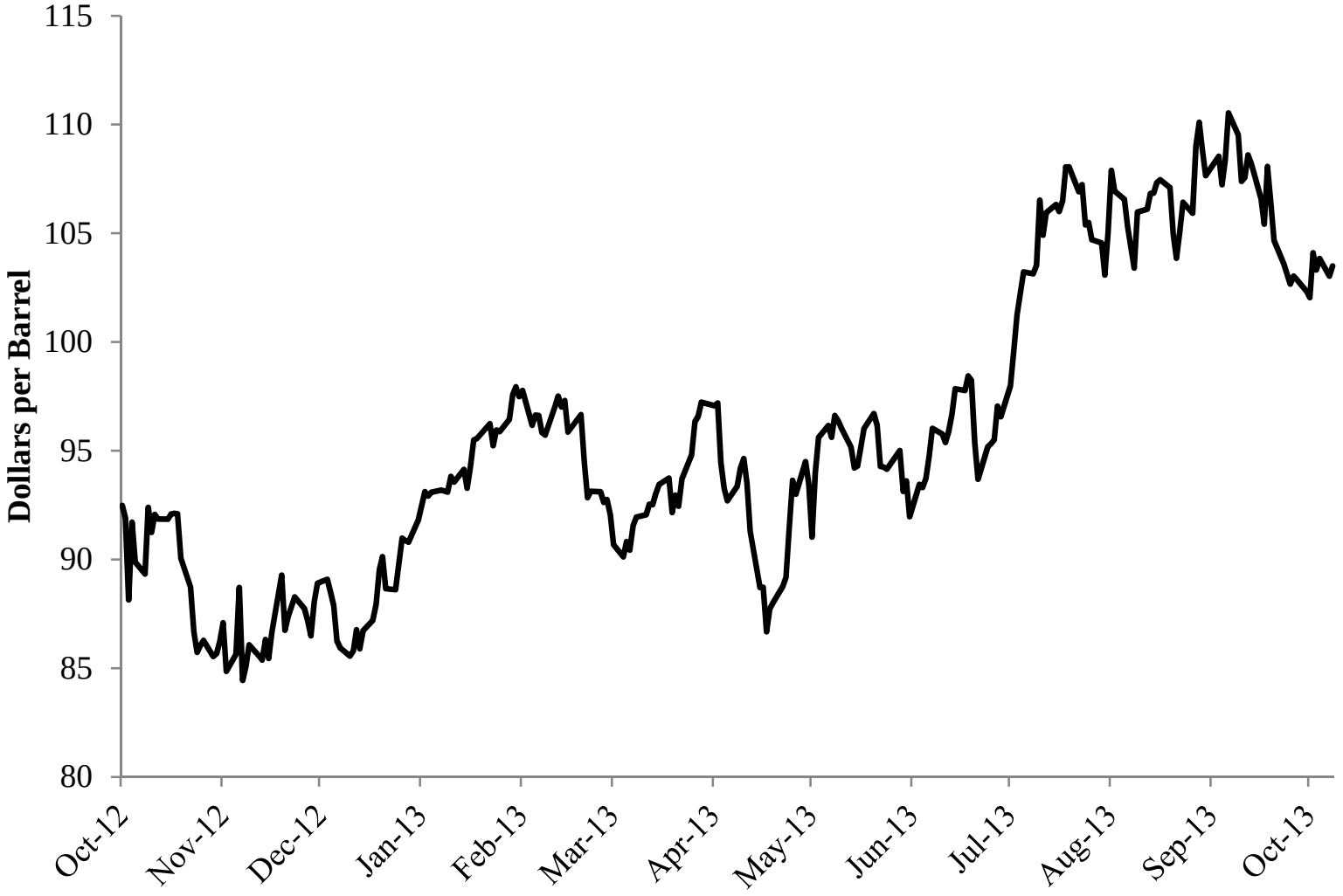
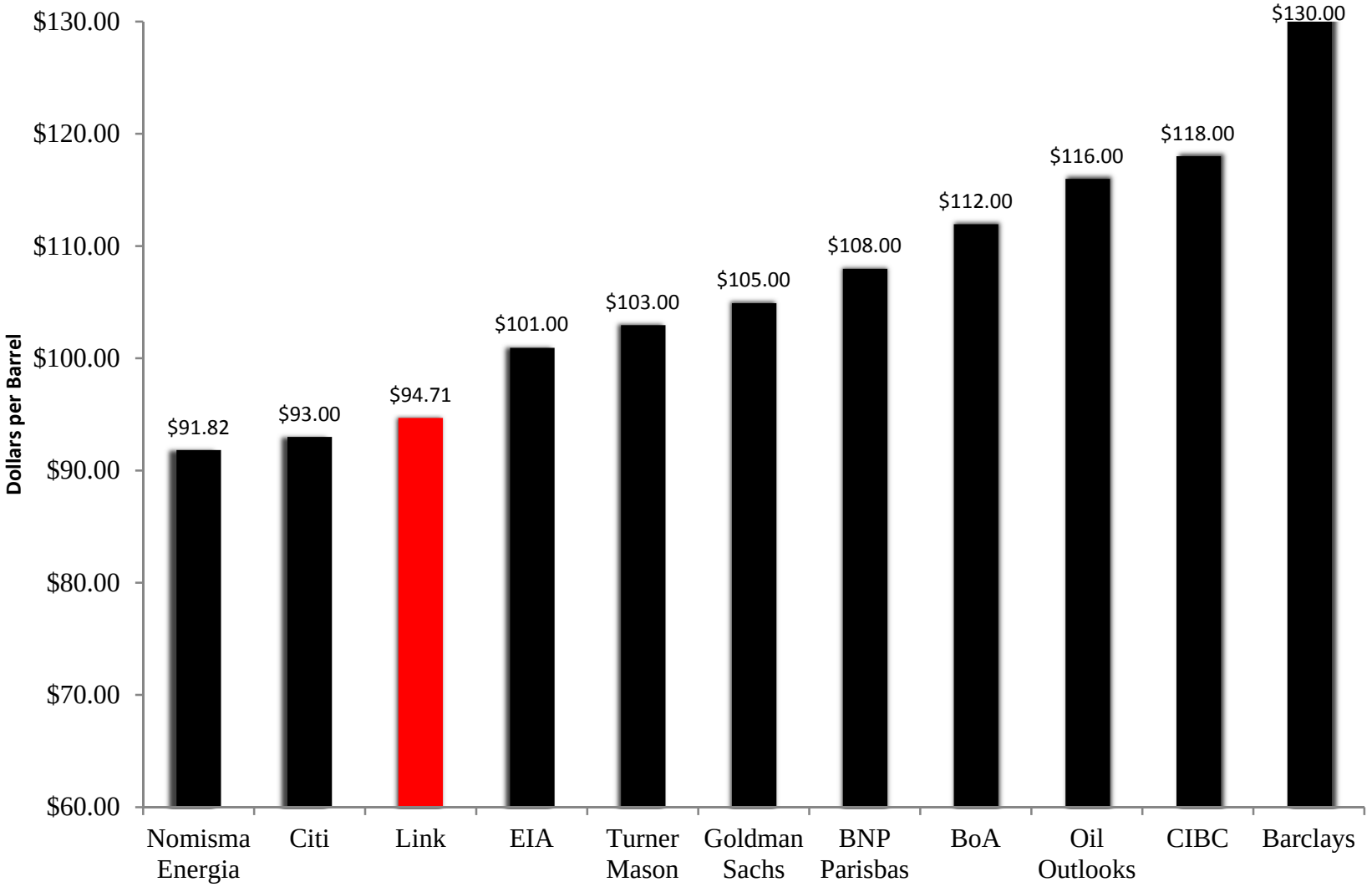
Since We Last Met..



The 2014 Price Forecast



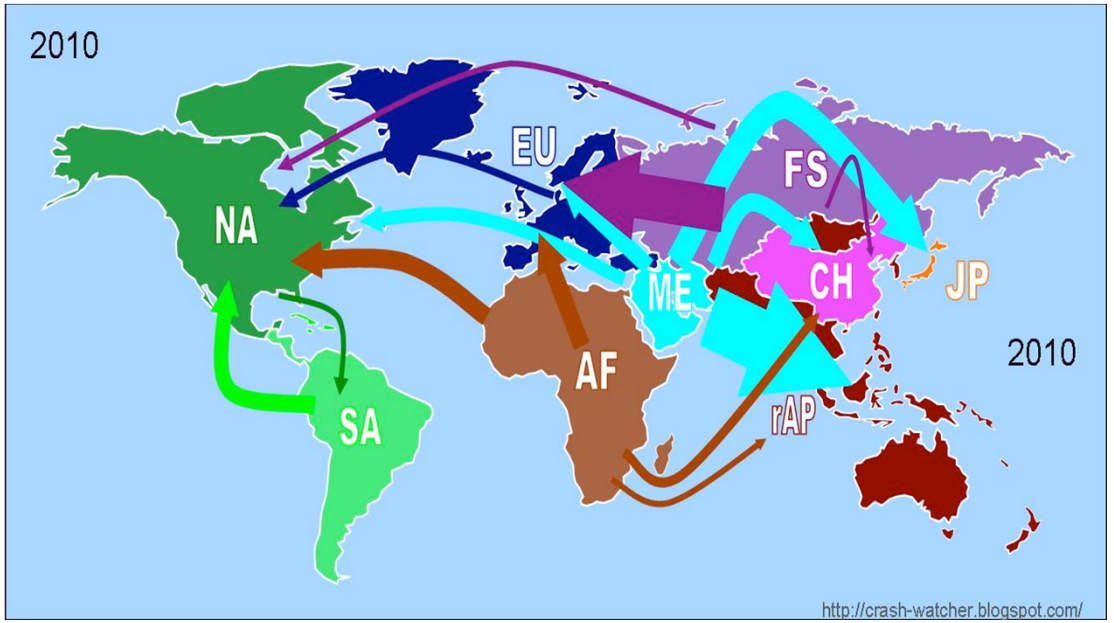
A Bearish Forecast?

- Steady Growth in Supply
  - Additions to OPEC capacity (mainly Africa)
  - Increases in non-OPEC crude oil production (US)
  - Increases in natural gas production
- Slow grow in consumption
  - Slow economic growth
  - Increasing efficiency

A Unified World Oil Market?

- **Unified World Oil Market**
  - Production flows seamlessly across physical, technical, and political barriers.

- **Policy Implications**
  - Supply shocks
  - Inventory draws



Existing Results

- The crude oil market is unified
  - Oil prices cointegrate
  - Arbitrage models
- The crude oil market is regionalized
  - Not all price pairs cointegrate
  - Price discrimination

Three Questions

- Is the world crude oil market unified?
  - Daily spot prices for 33 crude oils
  - November 27, 2002 through December 31, 2010
  - Test 528 pairings for cointegration using ADF

- What factors regionalize the world oil market?
  - Logit Model (Cointegration = 1.0)
  - API gravity, Country Risk, Distance between Sources

- What are the costs of regionalization?
  - Price differences of crude oil price

Unified vs. Regionalized ADF Results

Critical value	Cointegrate	Do not cointegrate
-3.90 (p = 0.01)	408	120
-3.33 (p = 0.05)	447	81
-3.04 (p = 0.10)	468	60

Cointegration Varies by Crude Oil

Crude Oil	Cointegrate	Non-Cointegrate
Kirkuk (Iraq)	11	21
Iranian Heavy	12	20
Cabinda (Angola)	21	11
Es Sider (Libya)	22	10
Minus (Indonesia)	32	0
Mars Blend (US)	32	0
Alaska North Slope (US)	32	0
West Texas Sour (US)	32	0

Logit Model

Dependent variable (C_{ij})

- Pair cointegrates (C_{ij} = 1, else C_{ij} = 0)

Independent variables

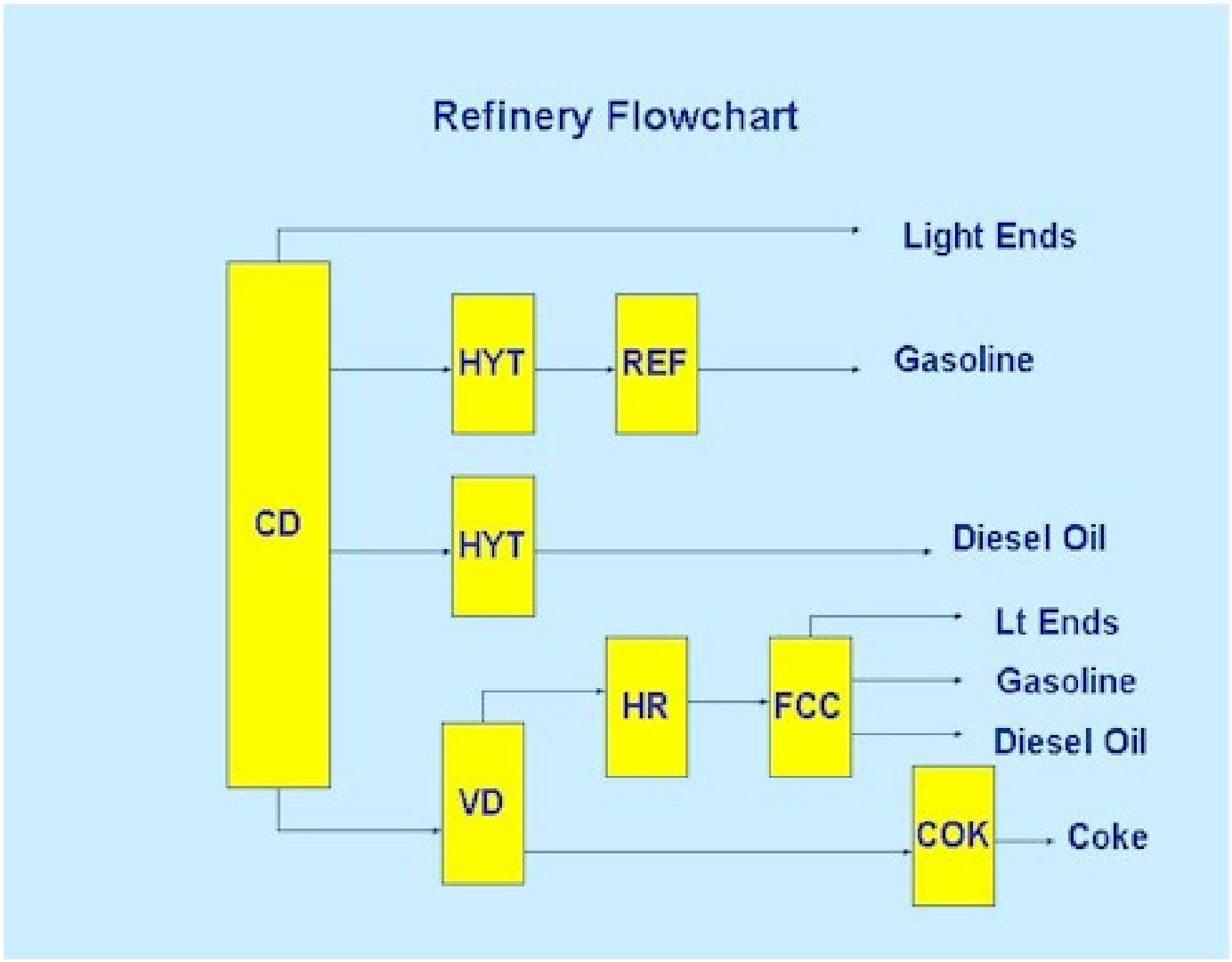
- Light_Heavy (40^o and 34^o)
- High_Low (Low risk = 0)
- Total Risk (Add country risk scores
- Distance (Distance between supply ports km)
- Opec_NonOpec
- Sweet_Sour (0.5% vs 1.5% sulfur)

Logit Results

	1 %	5 %	10 %
Constant	3.94**	5.15**	5.78**
Heavy_Light	-0.96*	-2.01**	-1.72**
High_Low	-1.58**	-2.12**	-2.15**
Total_Risk	-0.35**	-0.38**	-0.38**
Distance	2.58E-04**	3.18E-04**	3.28E-04**
Kirkuk	-1.57*	-2.42**	-2.95**
Iran_Heavy	-2.21**	-2.99**	-3.55**

Sweet_Sour, OPEC_NonOpec, Futures Not statistically significant

API Gravity



http://www.petrostrategies.org/images/Refinery%20Flowchart.jpg

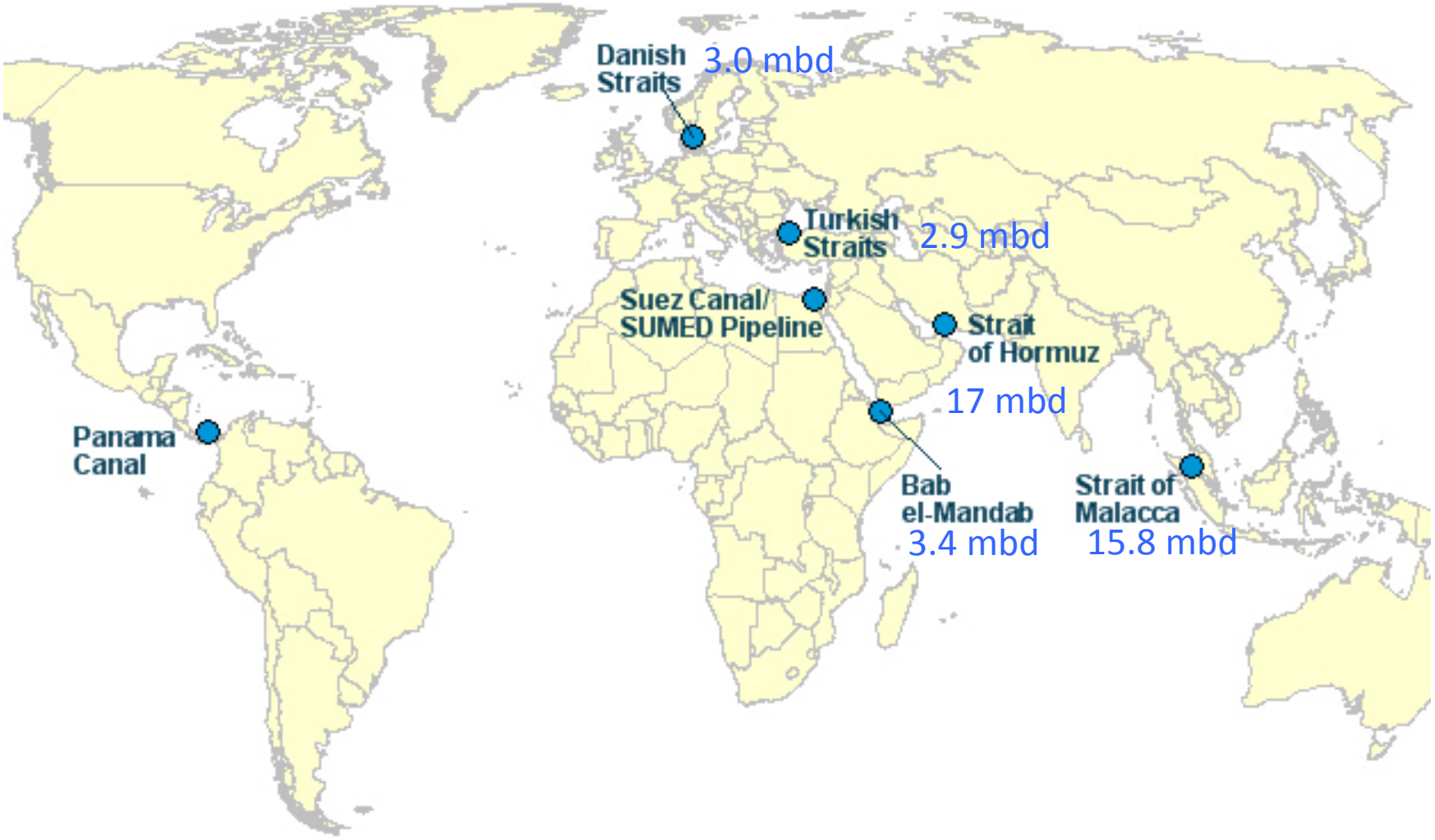
Regionlized 2002 Venezuela Strike

- U.S. imports of crude oil from Venezuela fell by 24.6 million barrels between November and December 2002
- Total US monthly imports fell by 23.9 million barrels
- Replacements available from Middle East (Saudi Arabia, Kuwait, and Iraq) but 30 day shipping
- US drew down crude oil inventories by about 10.5 million barrels.

Country Risk

- Risk of investing in a country; value depends on the overall stability of the business environment.
  - Regulatory changes through government action
  - Political events such as riots or civil wars
  - natural events such as earthquakes and hurricanes
- Ability of suppliers to deliver crude oil
  - Revolutionary Armed Forces of Columbia (FARC)
  - Attacks on Caño Limon pipeline interrupted supply

Geographic Risk & Geographic Regions



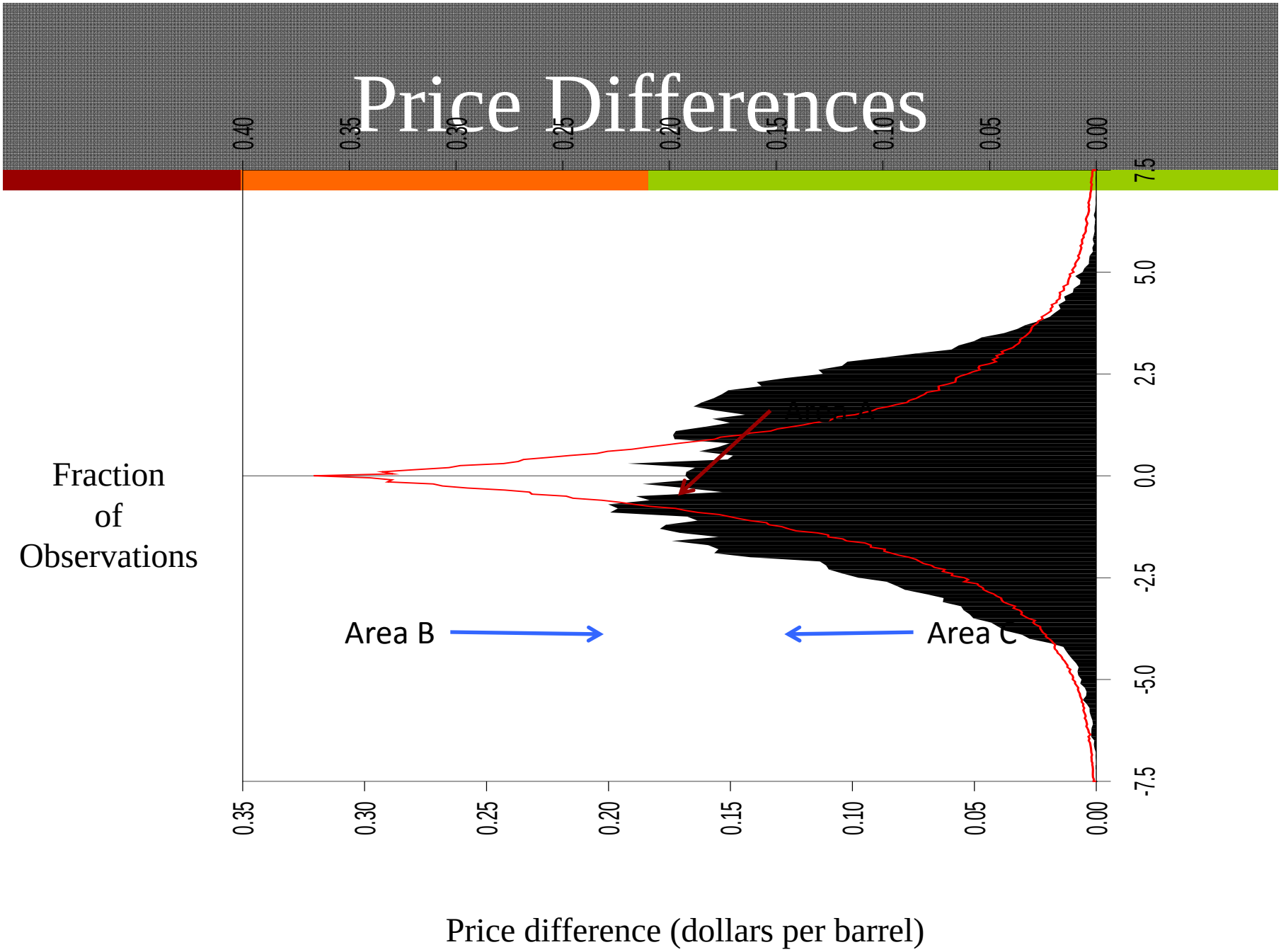
Cost of Regionalization
Reasons for Price Differences

- Arbitrage (physical differences, location)
  - Constant of cointegrating relation
  - Average difference

- Disequilibrium
  - Error from cointegrating relation

- Regionalization (stochastic trend)
  - Differences beyond average difference

Price Differences



Cost of Regionalization

- Arbitrage (physical differences, location)
  - $1.26 Intercept cointegrating relation
  - $3.96 Average difference across regions
- Disequilibrium
  - $1.43 Error from cointegrating relation
  - $1.63 Average error
- Stochastic trend
  - $0.20 Differences beyond average difference

Policy Implications

- Supply Shocks
  - Unreliable supplier price discount
  - Does the market understate risk?

- Inventory Draws
  - SPR Light sweet crude oils
  - Match crude oils with local refining capacity

US Crude Oil Production