Vertical Integration and Price Differentials in the U.S. Crude Oil Market

Shaun McRae

University of Michigan

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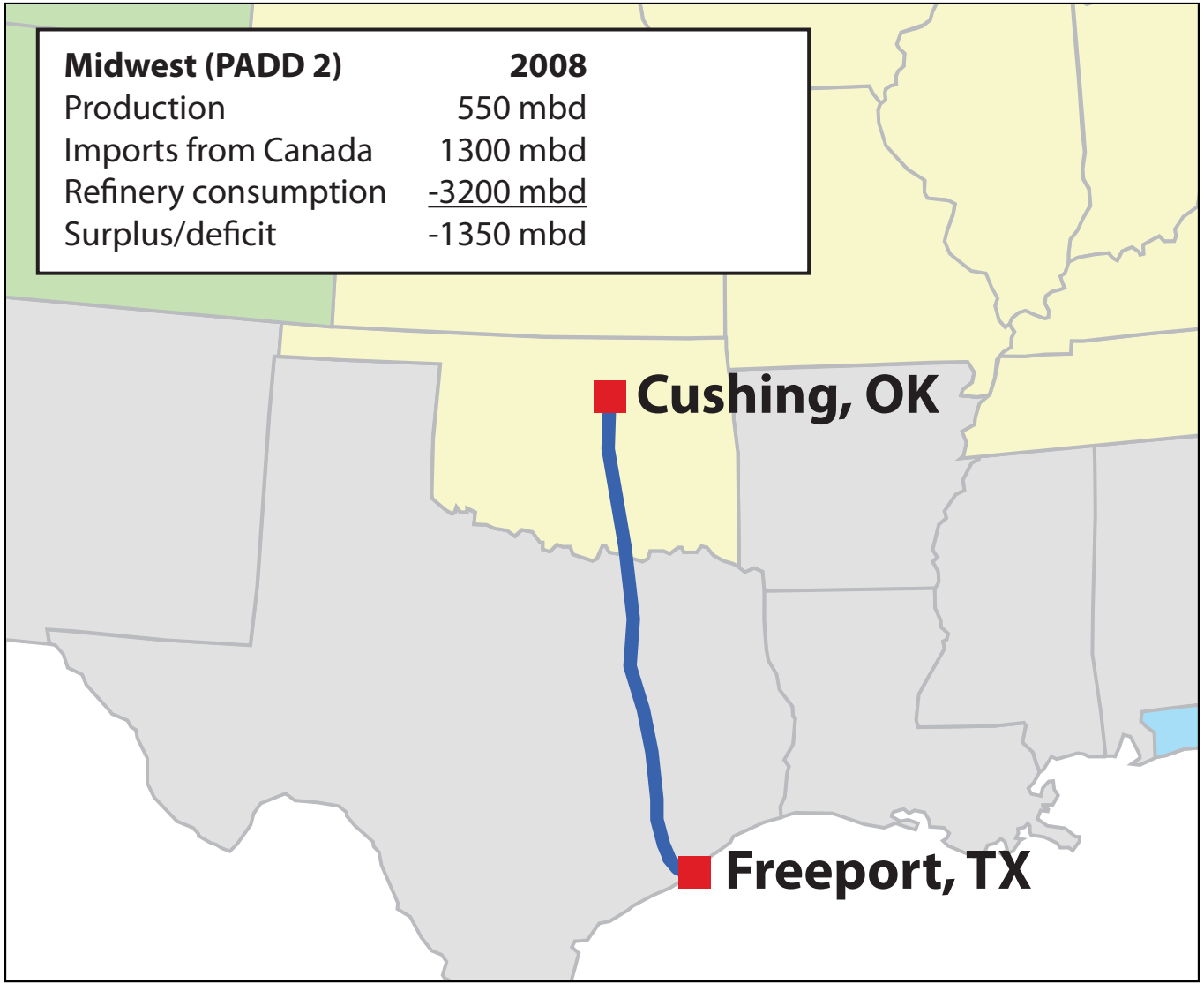
Vertical integration in regulated industries

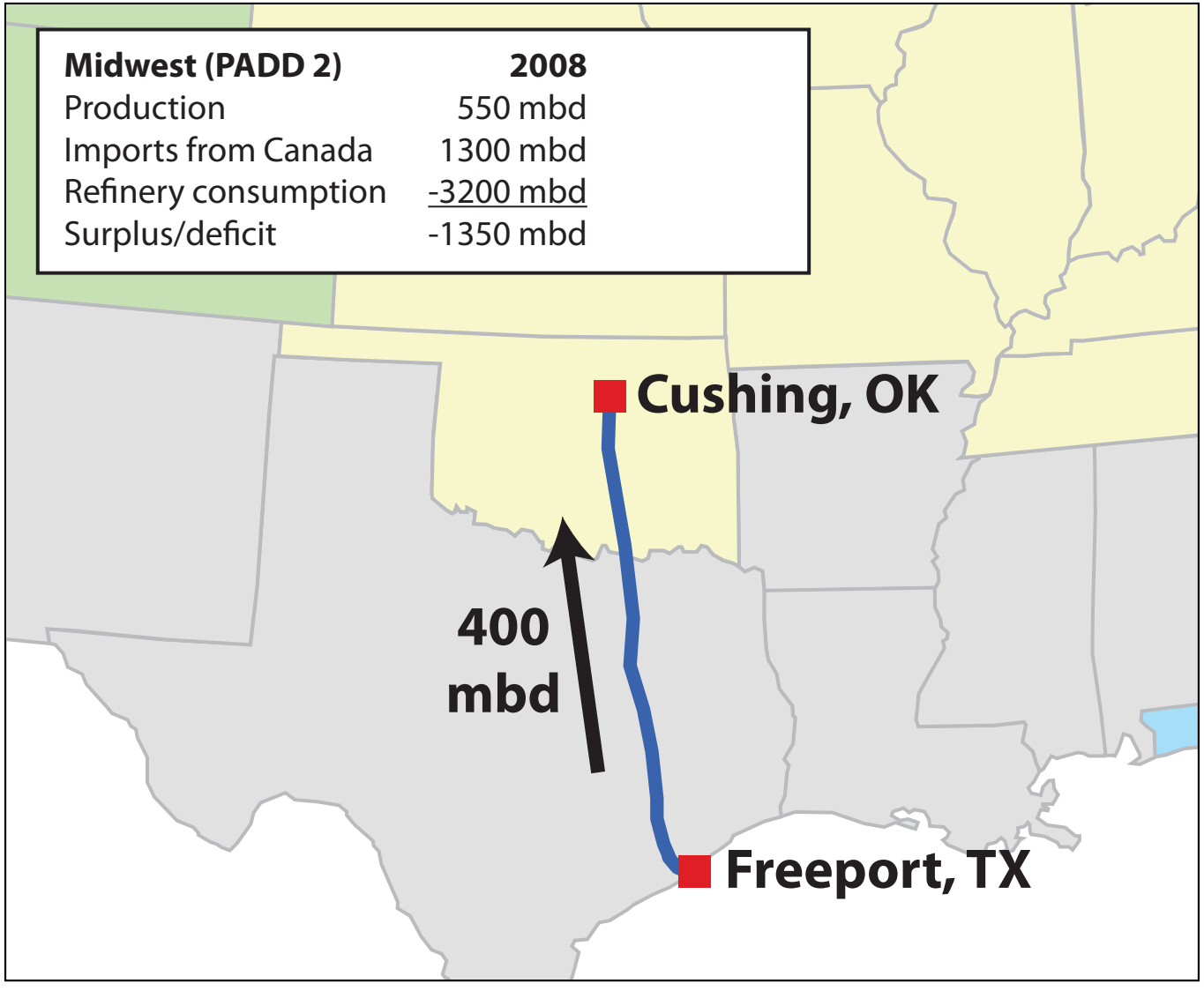
- Common concern in regulated industries is the vertical integration between regulated and unregulated segments
- Industry restructuring often requires structural separation between regulated and unregulated businesses
  - Electricity, railroads, telecommunications, etc
- Only one component of the oil industry is subject to price regulation: oil pipelines
- These pipelines are often part of vertically integrated firms that including production and refining businesses
- Why might this be harmful?

Seaway pipeline is a major crude oil pipeline that connects Cushing oil hub to the Gulf Coast

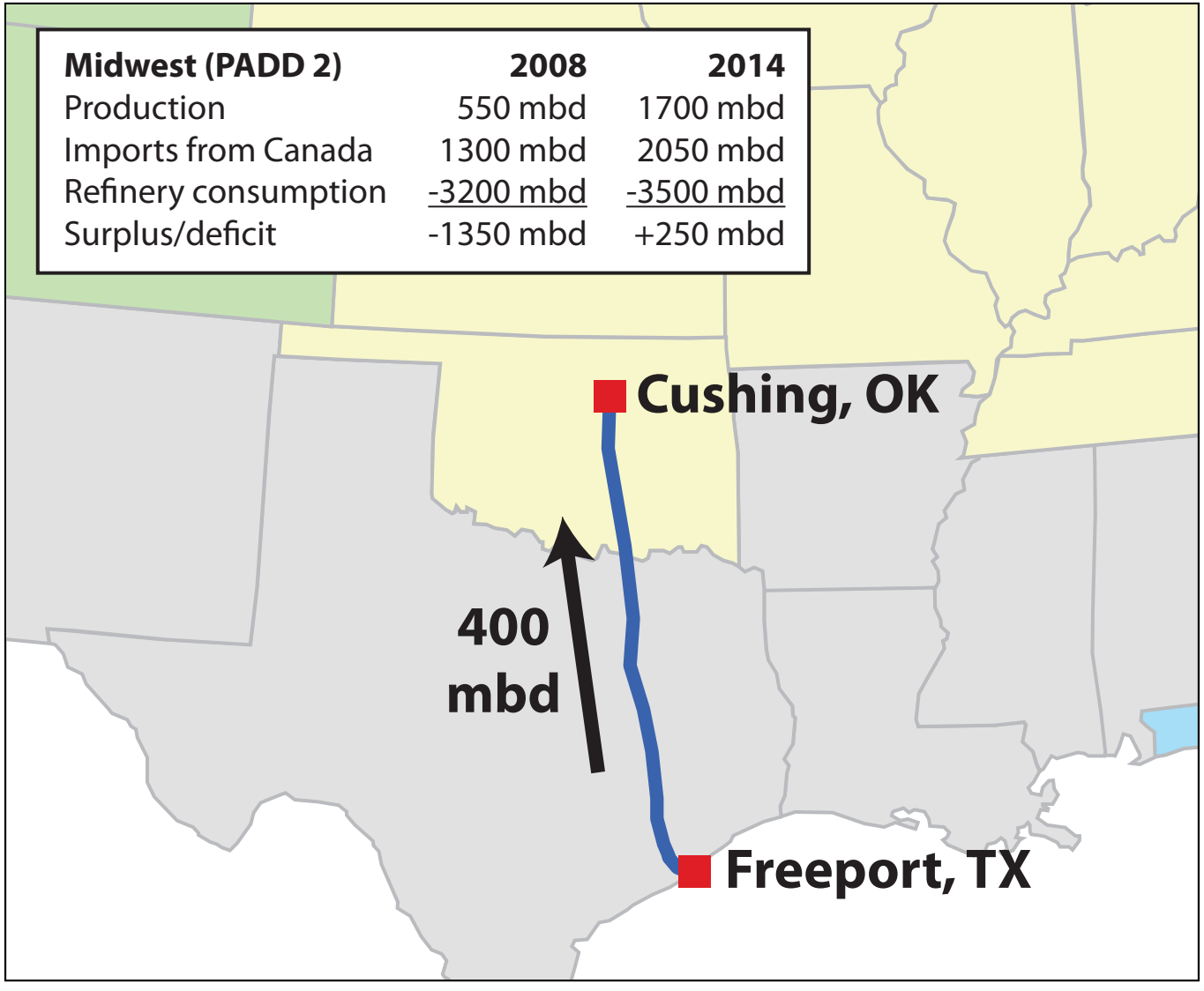
Midwest region has historically been a net importer of crude oil



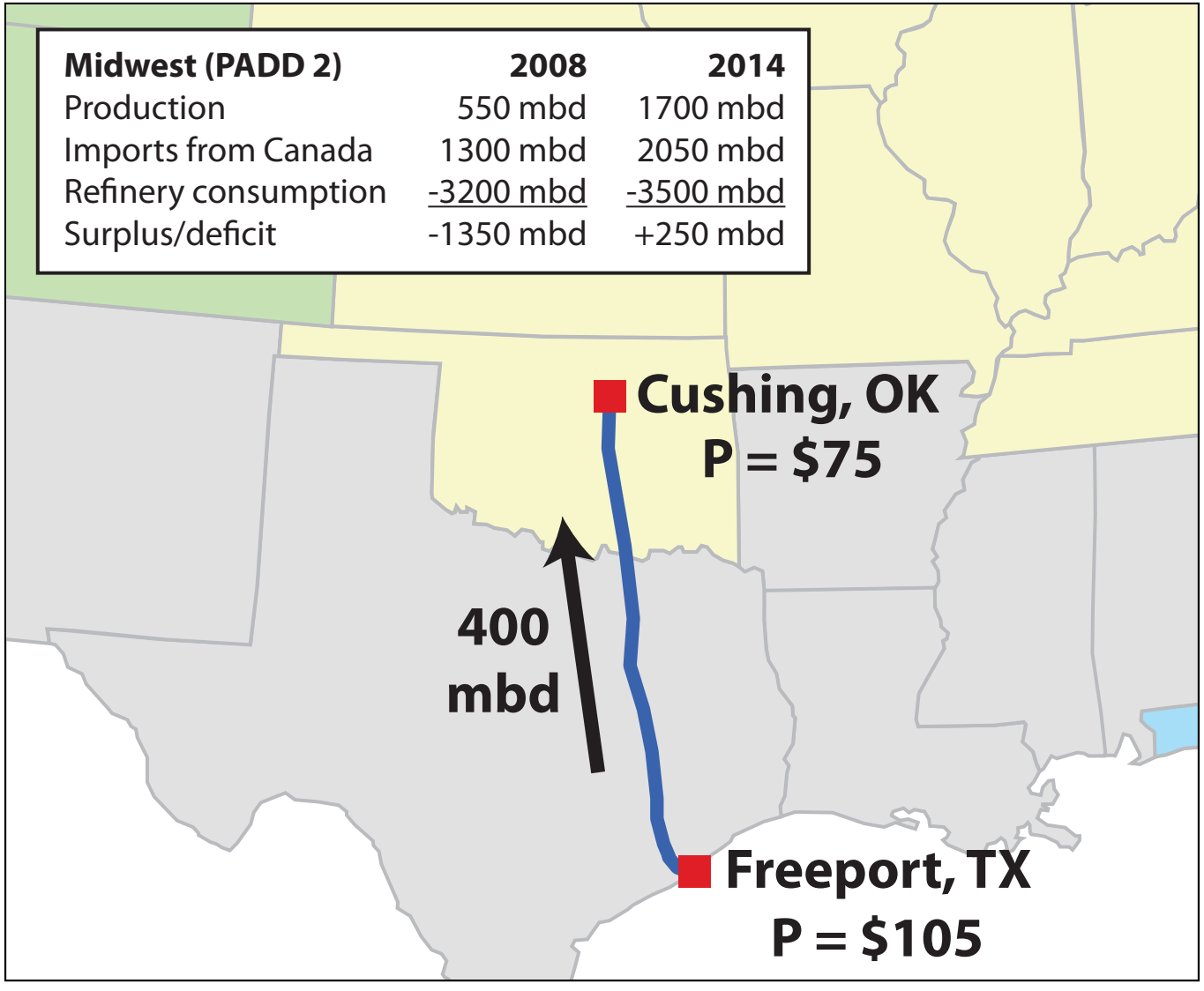
Seaway pipeline ran south to north to transport crude oil to Midwest refineries



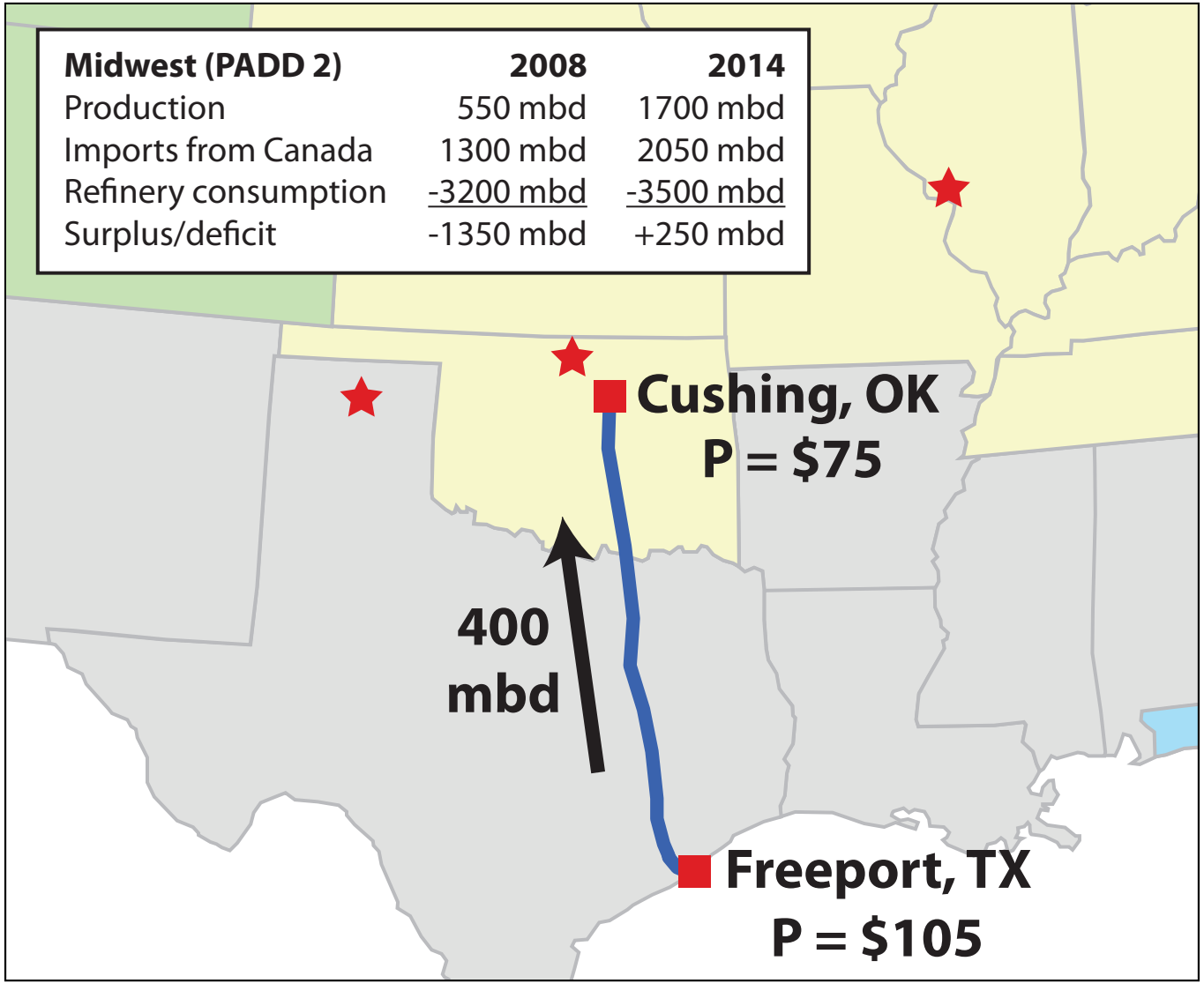
Oil production grew in Midwest and Canada, creating an excess supply of oil at Cushing hub



Seaway pipeline was not reversed despite price difference of $30 per barrel between regions



ConocoPhillips, 50% owner of Seaway pipeline, profited from lower refinery input costs



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"In terms of reversal of the Seaway line, we don't really think that's necessarily really in our interest."

ConocoPhillips CEO, March 2011

"[We] had been trying to convince ConocoPhillips to reverse it."

Enterprise CEO, November 2011.
Enterprise owns the other 50% of the Seaway pipeline

In November 2011, ConocoPhillips announced sale of its share in the pipeline

- At the same time, new owners of the pipeline announced that they would reverse the flow
- Price difference between north and south immediately narrowed
- In 2012, ConocoPhillips spunoff its refining, marketing and pipeline businesses into a separate company: Phillips 66

In this paper I examine the decision by ConocoPhillips to not reverse the pipeline earlier

- Long-standing antitrust concern about the effect of vertical integration in the oil industry

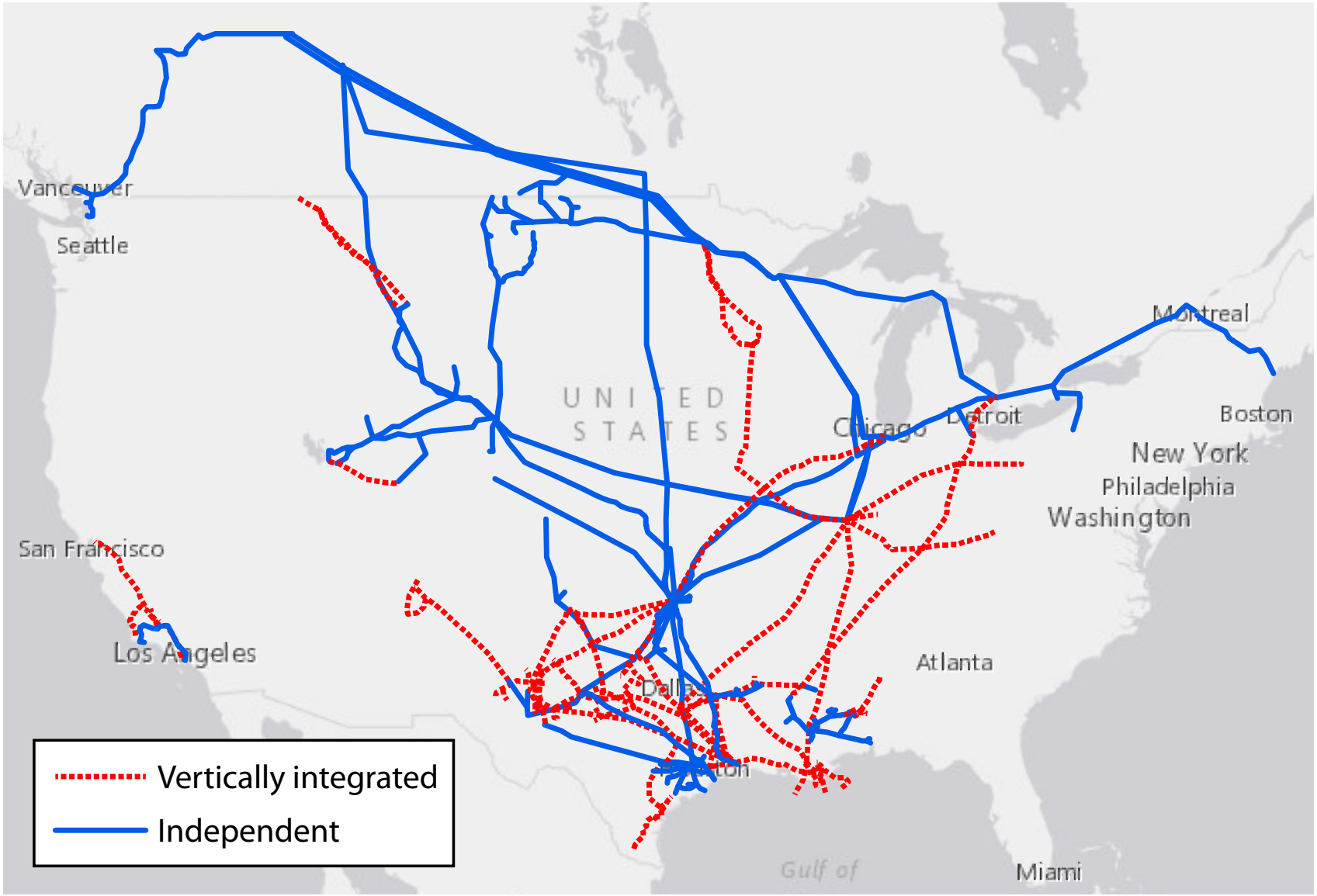
  The incentives of an independent pipeline company thus differ from those of a vertically integrated pipeline company, which seeks to maximize overall profits, not just transportation profits... if a vertically integrated pipeline owner is a significant buyer in the upstream market, and if the pipeline owner has market power upstream, the owner may have an incentive to limit throughput to depress the upstream market price. (DOJ, 1979)

In this paper I examine the decision by ConocoPhillips to not reverse the pipeline earlier

- DOJ was particularly concerned about pipeline undersizing: integrated firms might deliberately build pipelines too small in order to create favorable price differentials
  - One argument against this was that new firms could then enter and build additional pipelines
- The flow decision in this paper is a reversible way to set pipeline capacity: undersizing without the potential long-term costs
- I will calculate counterfactual profits as if ConocoPhillips had reversed the pipeline earlier—which explains why they did not
- This is still relevant in 2015: there are other vertically integrated pipelines in a similar situation

Outline of the talk

Many crude oil pipelines in the U.S. are owned by vertically-integrated oil companies



Oil pipeline regulation began in 1906 with the Hepburn Act

- Hepburn Act was an amendment to Interstate Commerce Act that allowed ICC to set maximum rates for railroads
- ICA was extended to include oil pipelines
- These were classified as "common carriers": required to provide non-discriminatory service at just and reasonable rates to anyone who wanted to transport oil
- Importantly, pipelines were not covered by the "commodities clause"
    - This prohibited common carriers from owning the commodities that they were transporting
    - Effectively bars vertical integration between carriers and upstream or downstream firms

Oil pipelines are regulated by the Federal Energy Regulatory Commission (FERC)

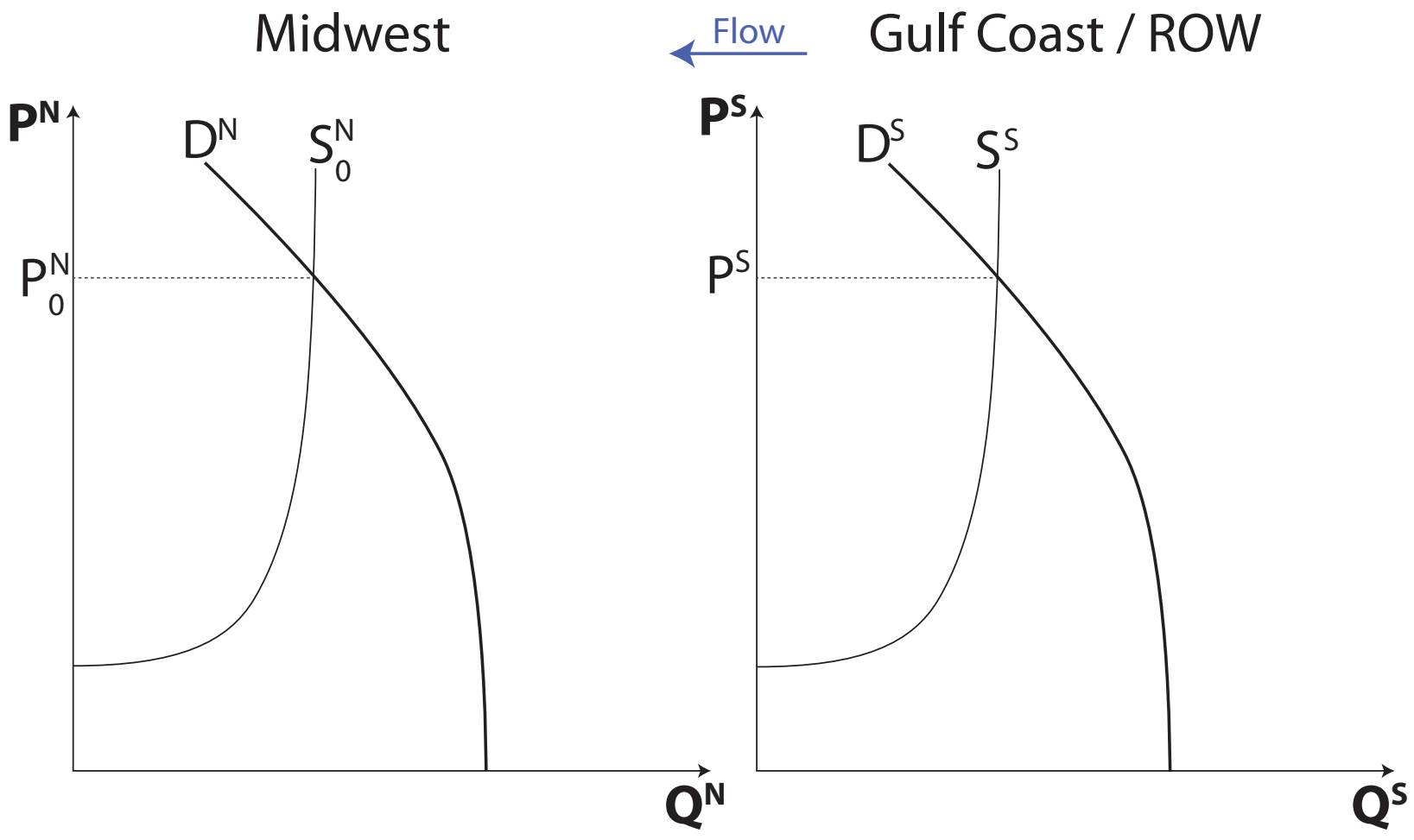
- Regulation is very "light-handed": only involves information disclosure and approval of price schedules
- No regulatory approval required to build new pipelines, reconfigure a pipeline, or shutdown a pipeline
- Several different methodologies available for setting regulated prices:
  - Cost-of-service rates
  - Indexed rates
  - Settlement rates (anything that shippers and pipelines agree to)
  - Market rates (requires pipeline to demonstrate lack of upstream or downstream market power)

Very different regulatory structure for natural gas and oil pipelines

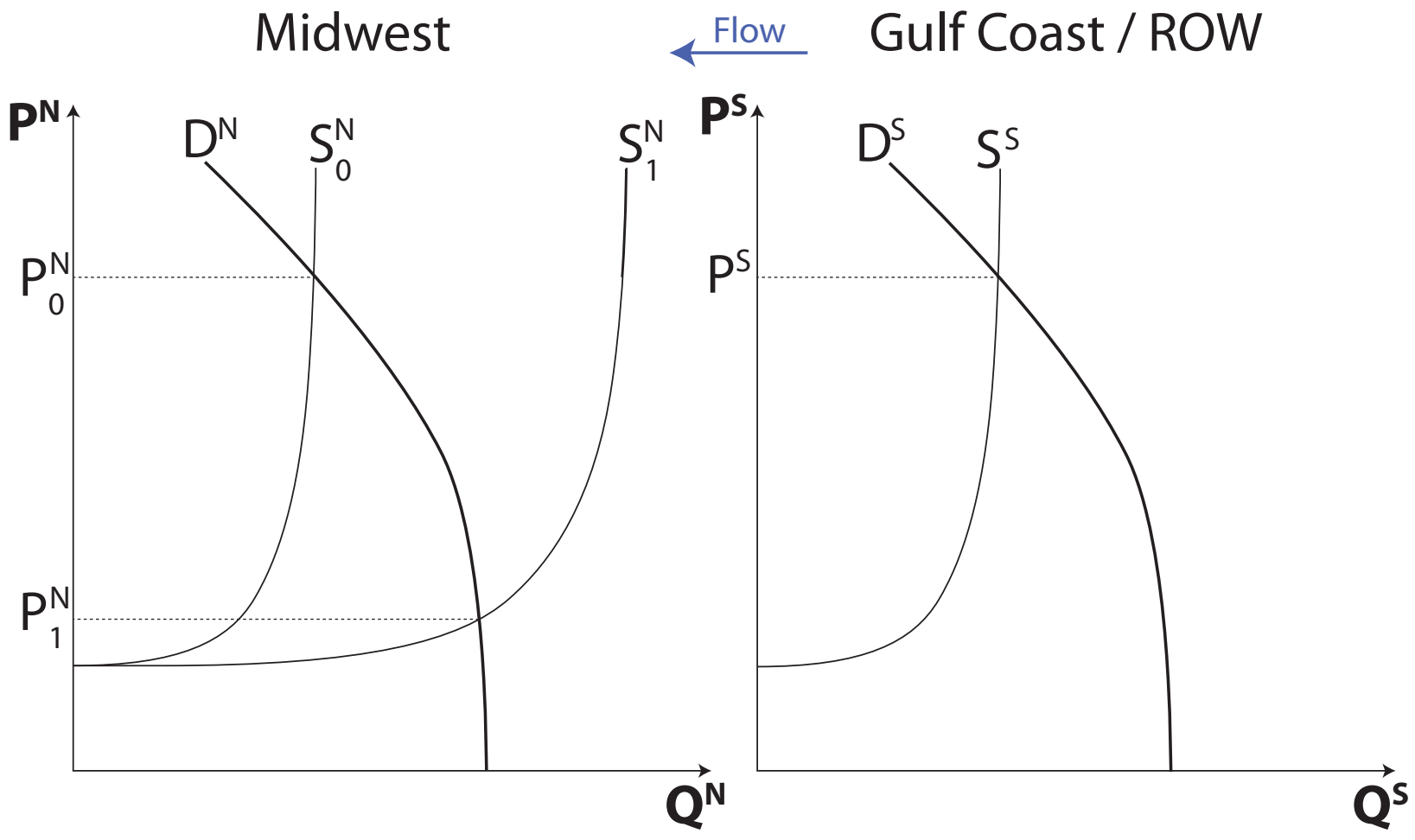
- Natural gas pipelines were specifically excluded from the Hepburn Act in 1906
- Natural gas pipelines are private carriers
  - Property rights to transport gas by pipeline can be traded among firms
- Regulatory approval required to build, change or shutdown a natural gas pipeline
- Vertical integration effectively barred (since 1992)
- Much more extensive information disclosure is required

Outline of the talk

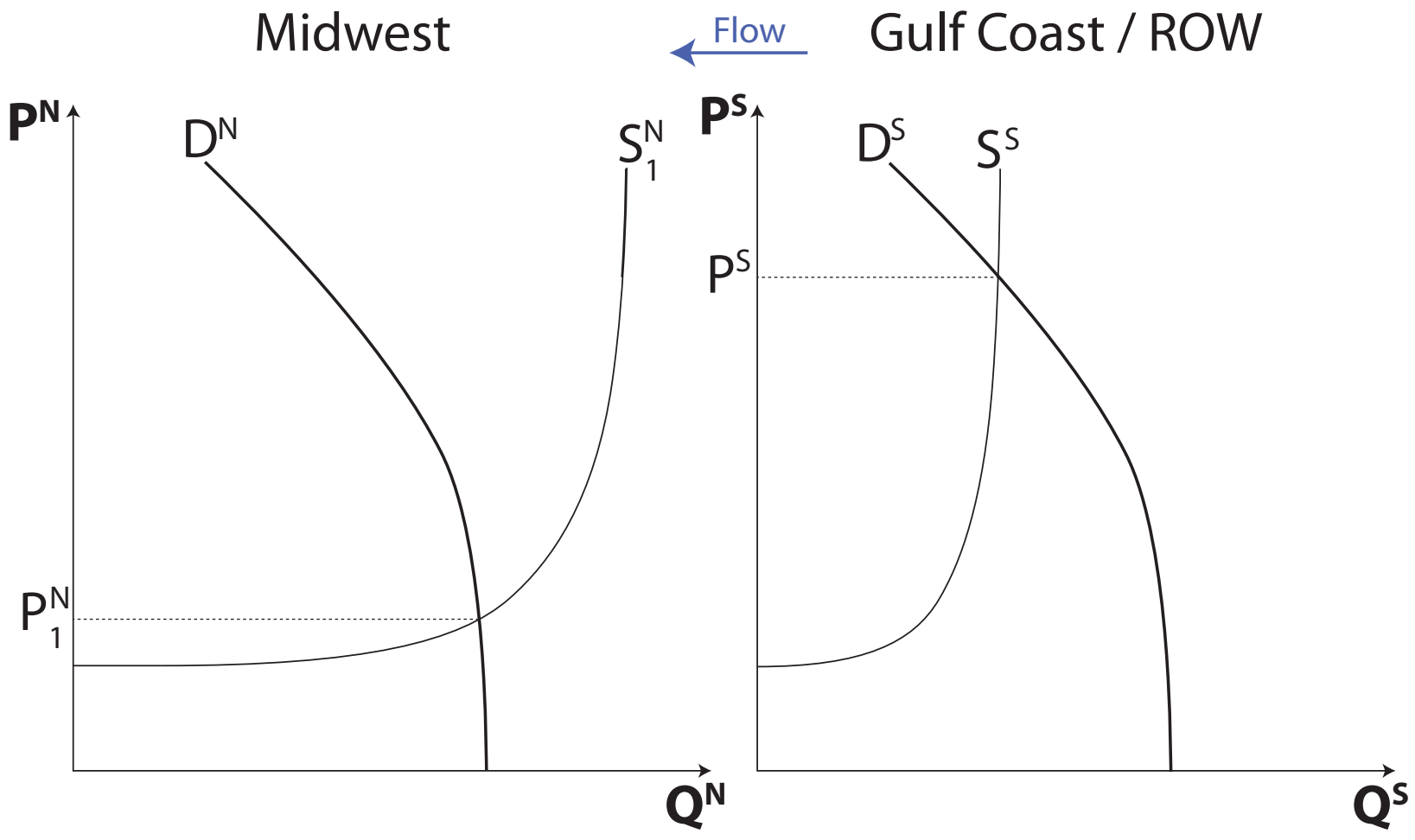
Two-region oil market model with unconstrained pipeline connecting the regions (runs S to N)



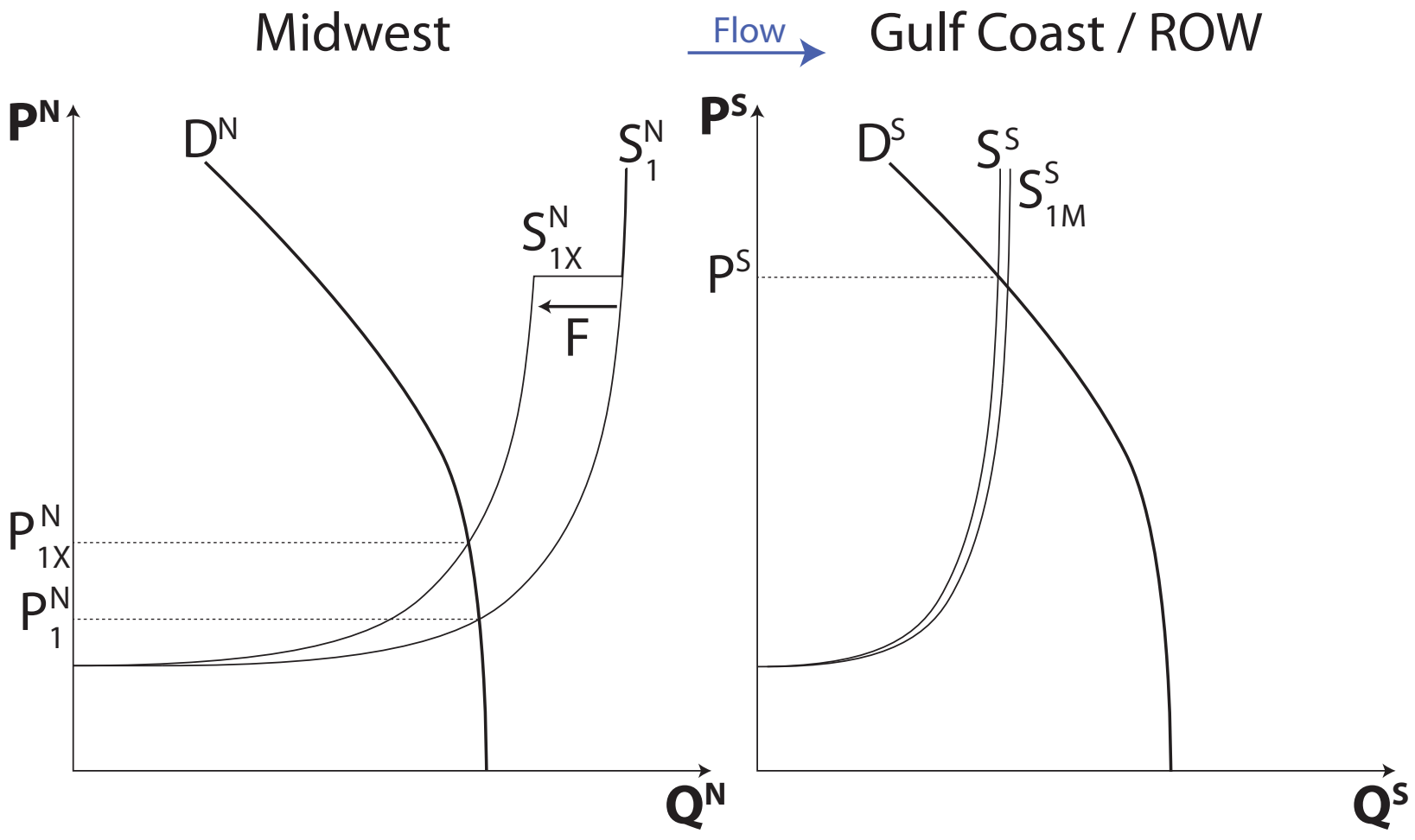
Supply shock in N region pushes down the price in that region



Existing pipeline configuration leads to autarky: no oil flows between the regions



Reversing the flow of the pipeline will increase the price in N region



When would the pipeline owner choose to reverse the pipeline?

- Owner of the pipeline can set the direction that the oil flows
- For independent pipeline owner, simple choice between revenue of 0 and revenue of RF
  - R = price per unit shipped, F = pipeline capacity
- So independent firm will always reverse the pipeline flow

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- Decision is more complicated for a pipeline owned by a northern refinery
  - Reversing flow will increase **pipeline** revenue by RF but increase **refinery** input costs by $K(P_{1X}^N - P_1^N)$
  - K is the refinery capacity

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- May be unprofitable for a vertically-integrated refinery and pipeline firm to reverse flow

Outline of the talk

Counterfactual analysis to show the role of vertical integration in delaying pipeline reversal

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- Conclusion: it was vertical integration that kept the pipeline from being reversed

Seaway pipeline profits would have increased by about $40 million per quarter if it had been reversed earlier

	Before reversal
Price per barrel	$1.10/barrel
Capacity utilization	10%
Revenue	$4.5 million
Variable costs	$1.5 million
Fixed costs	$8.0 million
Profit	-$5.0 million

All financial figures are in $ million per quarter

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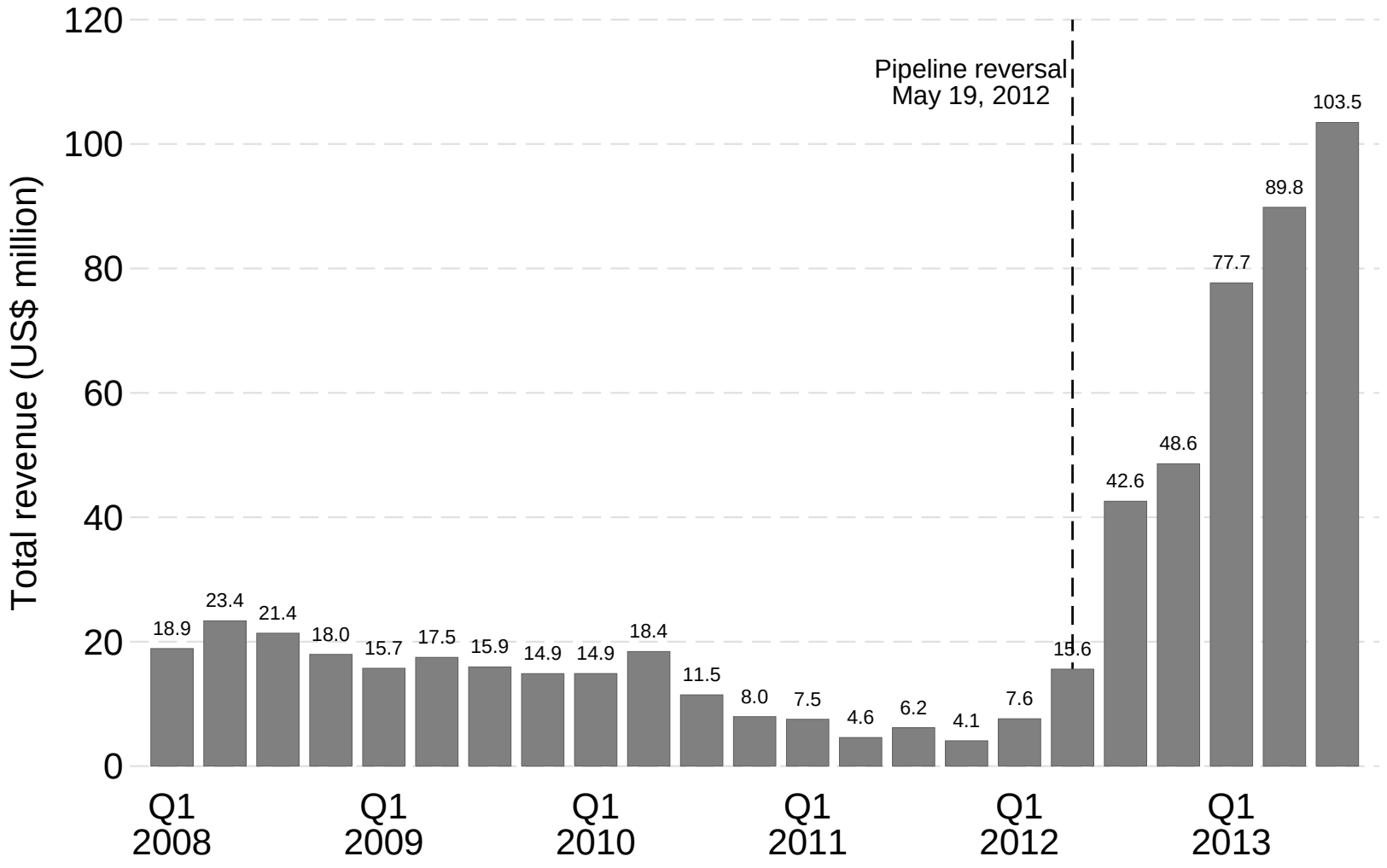
	Before reversal	After reversal
Price per barrel	$1.10/barrel	$4.00/barrel
Capacity utilization	10%	90%
Revenue	$4.5 million	$49.0 million
Variable costs	$1.5 million	$4.5 million
Fixed costs	$8.0 million	$8.0 million
Profit	-$5.0 million	$36.5 million

All financial figures are in $ million per quarter

Seaway revenue and profit jumped after the pipeline reversal, with limited capital expenditure



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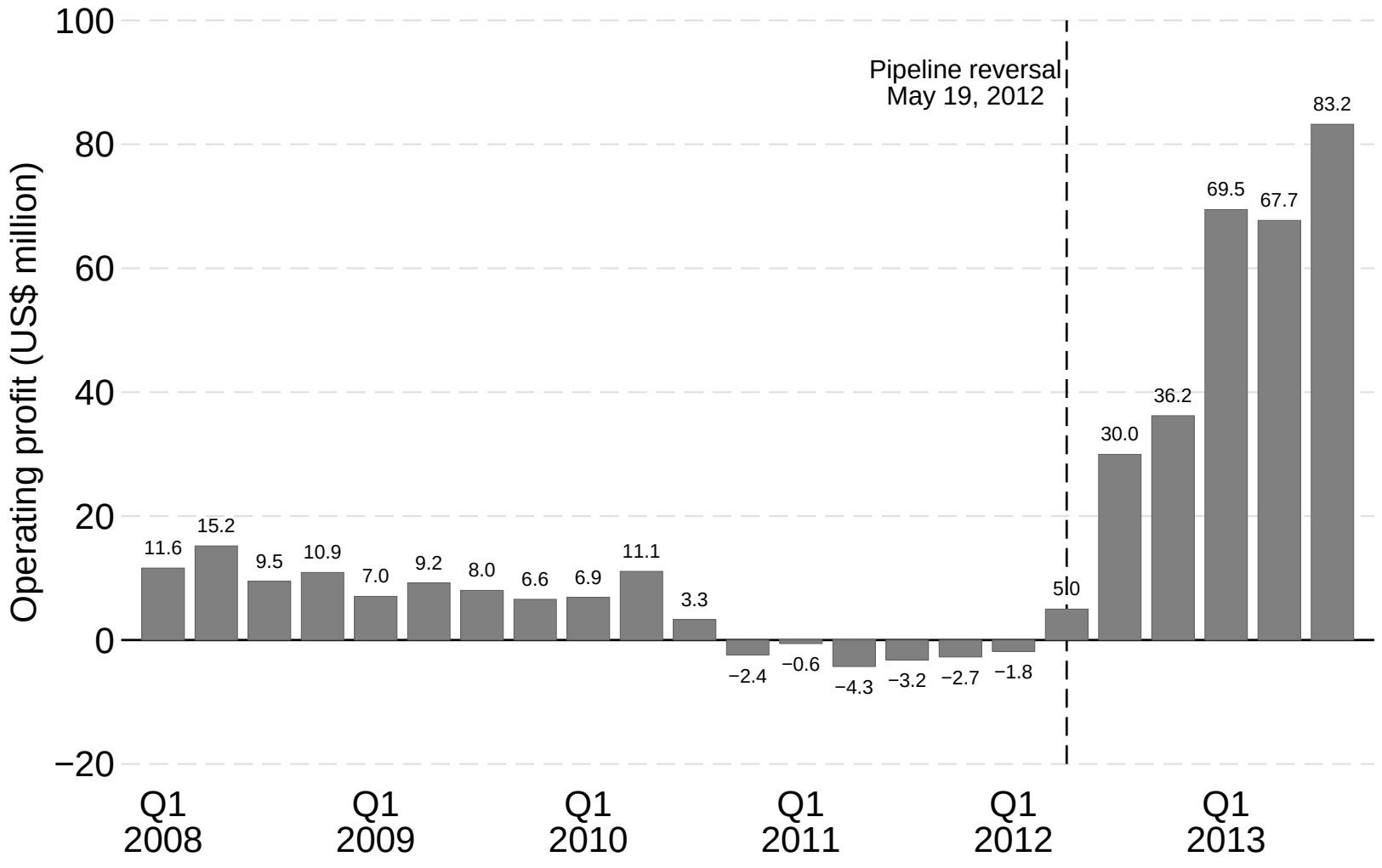

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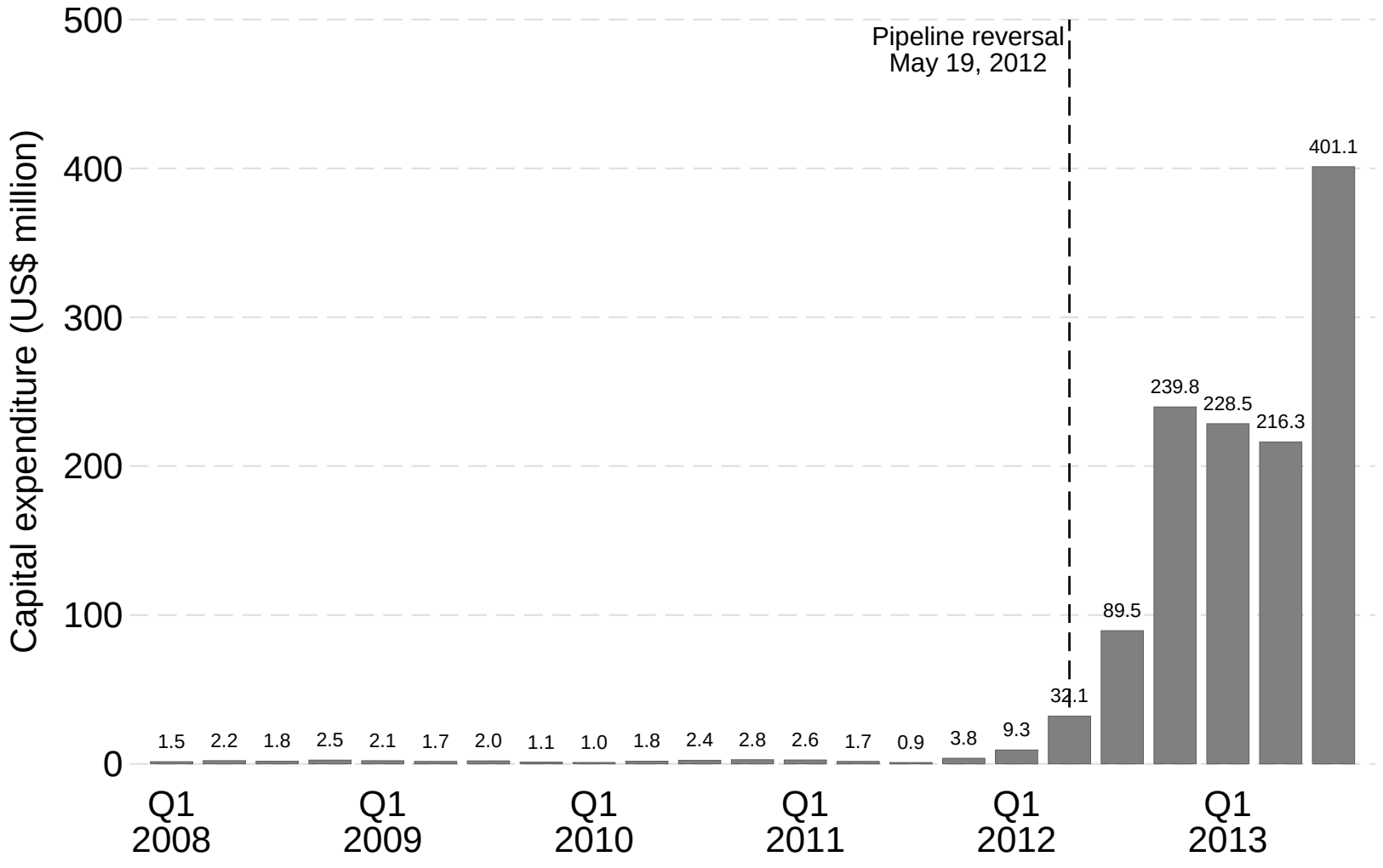
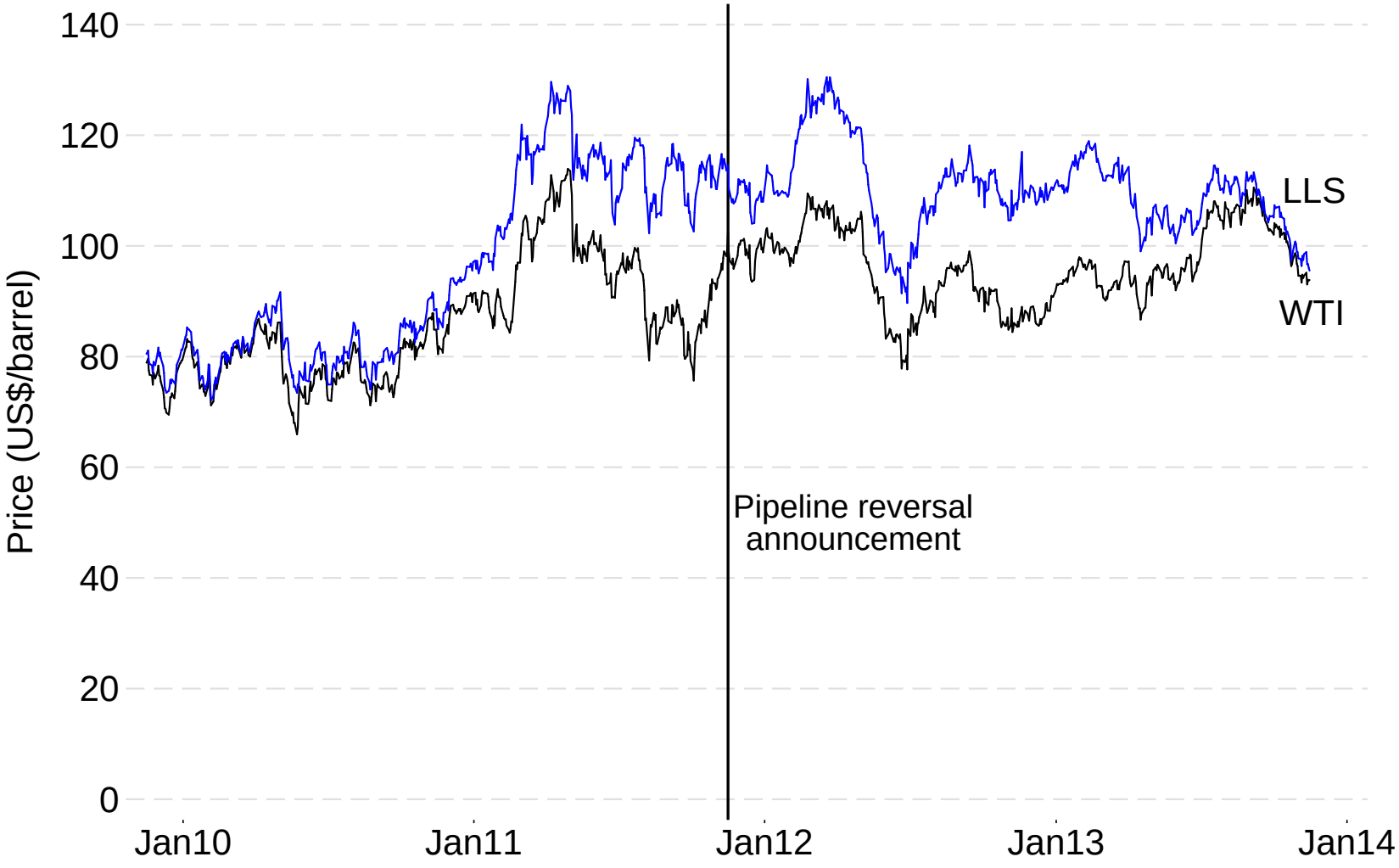


How much would the north-south price divergence have been reduced if the pipeline had been reversed earlier?

- To estimate counterfactual prices would require model of regional oil supply and demand, accounting for capacity constraints in production, transportation and refining, as well as interaction between physical, futures and storage markets
  - This would be a challenging empirical exercise
- Instead I use the observed change in price differentials around the time of the pipeline reversal announcement
  - November 16, 2011: Enbridge announced acquisition of ConocoPhillips' 50% shareholder in Seaway and its plan to reverse the flow and increase the capacity
  - E.g. JP Morgan analyst raised their forecast of WTI price by $12.50/barrel after pipeline reversal announcement

Difference between WTI and LLS was almost $30/barrel before pipeline reversal announcement



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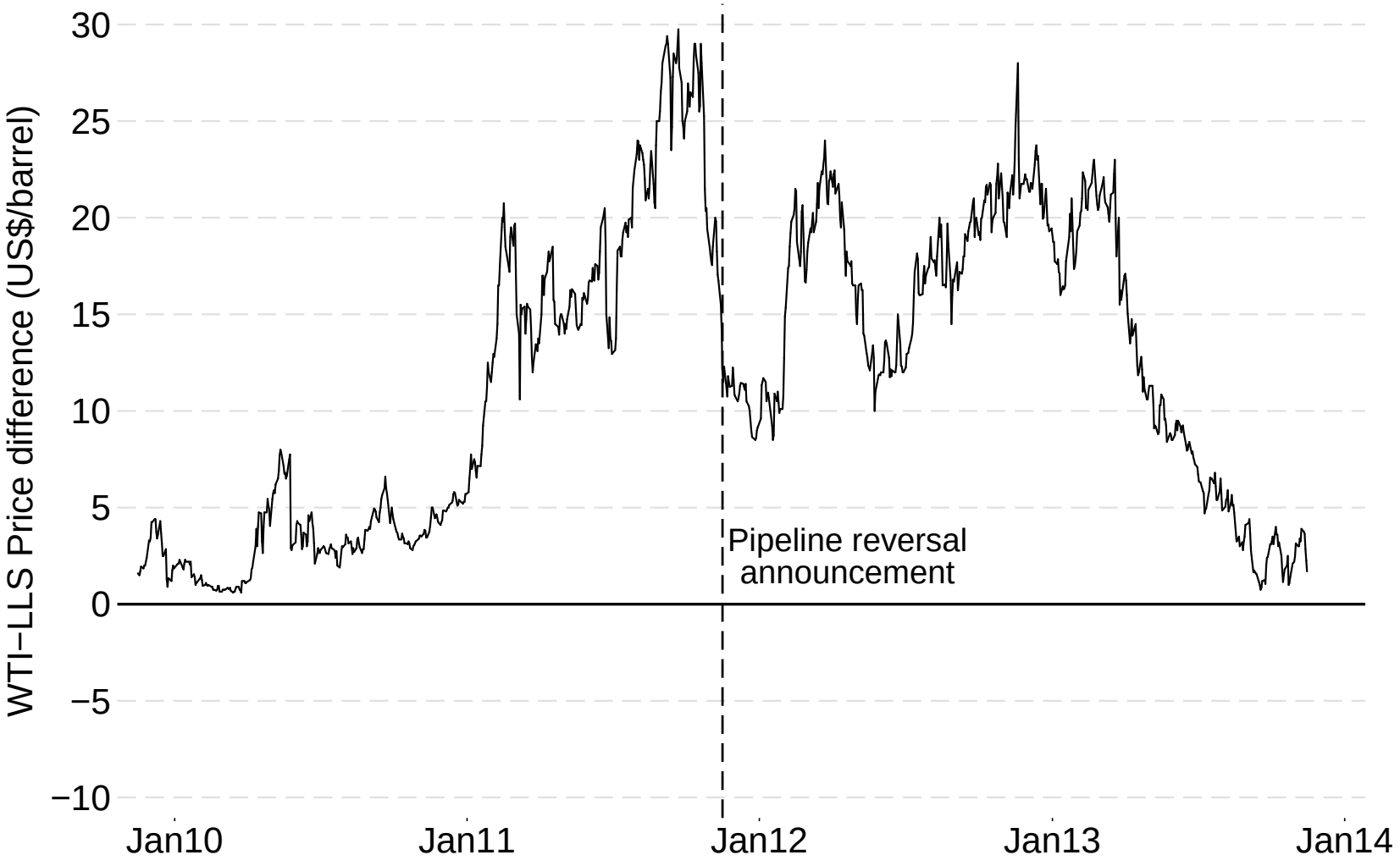


I quantify the change due to the pipeline announcement in an event study framework

- Change in WTI price on day t is:

$$\Delta P_t^N = \alpha + \beta \Delta P_t^S + \gamma Event_t + \varepsilon_t$$

- P_t^S is the LLS price
- $Event_t$ is equal to $1/N$ for an N-day event windows around the announcement date, and 0 otherwise
- γ is the cumulative increase in WTI price at time of announcement, after controlling for changes in LLS price

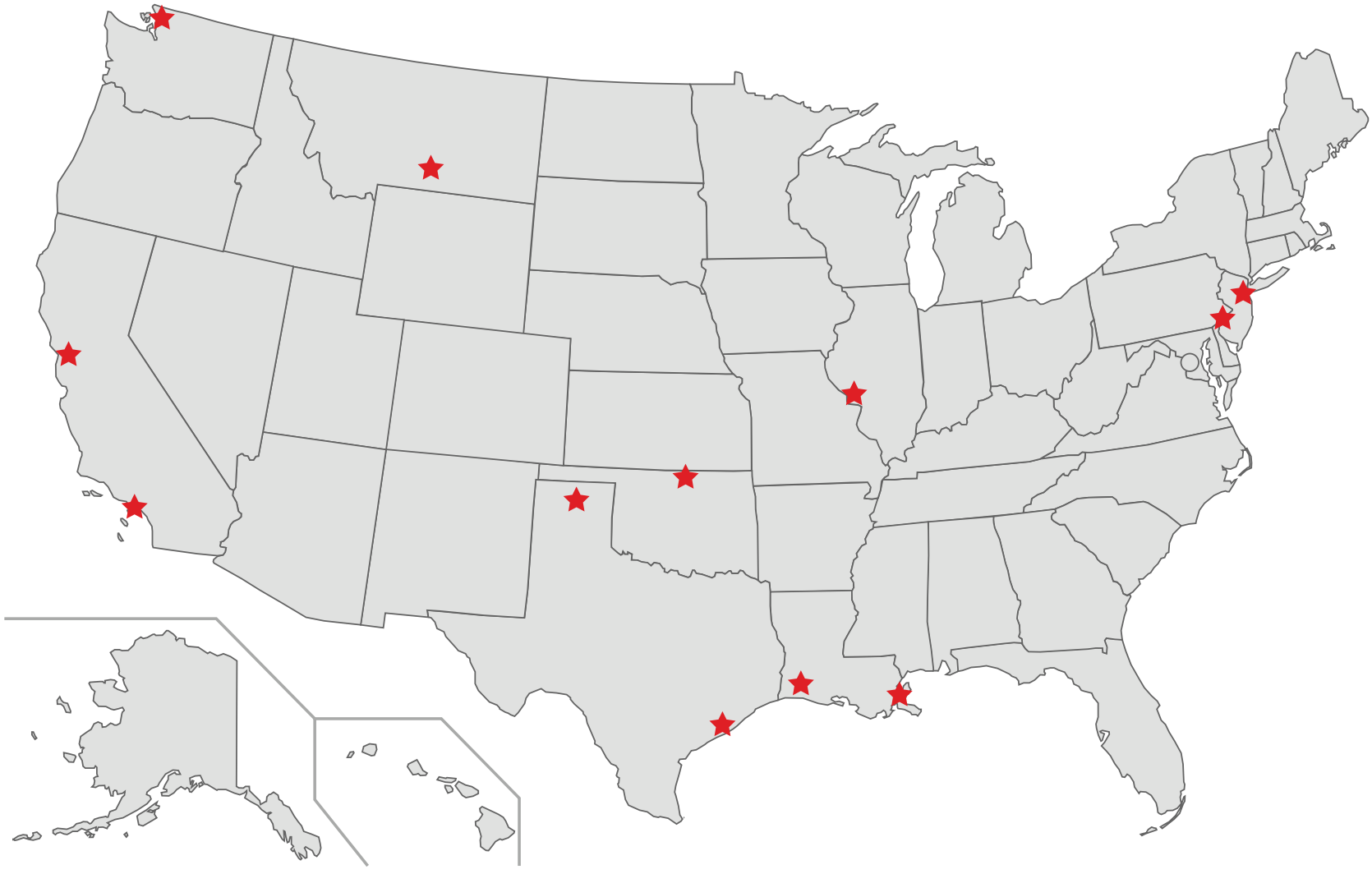
After controlling for changes in LLS price, WTI price increased by up to $7.52/barrel

	3 day window	11 day window	21 day window
Announcement event	3.323*	6.218*	7.520*
	(1.398)	(2.690)	(3.733)
Δ LLS Price	0.795*	0.795*	0.793*
	(0.015)	(0.015)	(0.015)
Δ Brent Price			
Observations	1005	1005	1005
Adjusted R^2	0.731	0.731	0.731

Effect of pipeline announcement is even larger with the inclusion of the Brent price

	3 day window	11 day window	21 day window
Announcement event	3.850*	6.613*	7.706*
	(1.330)	(2.559)	(3.553)
Δ LLS Price	0.567*	0.569*	0.568*
	(0.026)	(0.026)	(0.026)
Δ Brent Price	0.293*	0.291*	0.290*
	(0.027)	(0.027)	(0.027)
Observations	968	968	968
Adjusted R^2	0.759	0.759	0.758

Only 21% of ConocoPhillips' refining capacity was located in the Midwest



How did the change in the WTI price affect the refinery input costs for ConocoPhillips?

- WTI price acts as a benchmark for many transactions in the world oil market
- Producers sell products with forward contracts in which the price paid is linked to the WTI price at delivery
- Lower WTI price could reduce the input costs for all refineries where input price is linked to WTI benchmark
- Eventually producers would switch to alternative benchmarks (or at least change WTI price differential)

How did the change in the WTI price affect the refinery input costs for ConocoPhillips?

- Not possible to answer this exactly from publicly available data
- Instead, I estimate the passthrough of WTI to average input costs for all refineries in each region:

$$\Delta P_t = \alpha + \beta_1 \Delta P_t^{WTI} + \beta_2 \Delta P_t^{LLS} + \varepsilon_t \tag{1}$$

- P_t is the monthly average crude oil acquisition cost for refineries, separately for domestic and imported purchases

About 43% of change in WTI price was passed on to imported price for Gulf Coast refineries

	Δ PADD 1 import price	Δ PADD 2 import price	Δ PADD 3 import price
Δ WTI Price	0.030	1.086*	0.428*
	(0.131)	(0.115)	(0.075)
Δ LLS Price	0.828*	-0.232*	0.467*
	(0.130)	(0.100)	(0.093)
Constant	0.127	-0.091	0.053
	(0.123)	(0.205)	(0.126)
Observations	119	119	119

Even greater passthrough of WTI to refinery inputs of domestic oil

	Δ PADD 2 dom. price	Δ PADD 3 dom. price
Δ WTI Price	0.820*	0.767*
	(0.075)	(0.138)
Δ LLS Price	0.031	0.045
	(0.056)	(0.106)
Constant	0.065	0.110
	(0.143)	(0.196)
Observations	119	119

Are the lower input costs passed on in lower output prices?

- Lower input costs for refineries in Midwest would not necessarily increase profits if these were passed on to consumers through lower product prices
- Borenstein and Kellogg (2014) showed that the price differential had no effect on output prices:

Table 1: OLS Regressions of PADD 2 to PADD 3 Refined Product Price Differentials on PADD 2 to PADD 3 Crude Oil Price Differentials

	I	II	III	IV
	Gasoline price differences		Diesel price differences	
Coefficient on covariate:	PADD 2 minus PADD 3	Oklahoma minus Louisiana	PADD 2 minus PADD 3	Oklahoma minus Louisiana
WTI crude price minus LLS crude price	−0.003	−0.047	0.027	0.048
	(0.026)	(0.041)	(0.026)	(0.057)
Constant	0.043	0.012	0.063	0.069
	(0.010)	(0.017)	(0.011)	(0.026)
R^2	0.0001	0.012	0.009	0.011
N	72	72	72	72

Profits of integrated firm would have been up to $1.7 billion lower if pipeline had been reversed earlier

	Low Case	High Case
Δ pipeline profit	$0.2	$0.2
Refining inputs (PADD 2)	382 mbd	382 mbd
Δ input price	-$3.32	-$7.52
Δ refining profit	-$1.3	-$2.9
Refining inputs (PADD 3)		
WTI passthrough		
Δ refining profit		
Combined profit	-$1.1	-$2.7

All financial figures are in $ million per day

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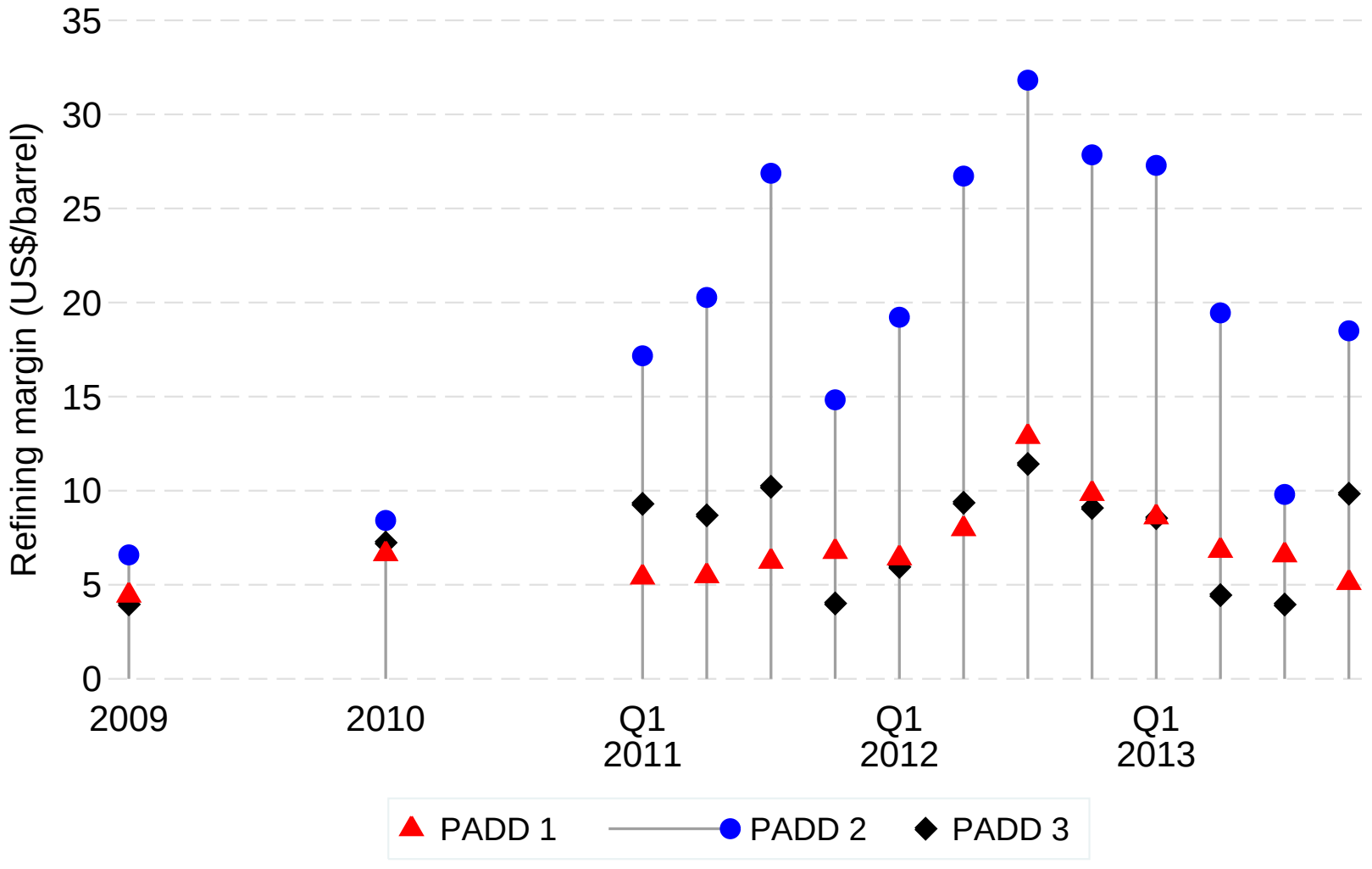
Refining inputs (PADD 2)	382 mbd	382 mbd
Δ input price	-$3.32	-$7.52
Δ refining profit	-$1.3	-$2.9
Refining inputs (PADD 3)	660 mbd	660 mbd
WTI passthrough	43%	43%
Δ refining profit	-$0.9	-$2.1
Combined profit	-$2.0	-$4.8

All financial figures are in $ million per day

ConocoPhillips U.S. refining profits increased from $900 million in 2010 to $2.4 billion in 2011



Counterfactual analysis to show the role of vertical integration in delaying pipeline reversal

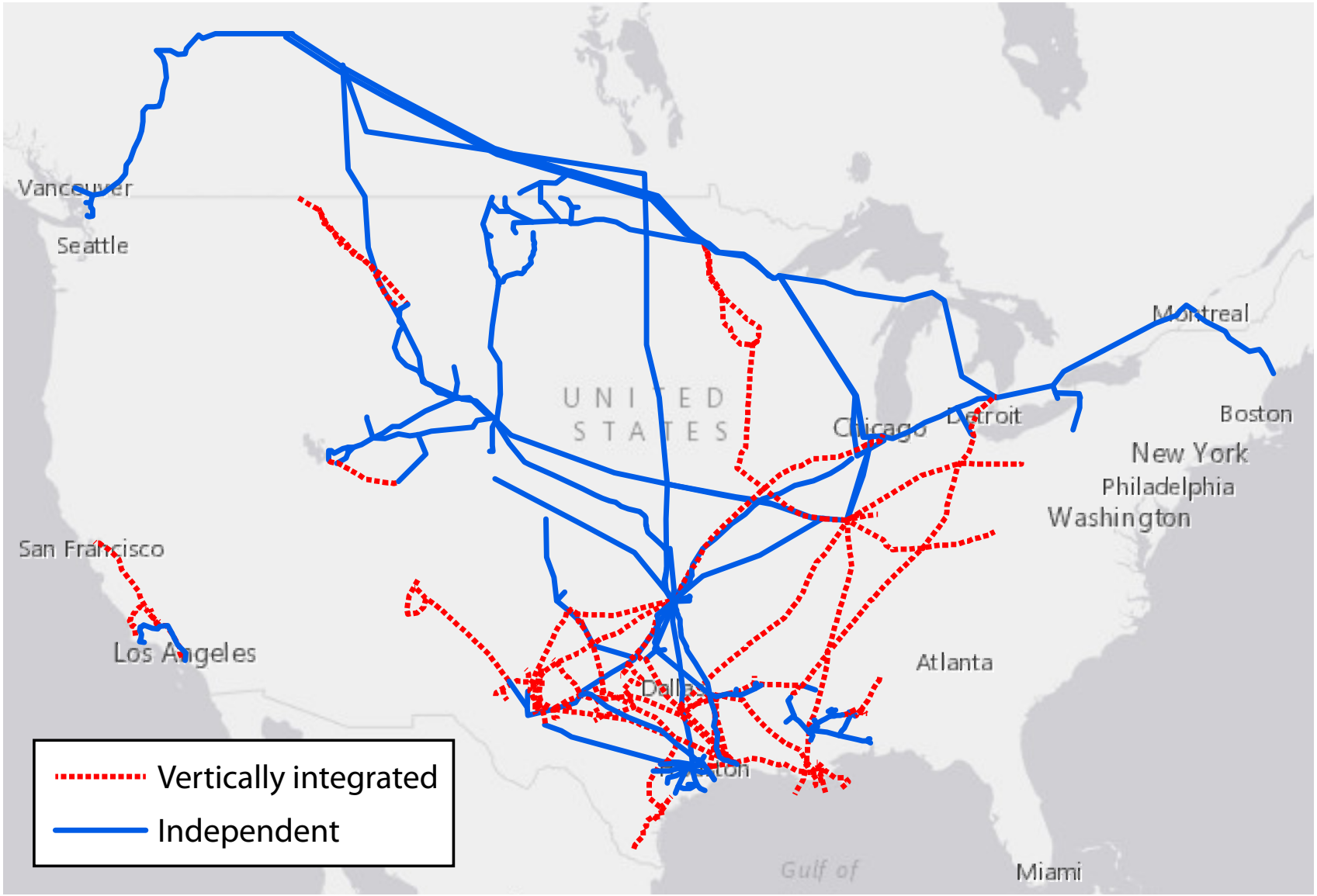
- In reality, Seaway pipeline was essentially unused throughout 2011
- What would have been the incremental change in profit for an independent pipeline owner, from reversing the pipeline in 2011?
  - Profits would have been higher (by about $0.2 million/day)
- What would have been the incremental change in profit for vertically integrated ConocoPhillips, from reversing the pipeline in 2011?
  - Profits would have been lower (by up to $5.0 million/day)
- Conclusion: it was vertical integration that kept the pipeline from being reversed

Outline of the talk

What were the welfare effects of the delay in pipeline reversal?

- Not reversing the pipeline earlier led to a large transfer from oil producers (both domestic and foreign) to oil refiners
- Little direct effect on end consumers of refined products
- Welfare losses due to the inefficient use of the pipeline:
  - Domestic production of oil was lower than it would have been if producers were receiving world oil price
  - More expensive forms of transportation (particularly rail) were used to transport oil while the pipeline was unused
  - Alternative pipeline plans were developed and latter scrapped

Many vertically integrated pipelines suggest this is not an isolated example



Inefficient utilization of Capline pipeline has lasted for even longer than Seaway

- Capline pipeline runs from Louisiana to Illinois: capacity of 1.2 million barrels/day
- Current configuration is south to north
- Capacity utilization is very low (about 10-15%)
- Joint owners of the pipeline: Marathon, BP and Plains Pipeline
- Marathon said in 2012 (and 2013, and 2014) that reversing the pipeline is "under review"

Two potential policy directions for improving efficiency in oil transportation sector

- Barring vertical integration between pipelines and upstream or downstream operations
  - To what extent are there operating synergies from joint ownership?
  - Probably smaller than previously argued given the increasing number of independent pipeline operators
- Encouraging greater use of market-based pricing for pipelines
  - Considerable uncertainty surrounds the reversal process: firms do not know what rates will be approved for the reversed pipeline
  - It took reversed Seaway pipeline more than two years to finalize new rates
  - Seaway pipeline rates are still lower than the price difference between the two regions
  - Would ConocoPhillips have reversed the pipeline earlier if it knew it could have charged higher rates?

"Common carrier" requirement for oil pipelines means little when capacity is constrained

- Total applications to use the reversed Seaway pipeline greatly exceeded the pipeline's capacity
  - Applicants wanted to ship 70 million barrels/day through the pipeline
- Why? Pipeline rate capped at $4/barrel, price differential exceeded $20/barrel
- FERC allowed Seaway to reserve 90% of capacity for existing shippers and run a lottery for the remaining 10%
- Inefficient way to allocate pipeline capacity compared to the active market for natural gas pipeline capacity

Conclusion

- Technological revolution in the oil sector in the U.S.
- But fully developing the potential of the industry requires considerable investment in transportation infrastructure—for which the current regulatory environment creates considerable barriers
- This paper showed how vertical integration between a refiner and a pipeline led to inefficient use of a major pipeline for over a year
- This is not an isolated example—vertical integration between producers, refiners and pipelines is common
- Natural gas pipelines provide better example for regulation in this sector