Crude Oil Price Differentials and Pipeline Investment

Shaun McRae

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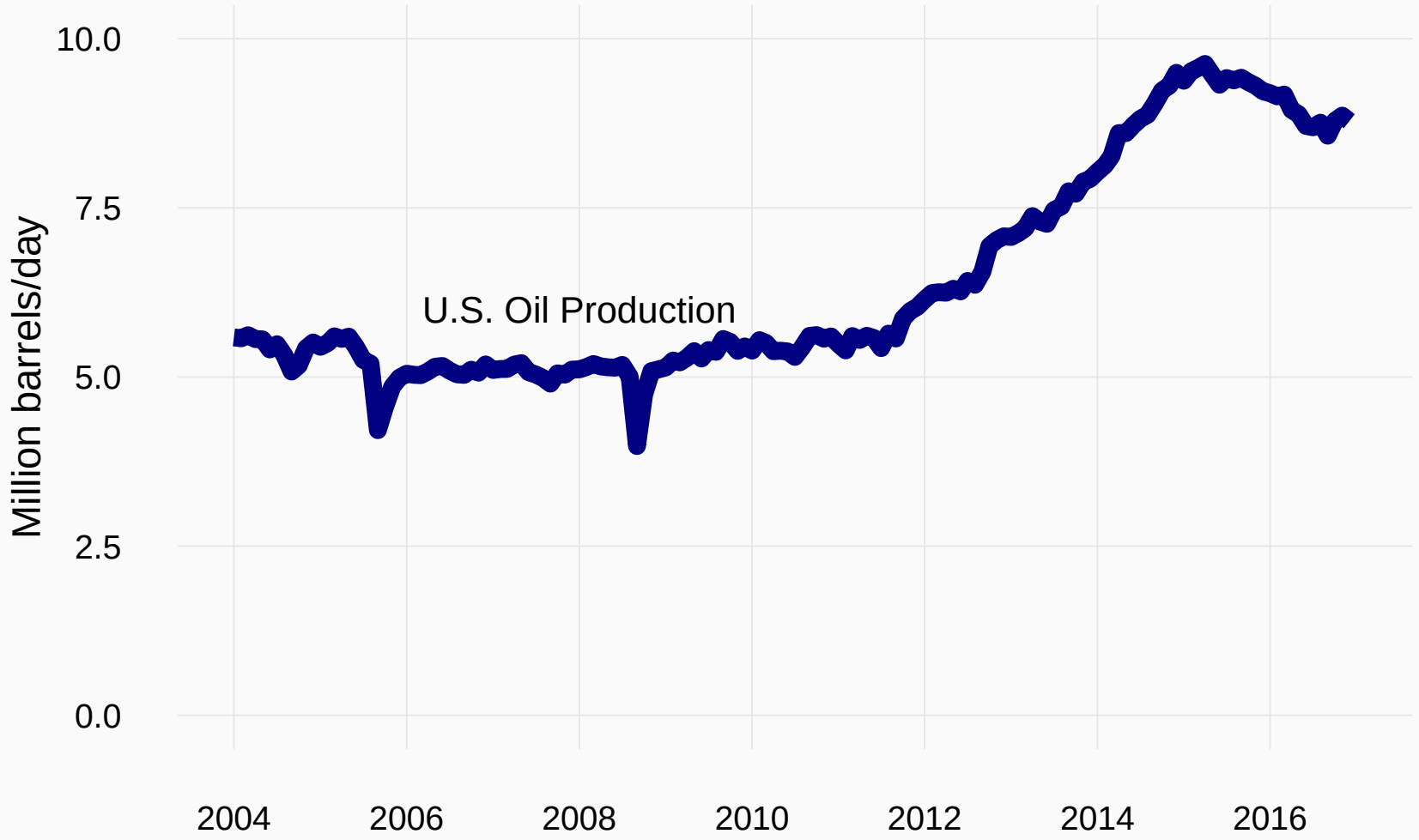
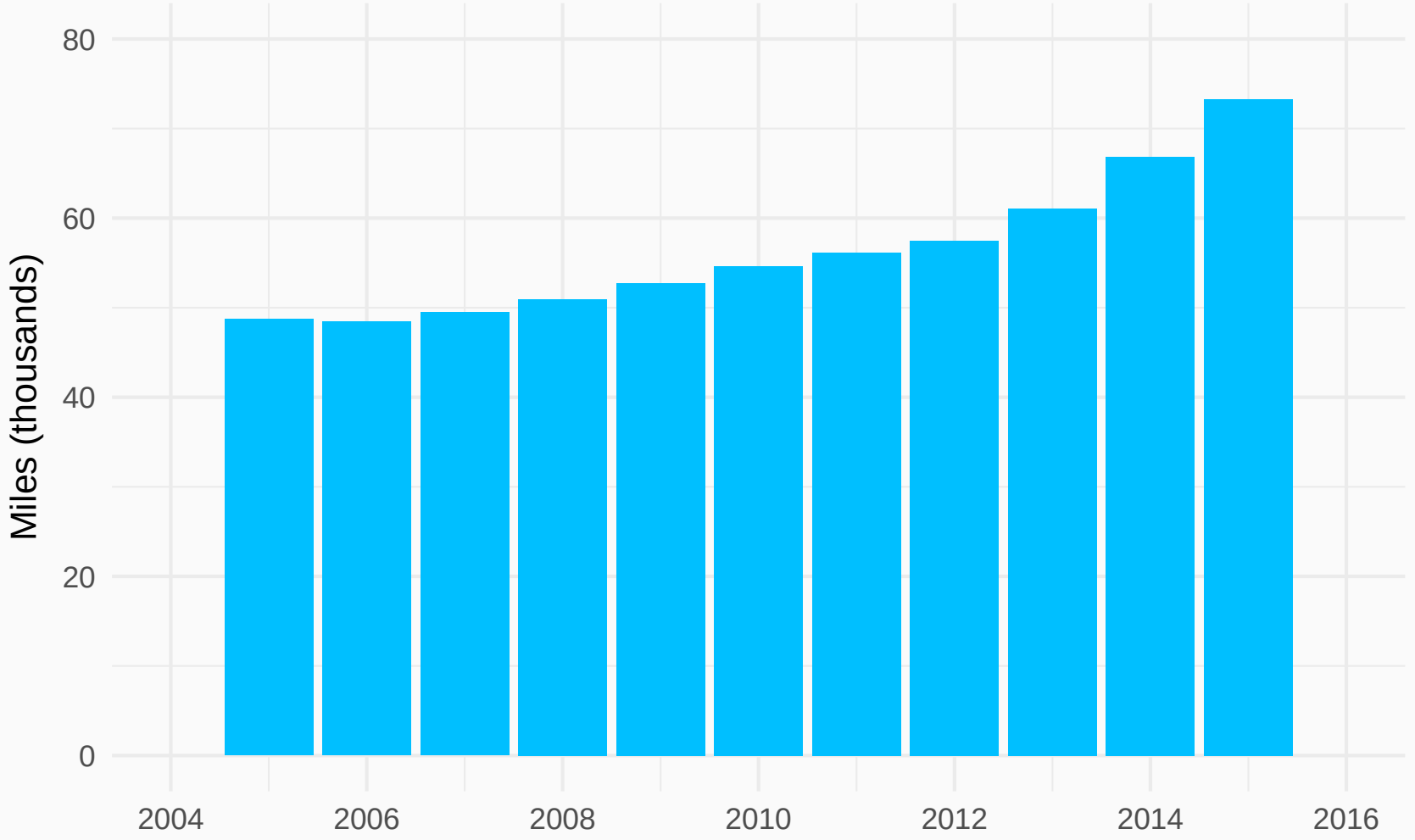
ITAM

Rapid growth in production since 2011 has reshaped geography of oil markets in the US



Source: EIA crude oil production

Total length of US crude oil pipelines increased by 37% between 2010 and 2016



Source: PHMSA Annual Hazardous Liquids data

Economic costs and benefits of major oil pipeline projects are ignored or misstated in media reports

By IRINA IVANOVA / MONEYWATCH / January 24, 2017, 5:18 PM

Who benefits from revived Keystone XL and Dakota Access pipelines?

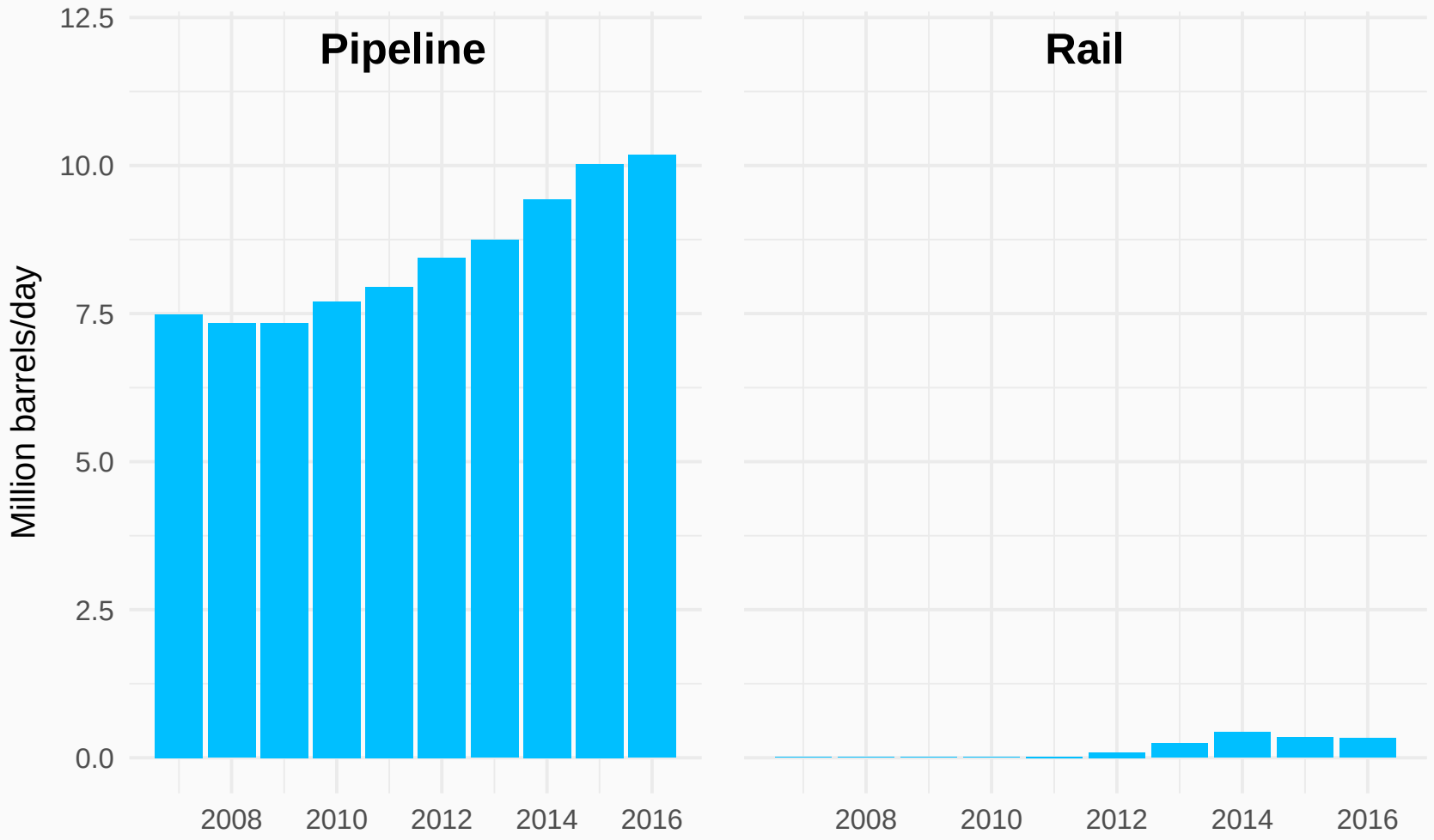
President Donald Trump announced Tuesday that construction would move forward on the Keystone XL and Dakota Access pipelines, both of which had

http://www.cbsnews.com/news/who-benefits-from-the-keystone-xl-pipeline-and-dakota-access-pipeline-pros-cons/

This paper studies the economic effects of additions to pipeline capacity

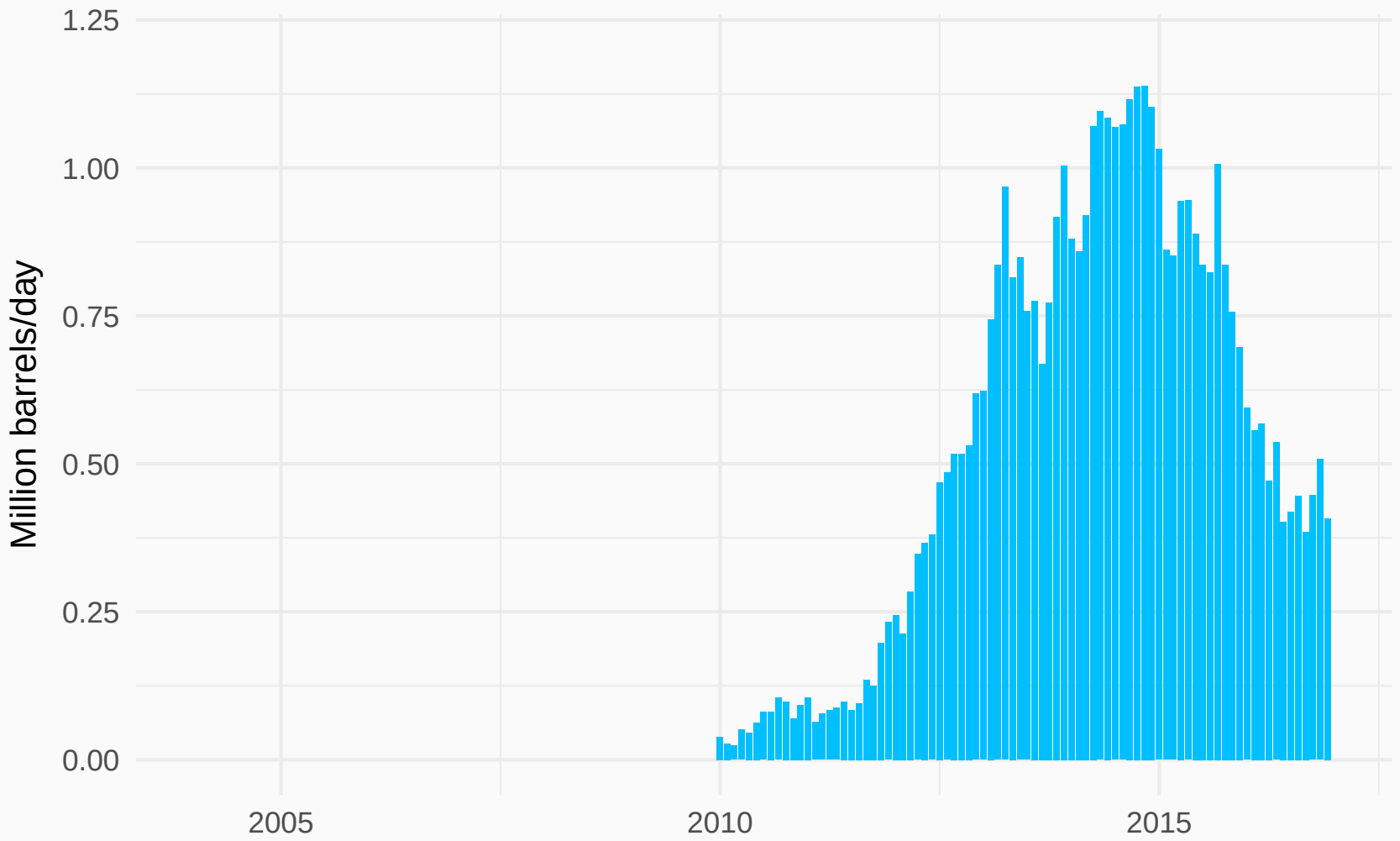
- Additional pipelines displace shipment by more expensive alternatives (such as rail or trucks)
- Greater use of cheaper pipelines reduces the price dispersion across regions and the price discount to world prices
    - Refiners pay more for their inputs
    - Oil producers receive more for their output
- Possible environmental effects from displacement of rail—not considered here

Oil deliveries by pipeline to refineries increased by a third since 2009, matching increase in overall pipeline length



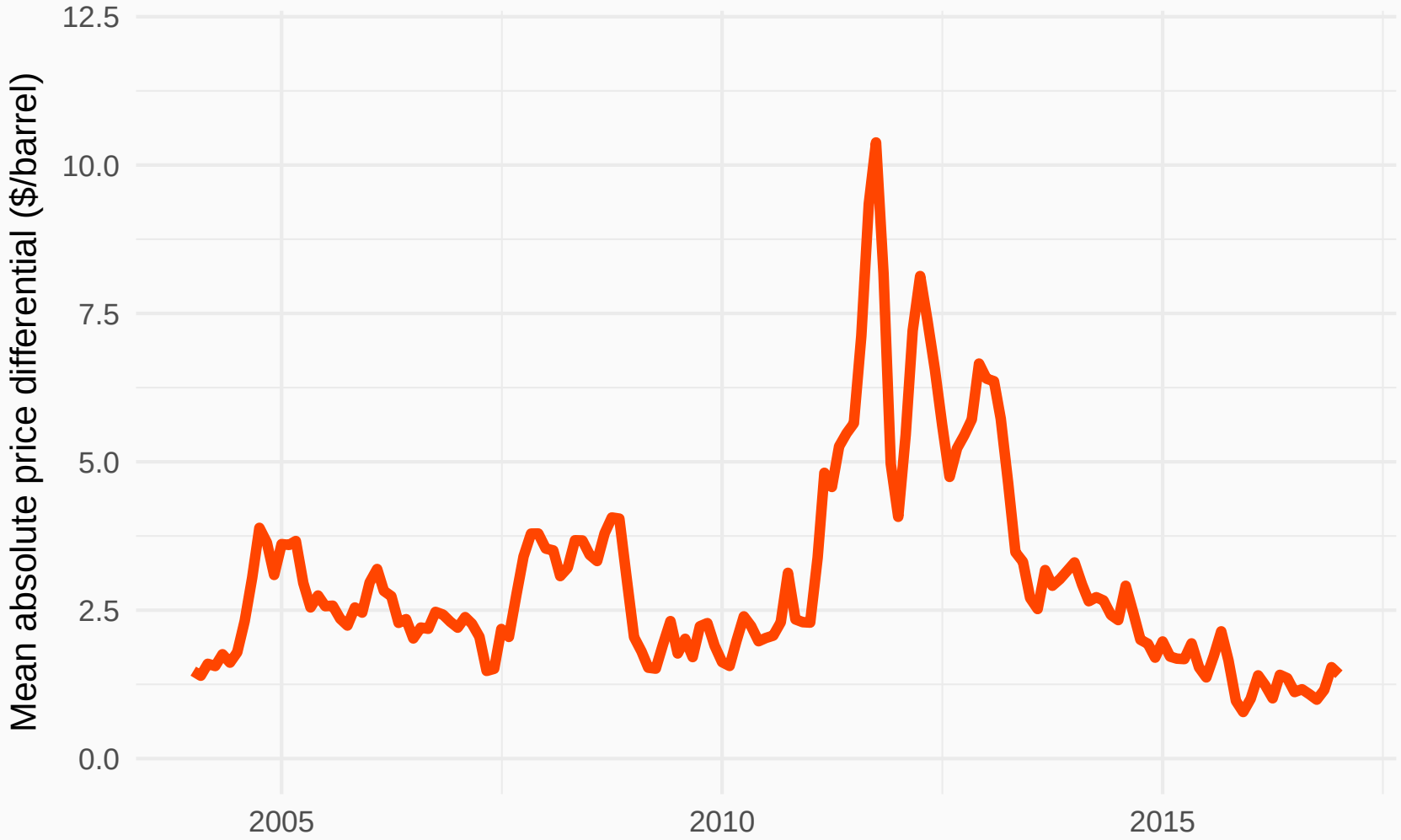
Source: EIA refinery receipts of crude oil by pipeline and rail

Monthly oil shipments by rail in 2016 less than half their level during 2015



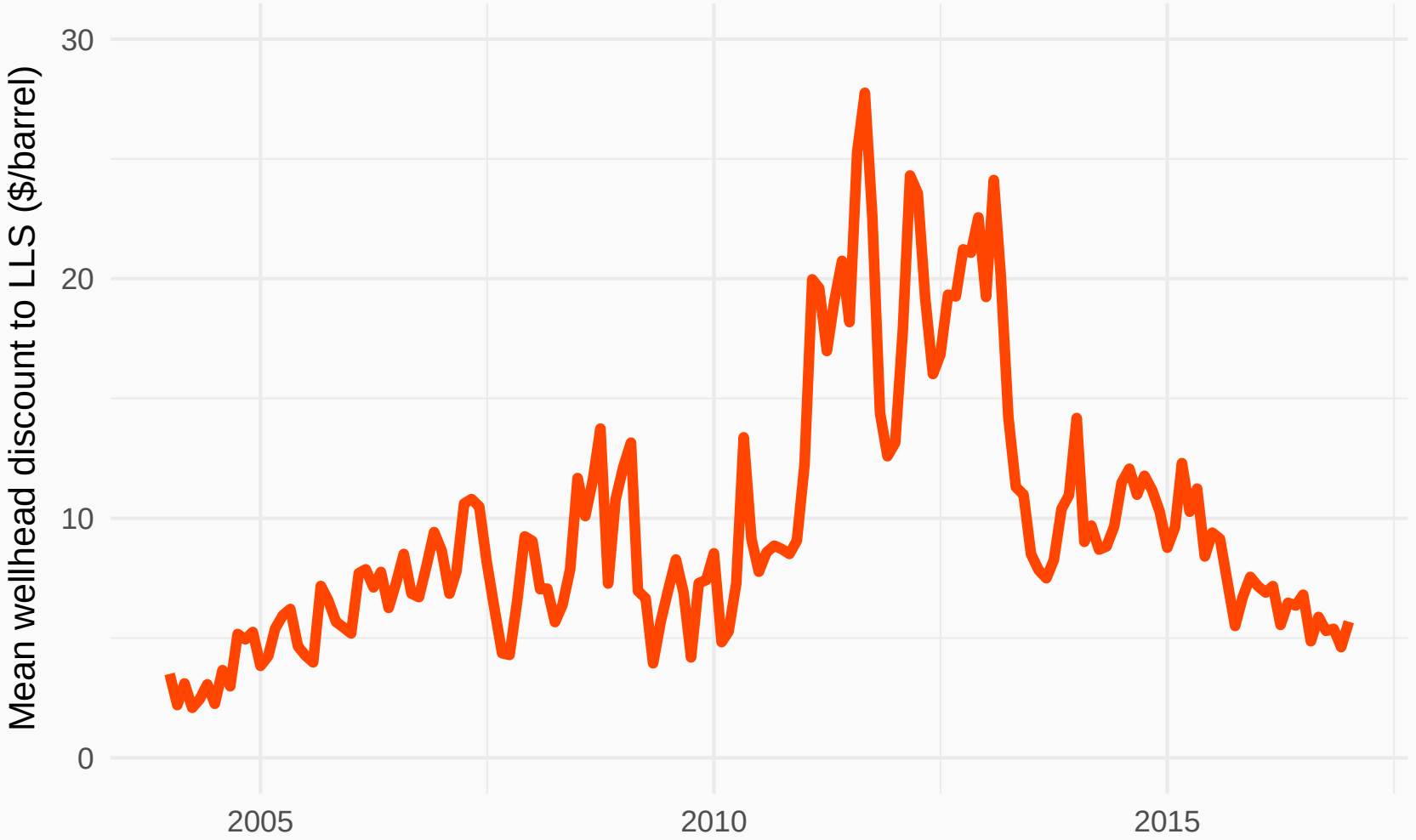
Source: EIA movements of crude oil by rail

Large decline in the mean absolute deviation in US wellhead prices since its peak in 2011 and 2012



Source: EIA state-level crude oil first purchase prices

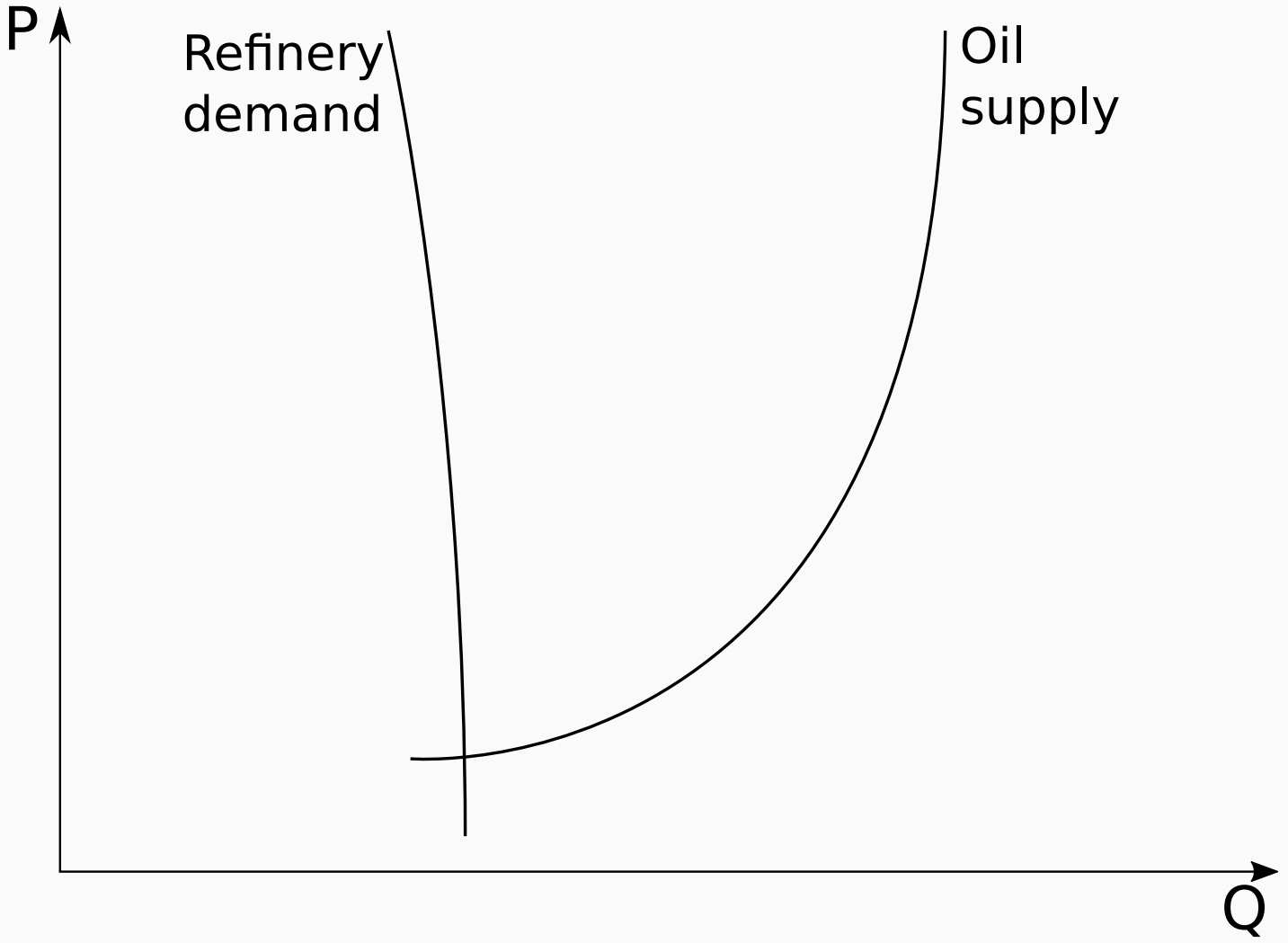
Similar decline in the mean discount of US wellhead prices from benchmark price (LLS)



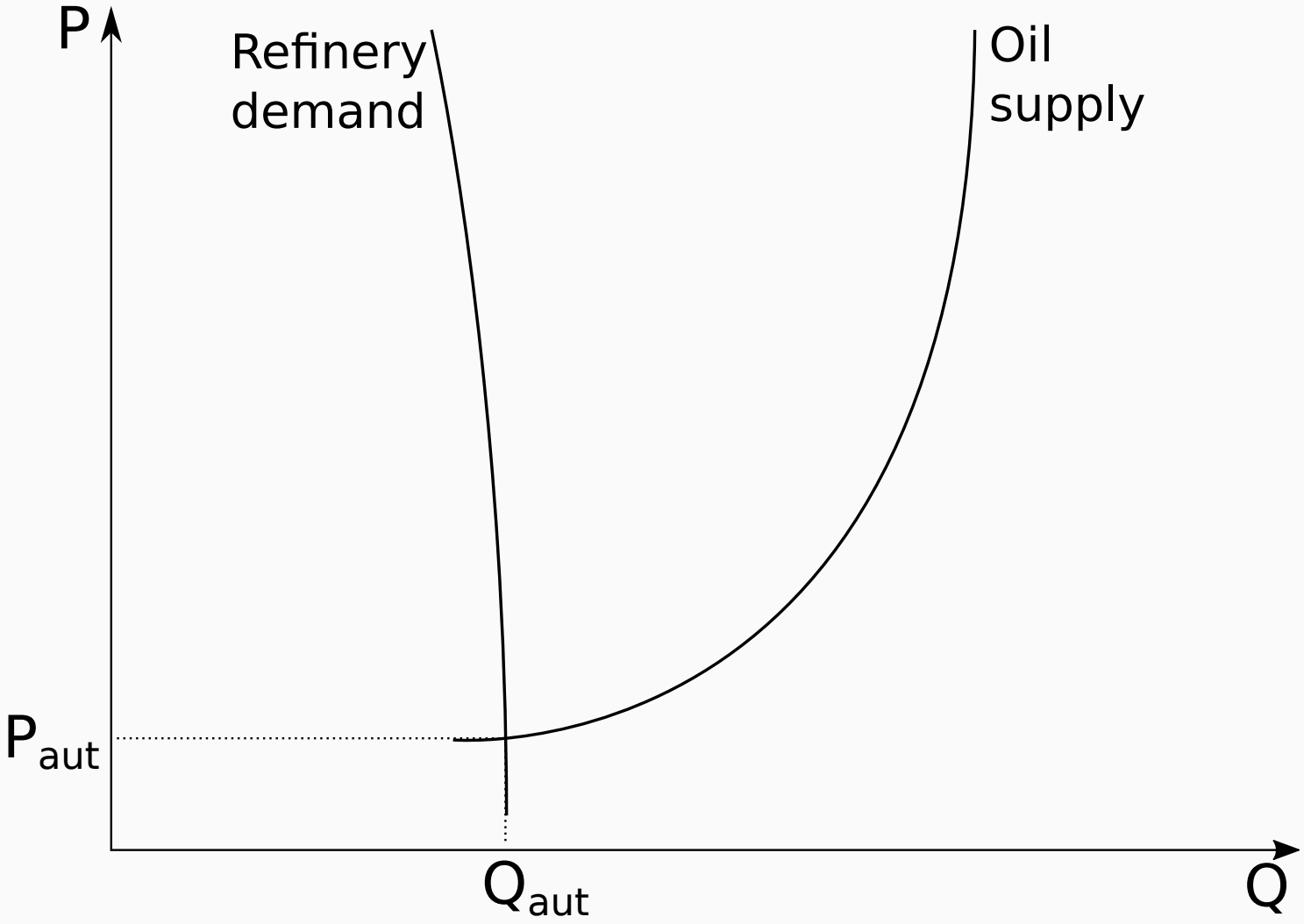
Source: EIA state-level crude oil first purchase prices; Bloomberg

Stylized economic framework

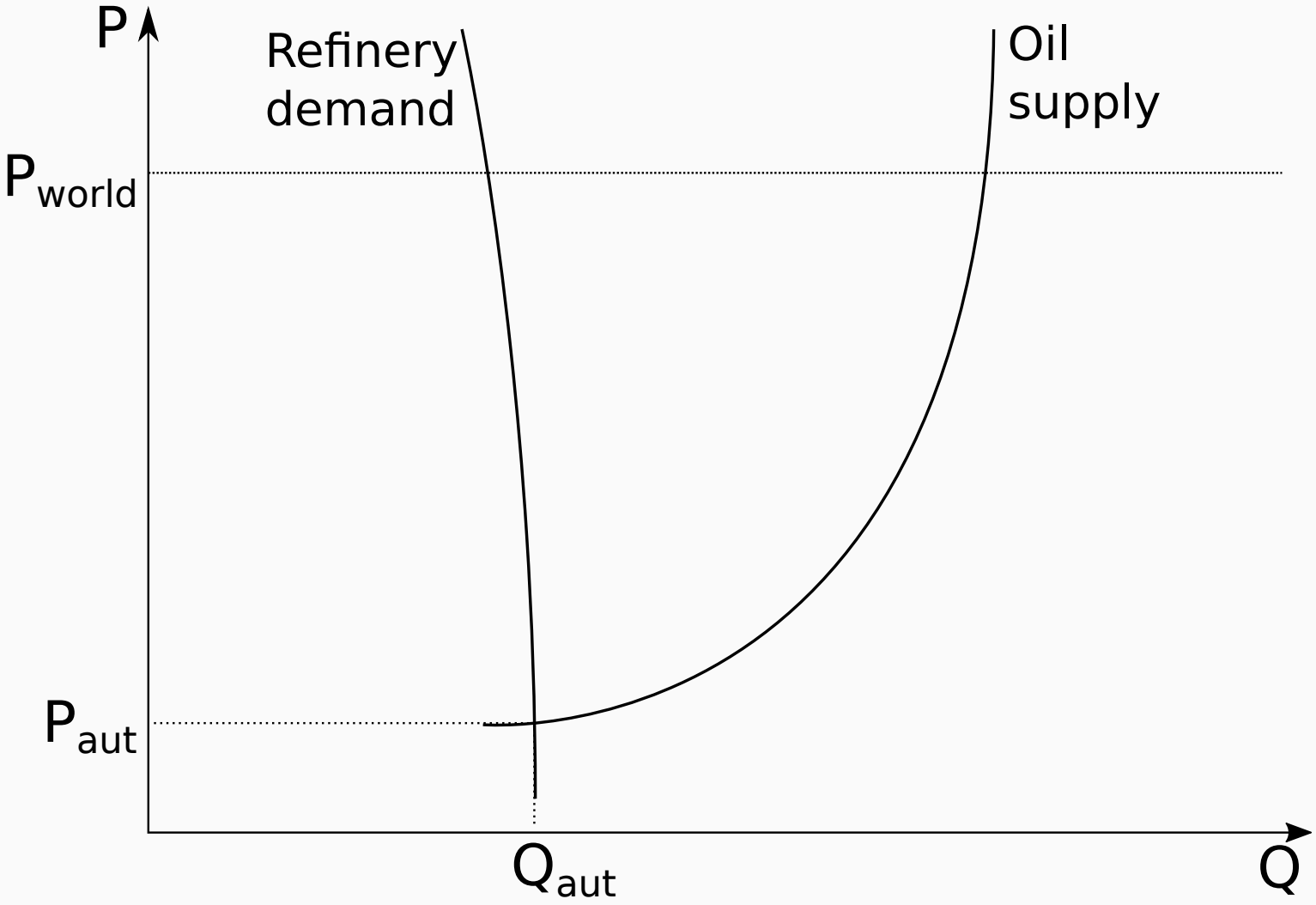
Suppose we have an isolated region with oil production and inelastic oil demand from local refineries



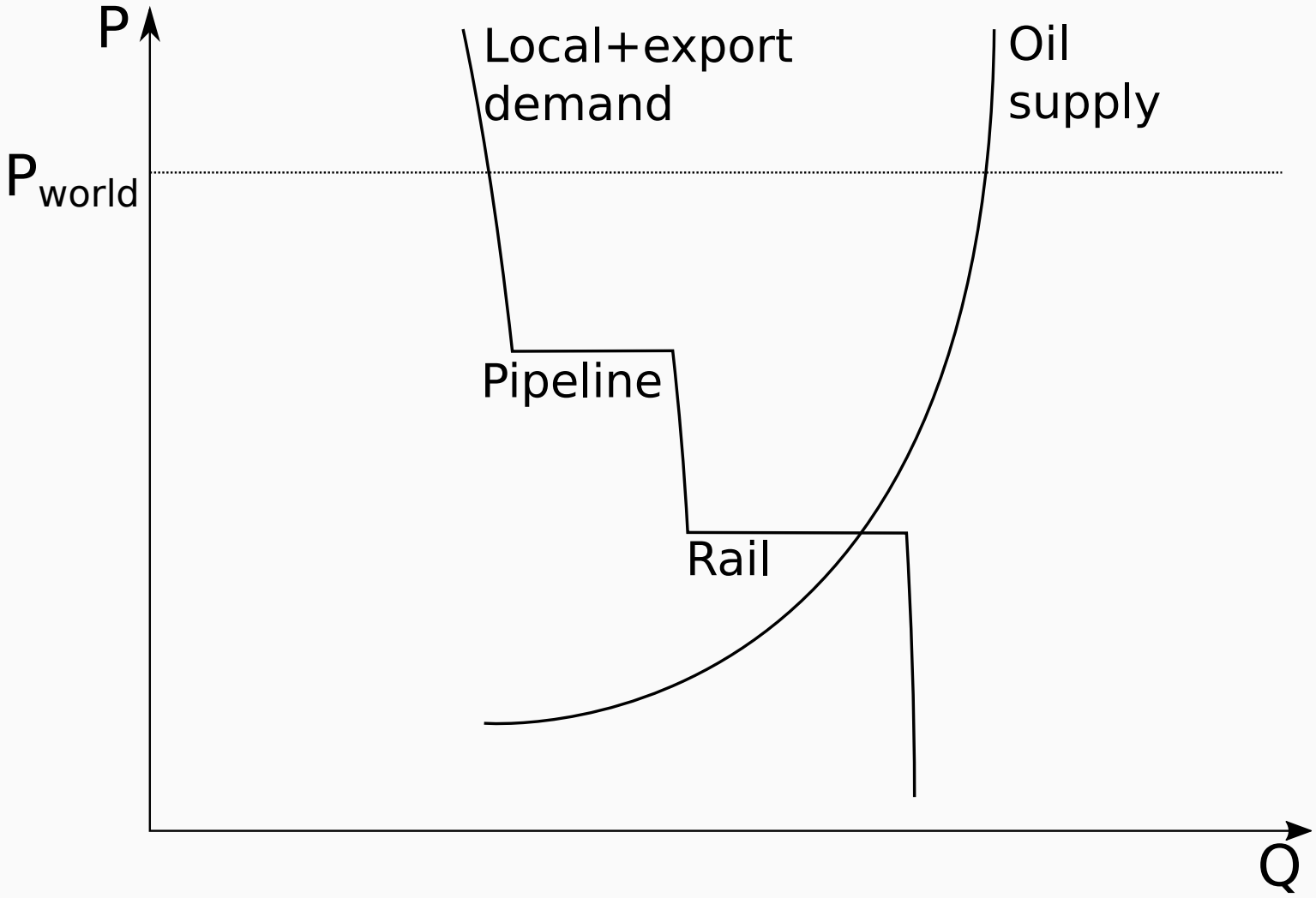
Without any trade (“autarky”) the price of oil in this region will be very low



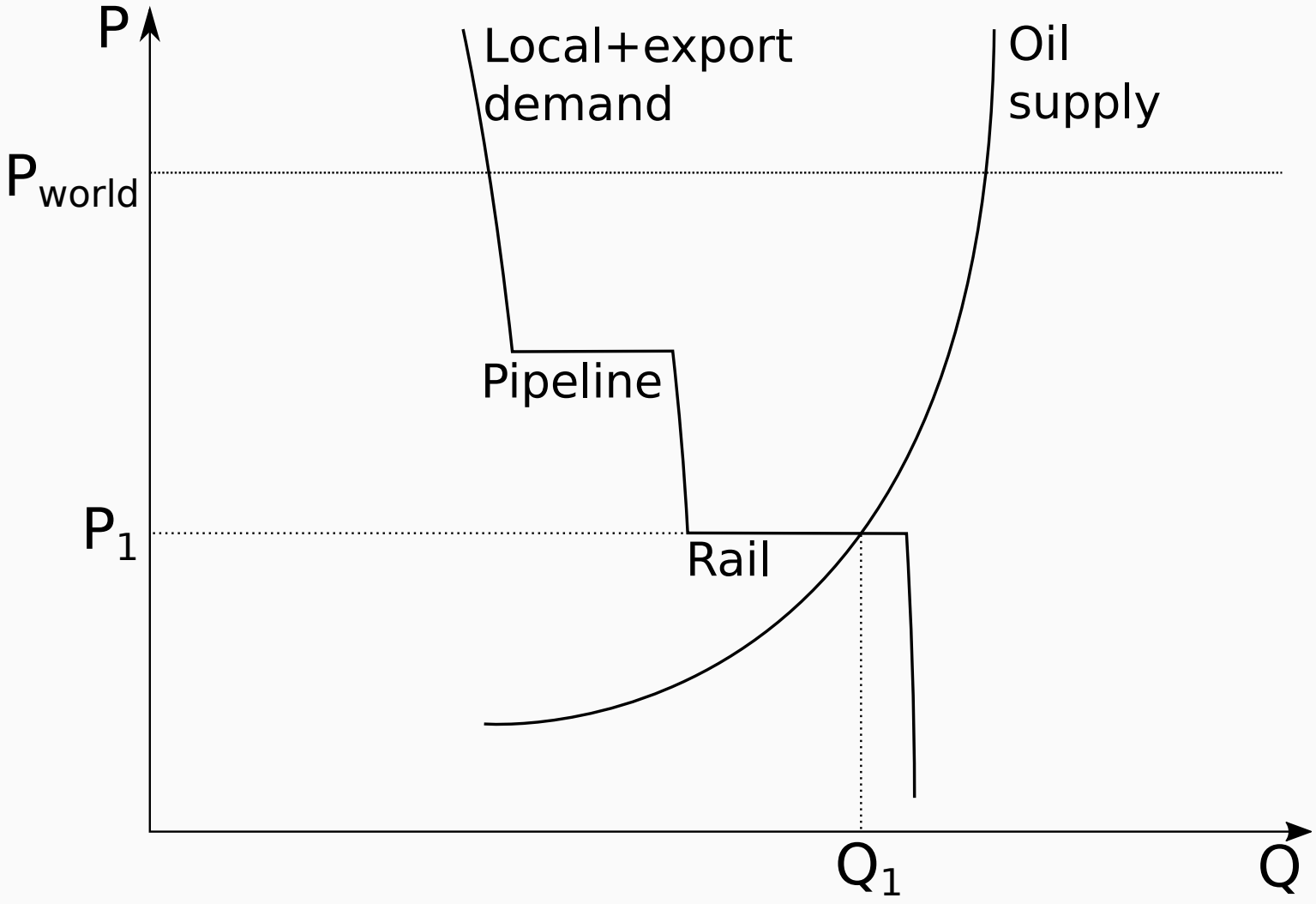
The world price of oil is much higher… but the oil needs to be transported out of the region to a market hub



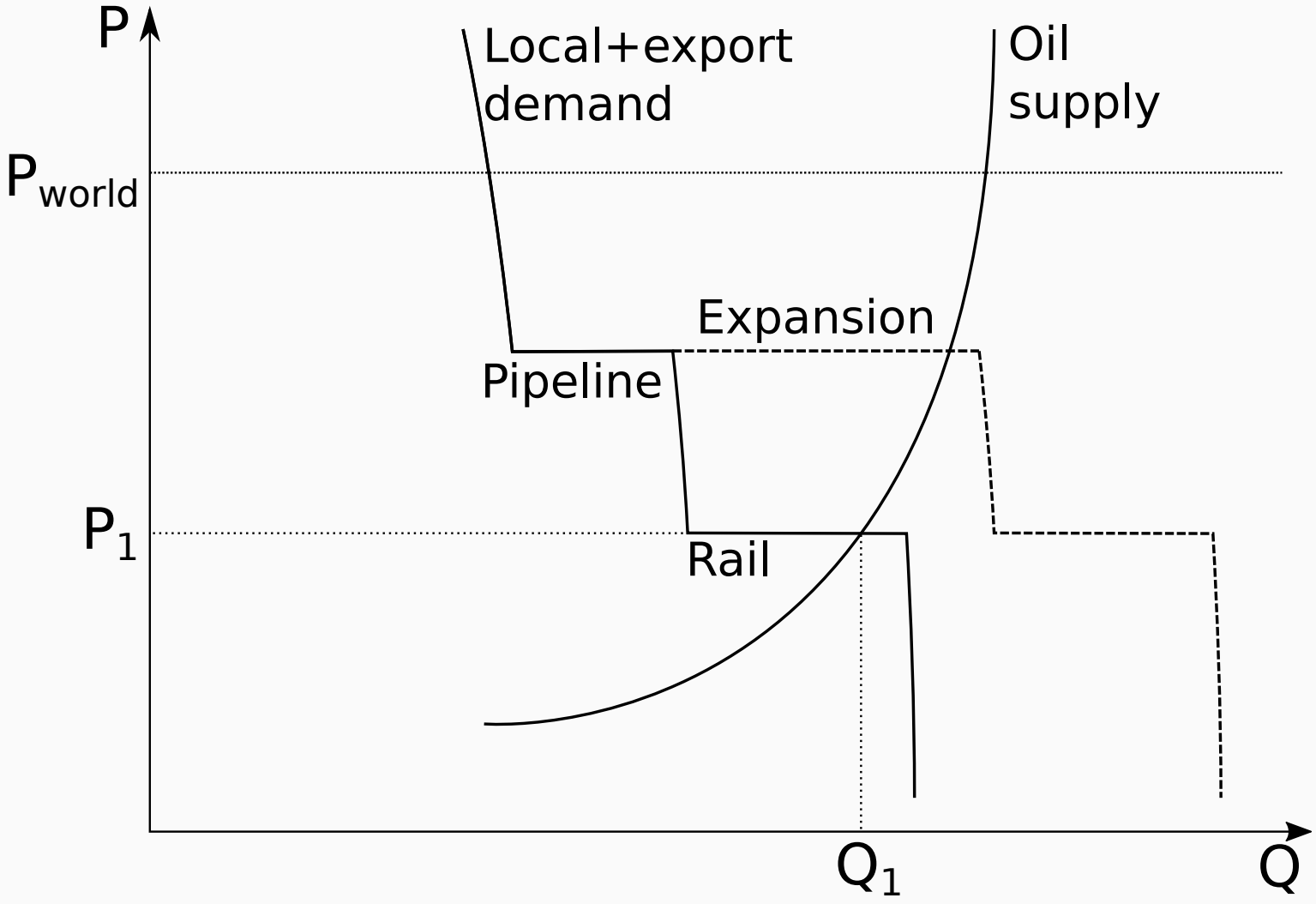
There are low and high cost methods for transporting the oil, each with a limited capacity



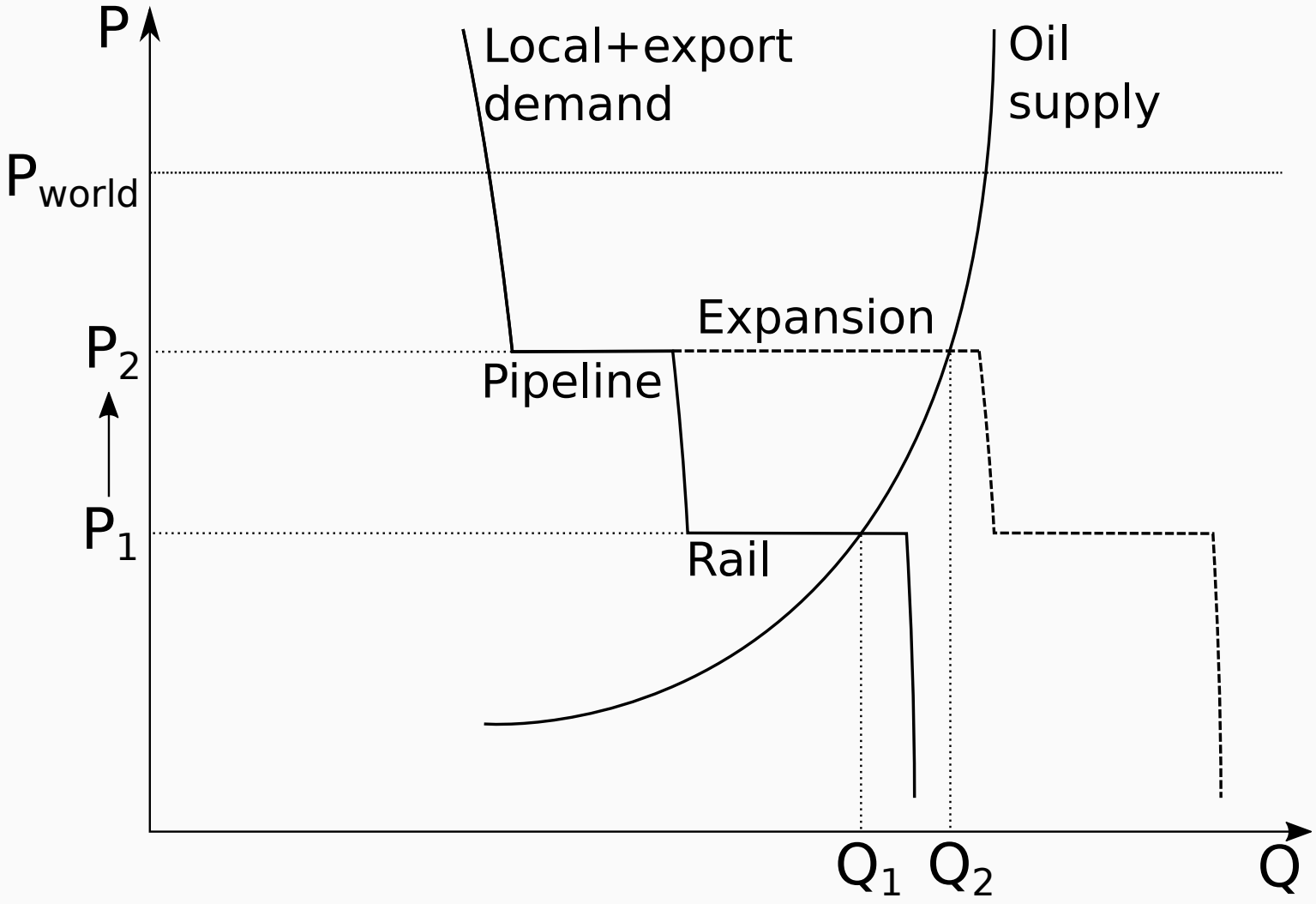
Local oil producers will receive price P_1, discounted from the world price to reflect the cost of transporting the last barrel



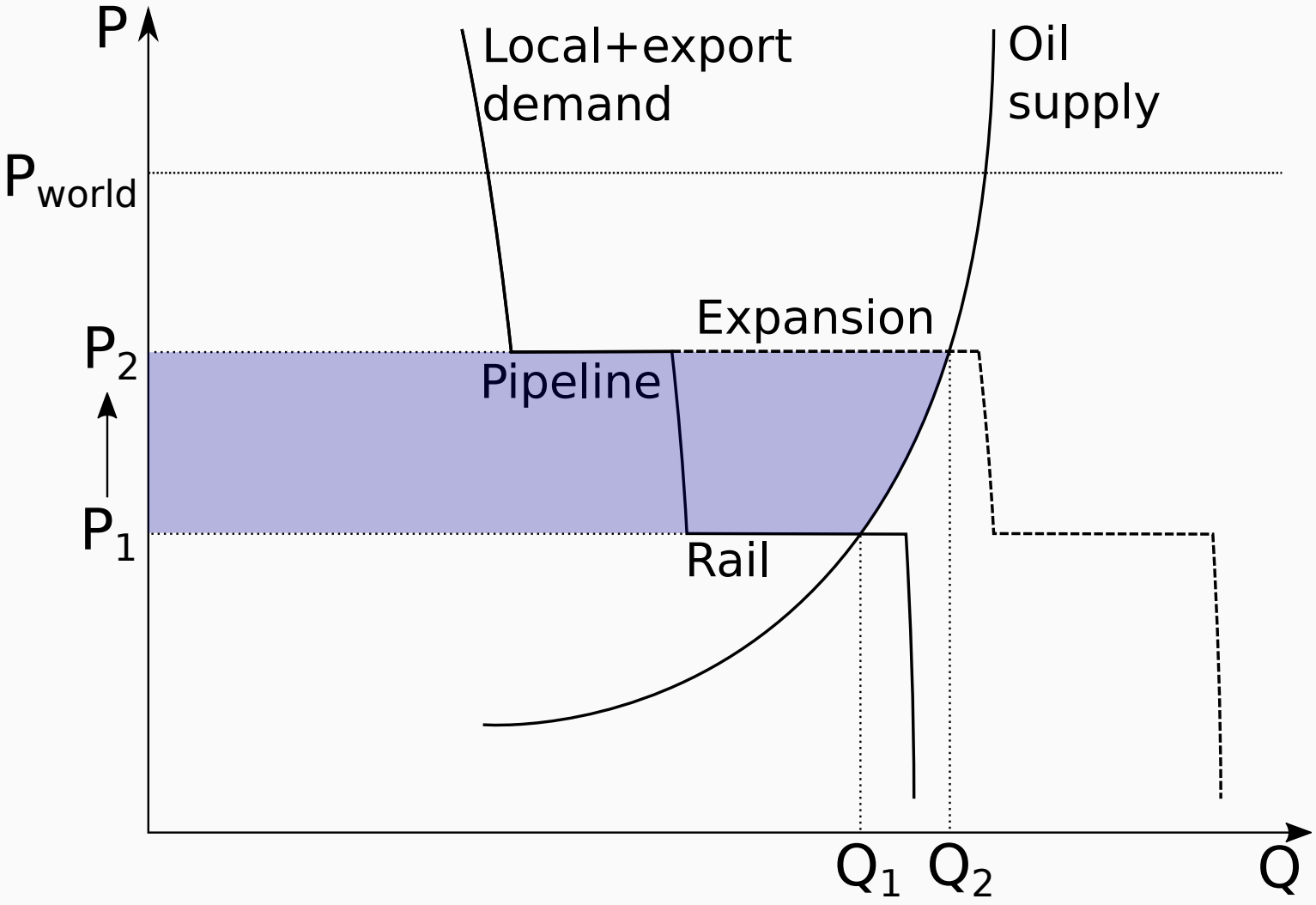
Suppose there is an expansion in pipeline capacity out of the region, so that all exported oil can be carried by pipeline



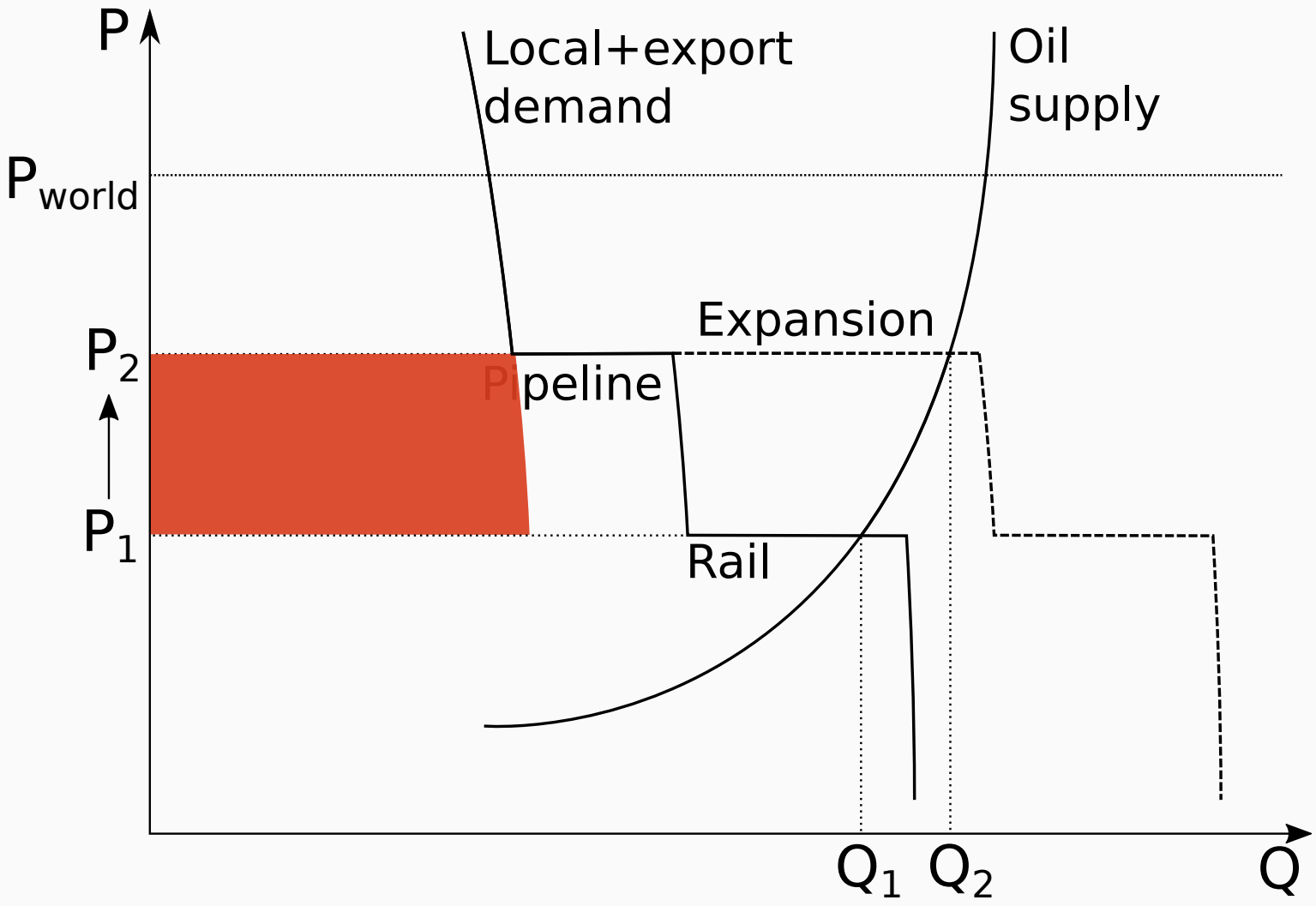
The price received by local oil producers increases from P_1 to P_2, reducing the discount from the world price



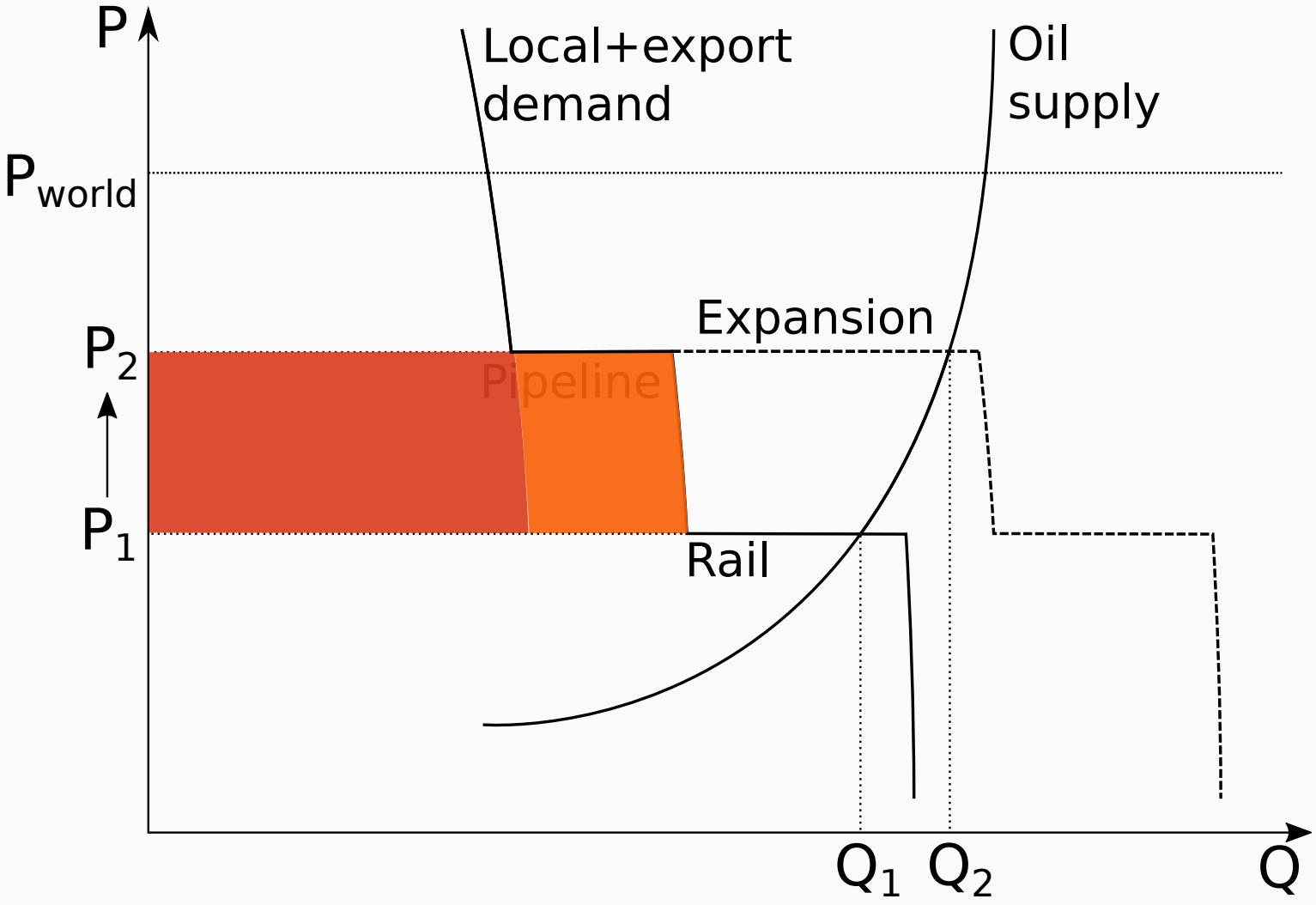
Local oil producers will be better off as a result of the higher price (and slightly higher production quantity)



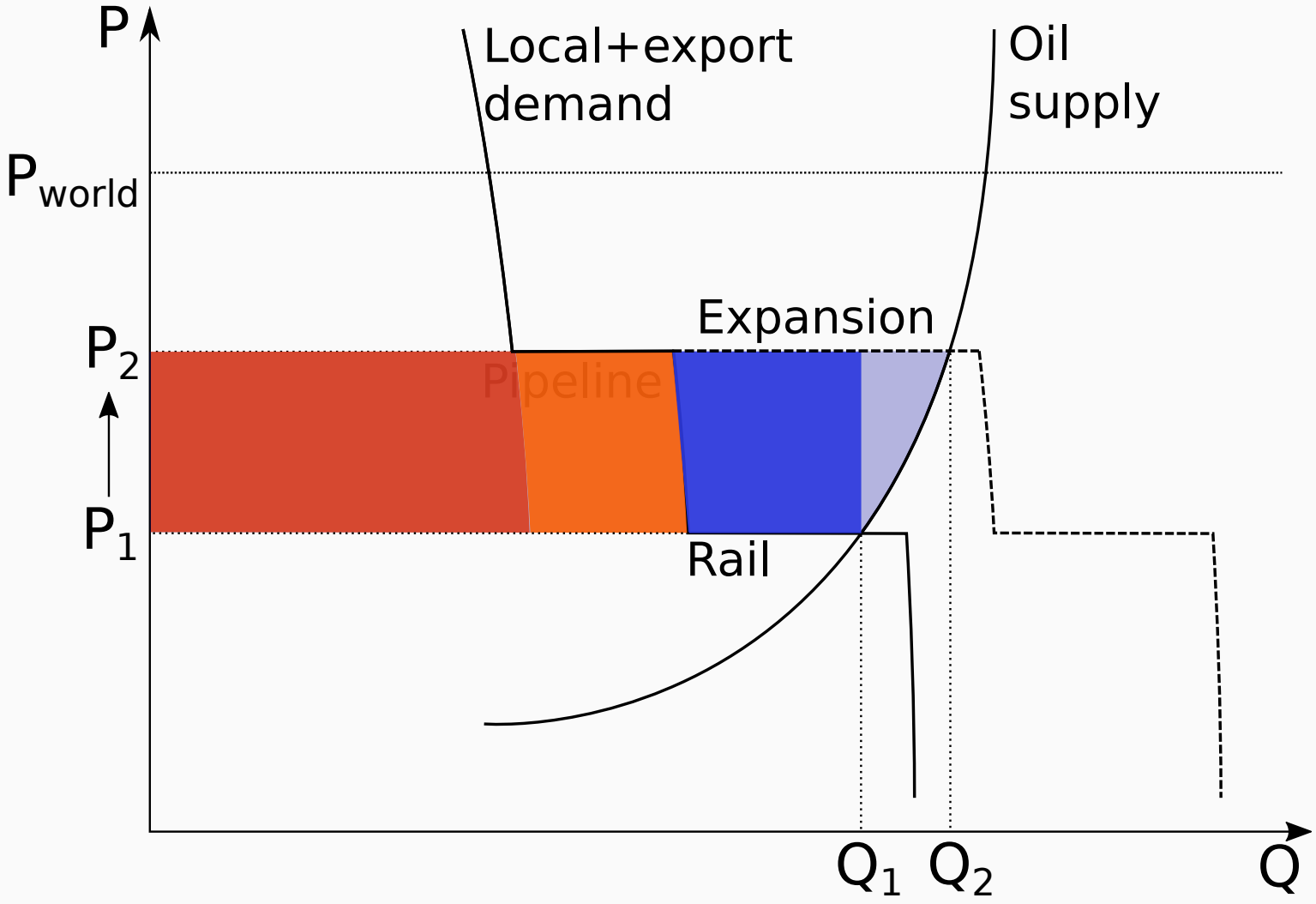
Local oil refineries are worse off because now they pay a higher price P_2 for their crude oil input



Oil shippers with access to the original pipeline are also worse off, because they can no longer profit from buying oil at P_1

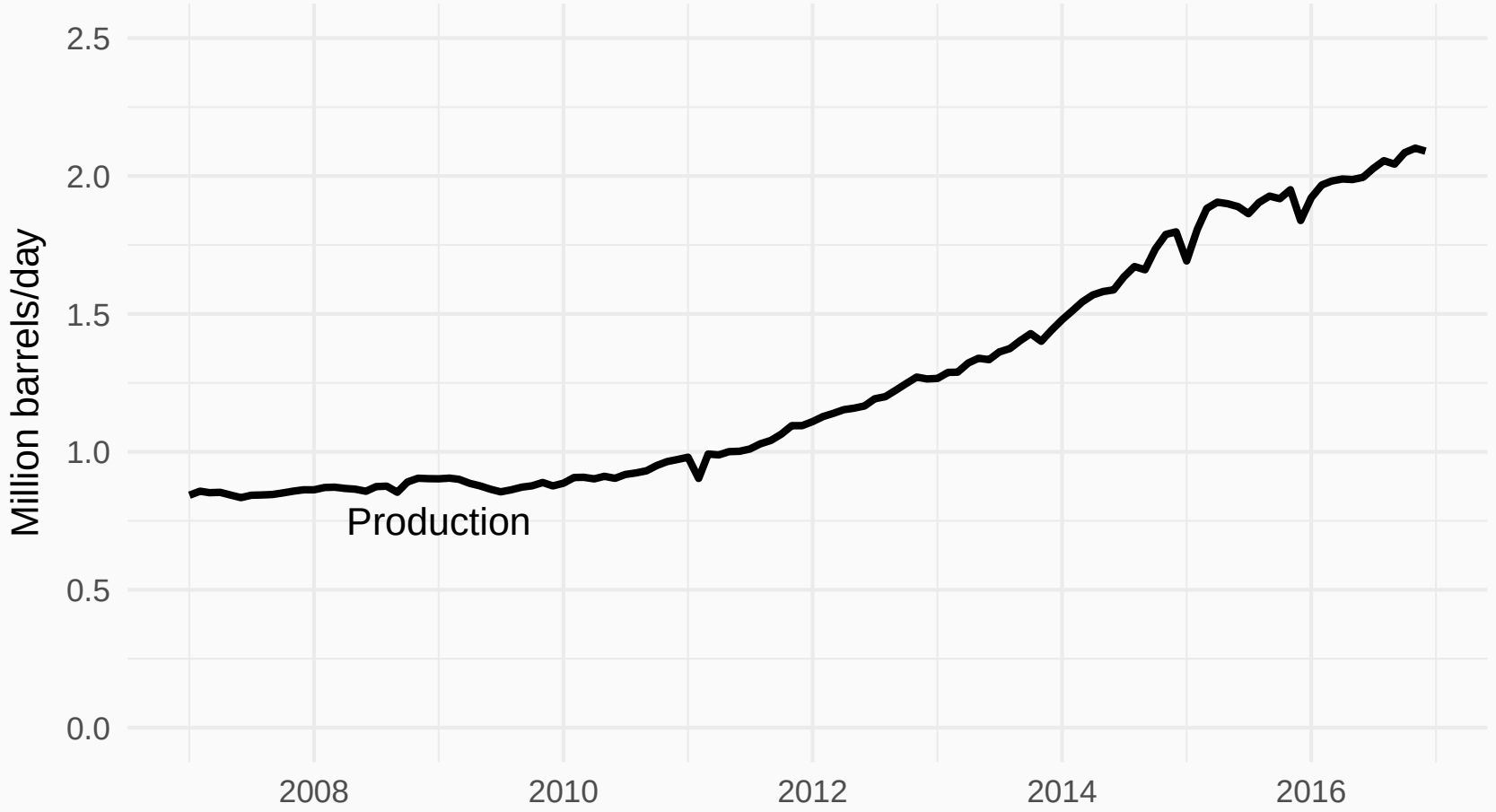


Overall welfare increases after the pipeline expansion, due to reduction in transportation costs and higher oil production



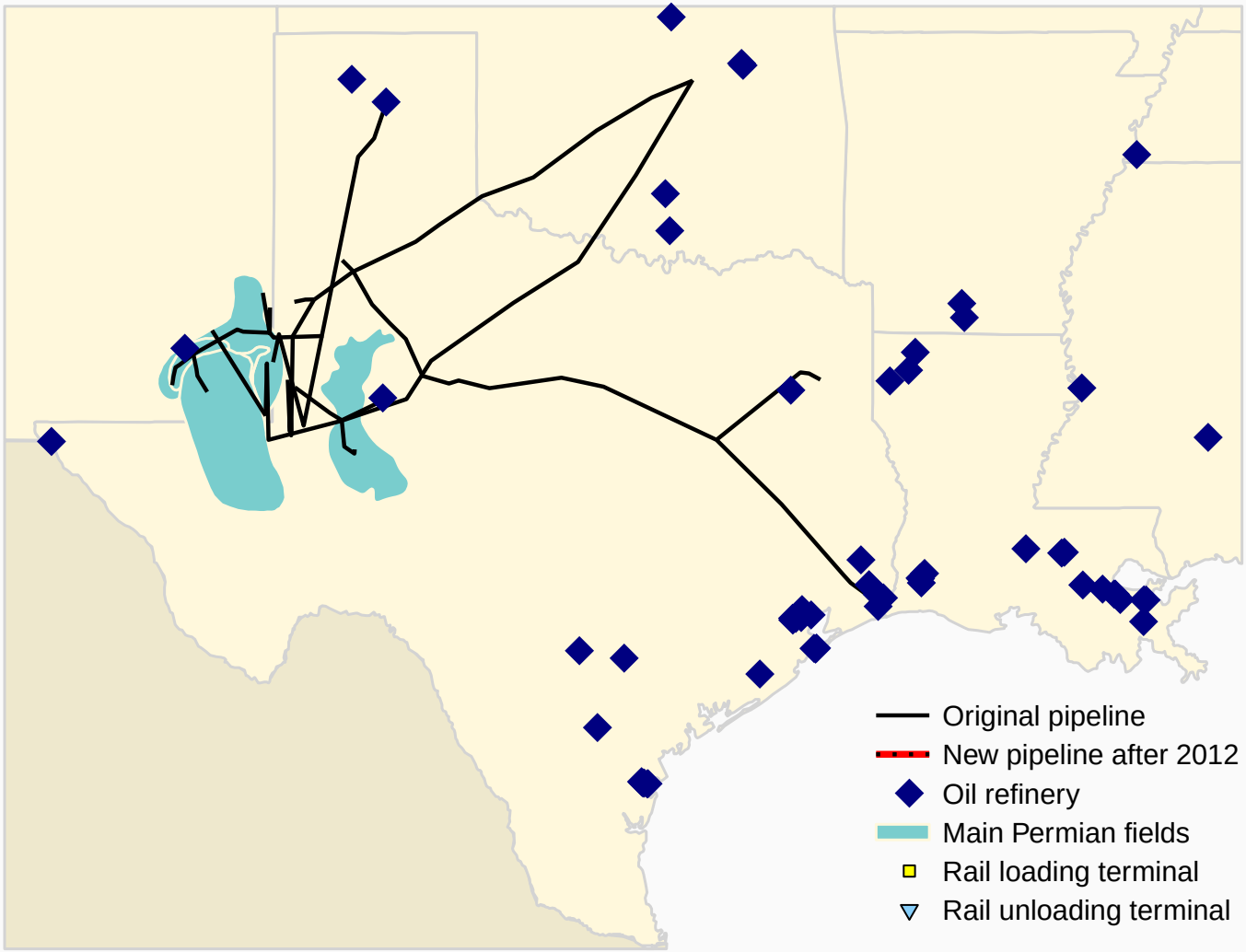
Pipeline expansions in the Permian basin

Oil production in the Permian basin increased by 1.2 million barrels/day between 2010 and 2016



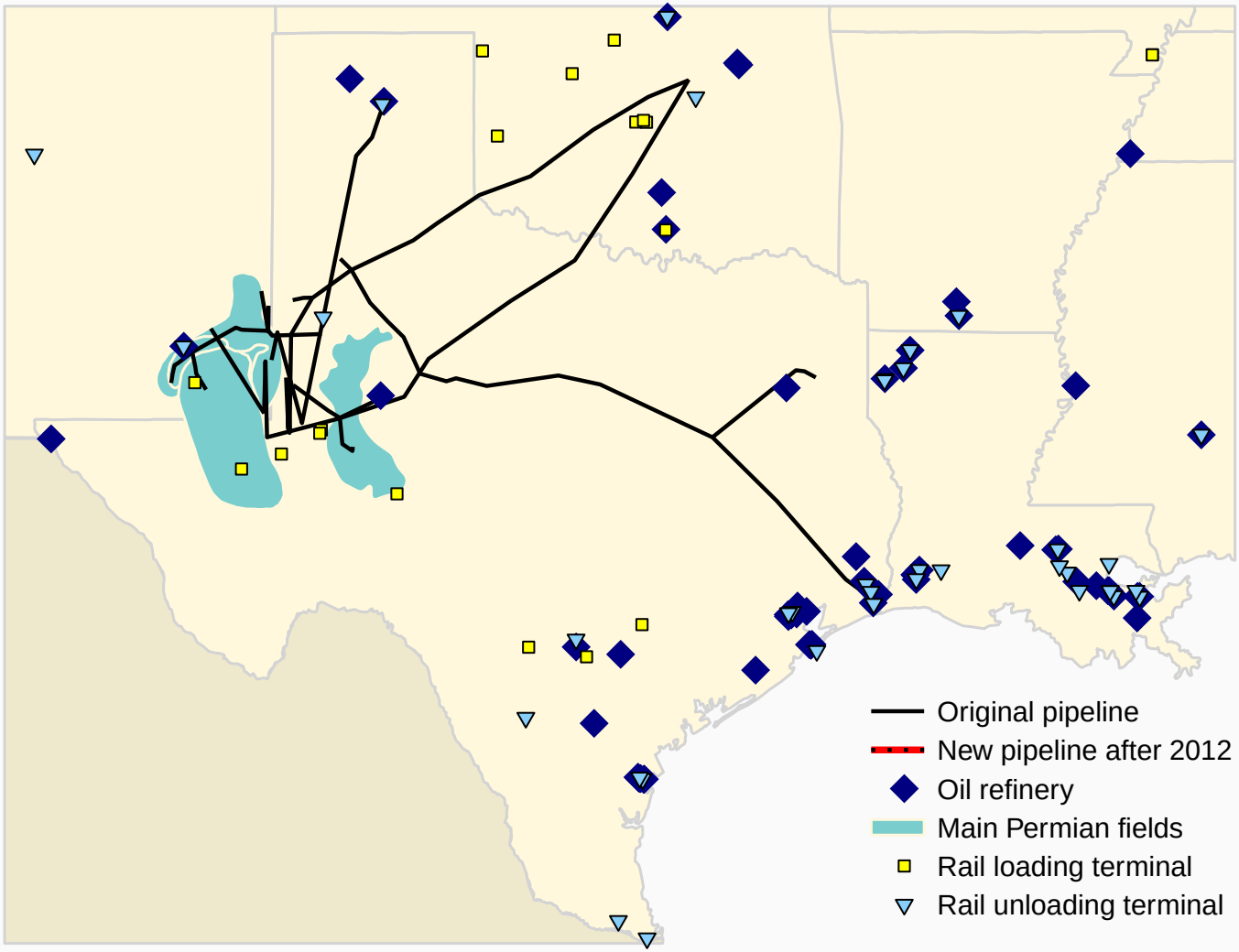
Source: EIA Drilling Productivity Report

Only four pipelines out of Permian basin in 2010: Borger, Basin, Centurion, West Texas Gulf



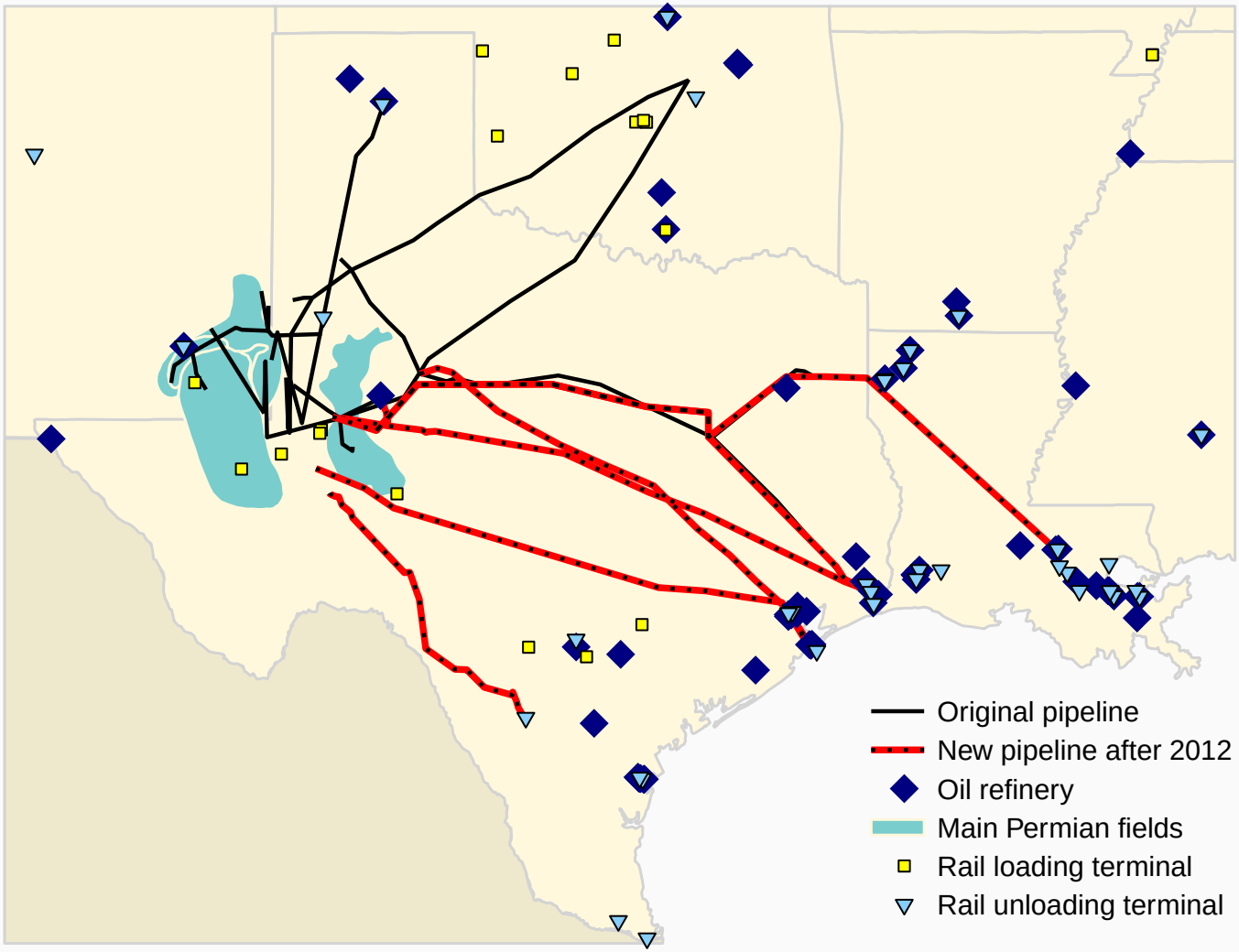
Source: EIA geographical shape files

Rail loading terminals in Permian and Eagle Ford allowed shipment by rail to Gulf Coast refineries



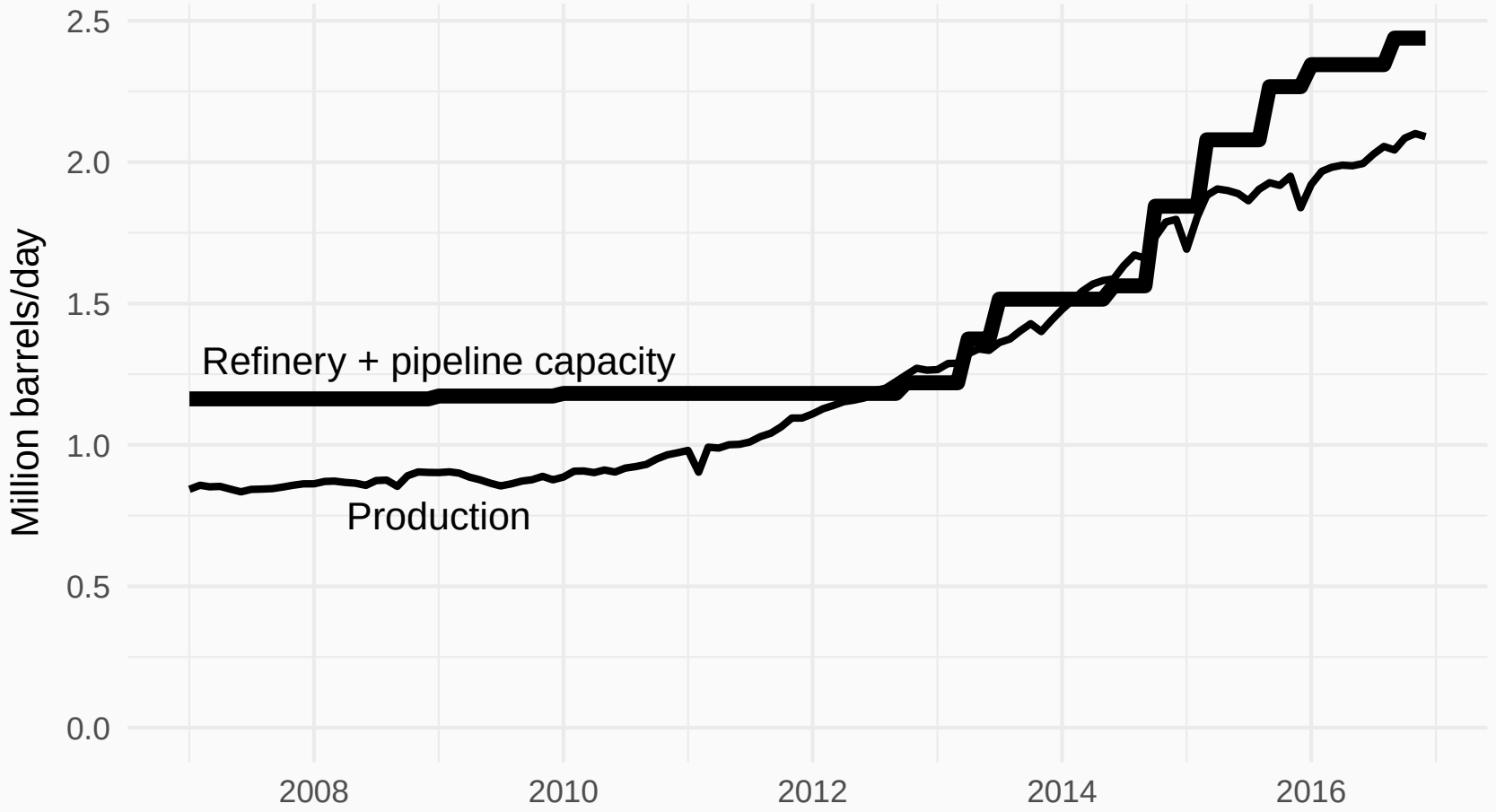
Source: EIA geographical shape files

Six new pipelines were constructed (or converted) between 2012 and 2016, increasing access to Gulf Coast



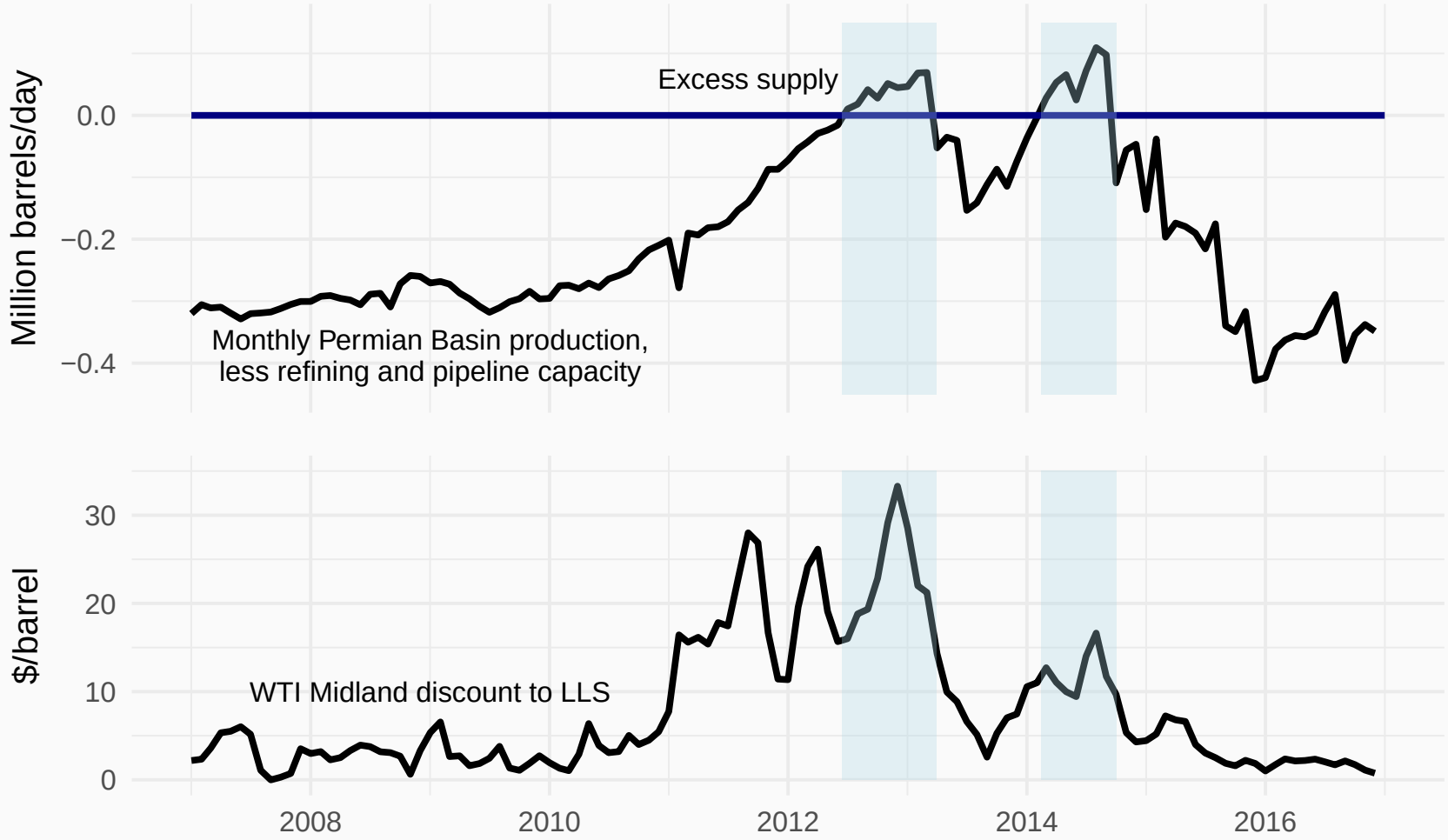
Source: EIA geographical shape files, Sunoco Logistics

Permian production exceeded refinery and pipeline capacity in 2012 and again in 2014



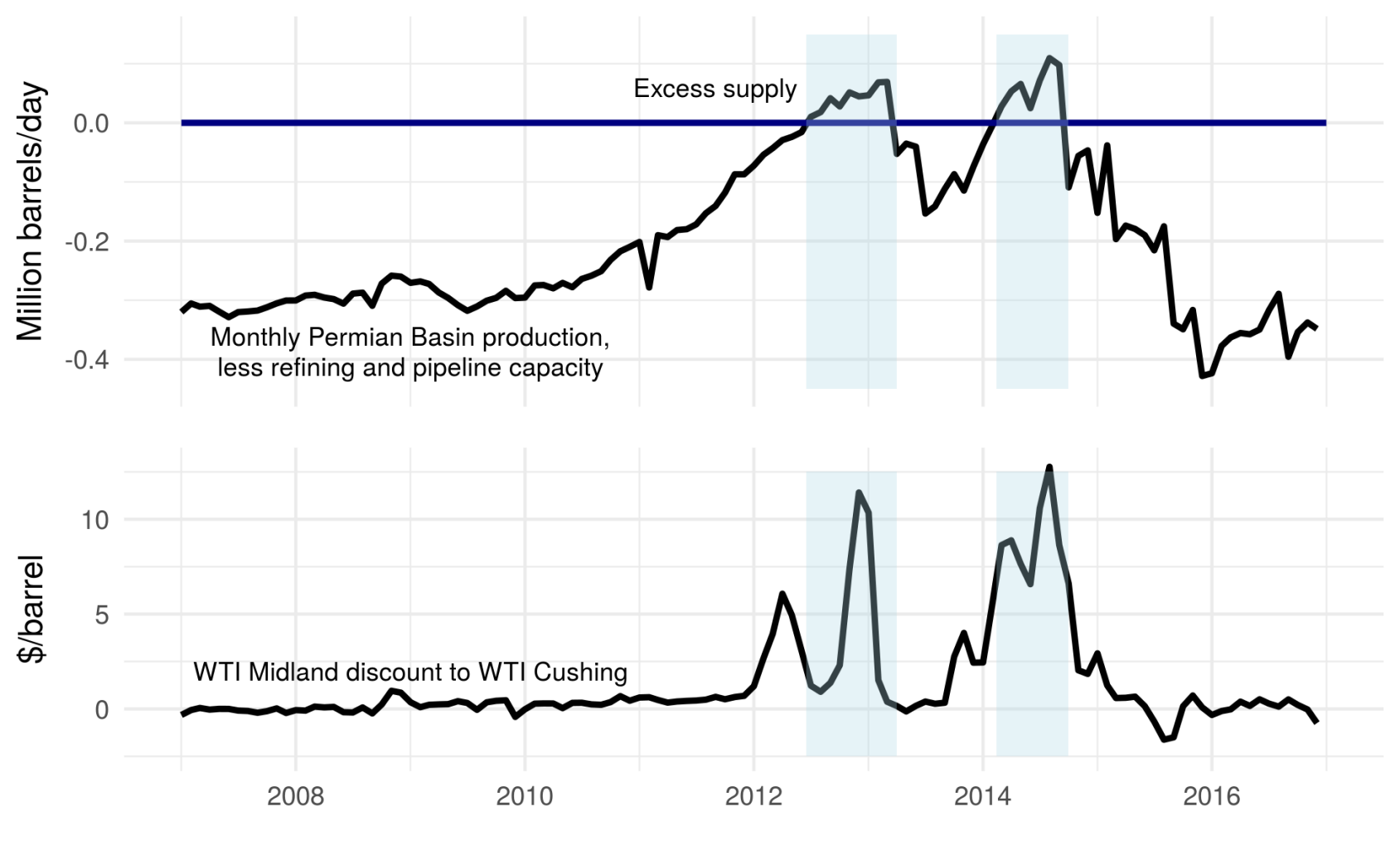
Sources: EIA oil production; EIA refinery capacity utilization; RBN Energy and other news reports

Periods with excess supply associated with large price differentials between Permian (WTI Midland) and Gulf Coast (LLS)



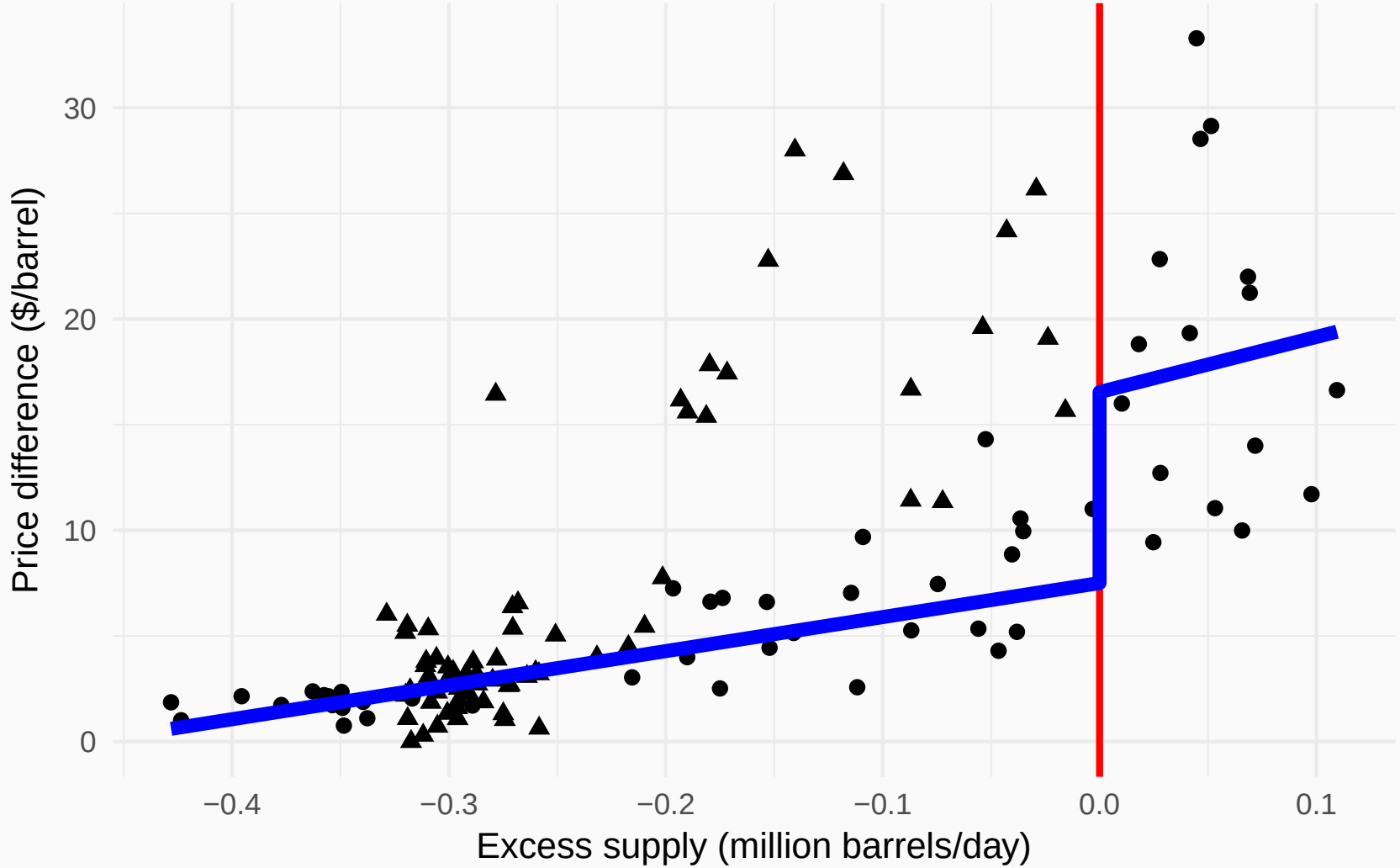
Sources: Excess supply calculation (previous slide); Bloomberg

Periods with excess supply associated with large price differentials between Permian (WTI Midland) and WTI Cushing



Sources: Excess supply calculation (previous slide); Bloomberg

Periods with excess supply associated with large price differentials between Permian (WTI Midland) and Gulf Coast (LLS)



Sources: Excess supply calculation (previous slide); Bloomberg

Empirically analyze the relationship between price differences and excess supply

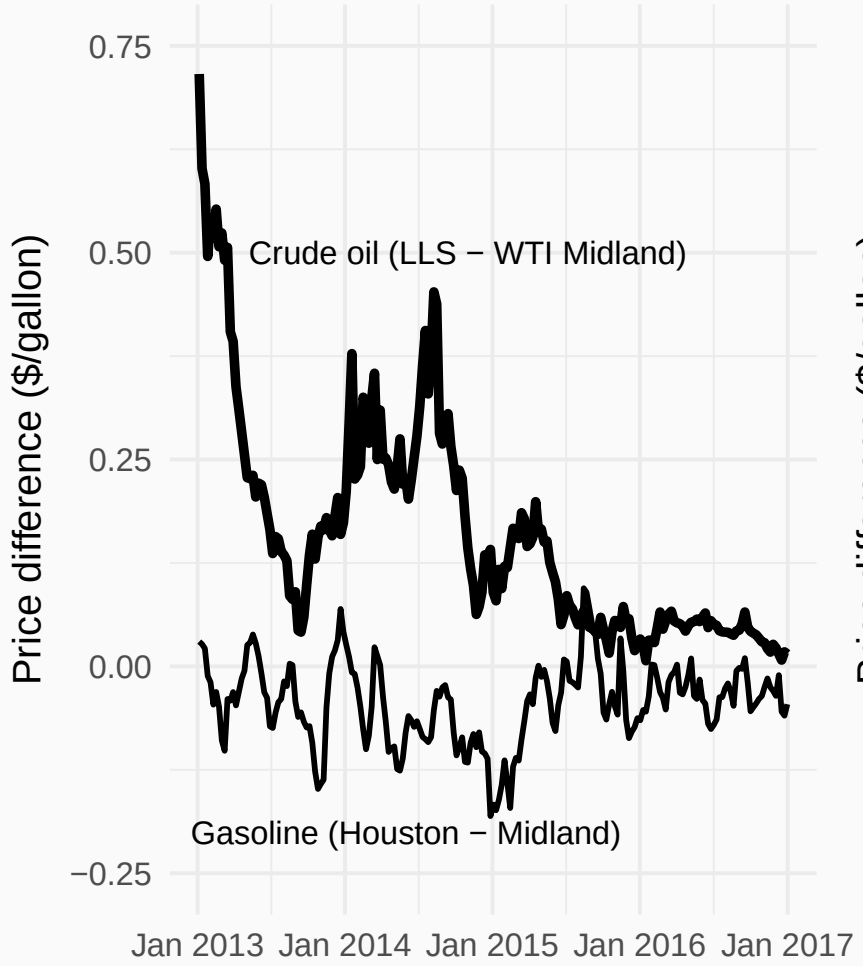
- Allow WTI Cushing-LLS price differential to matter when marginal oil is sent to Cushing
- Include year fixed effects
- Change definition of refinery capacity

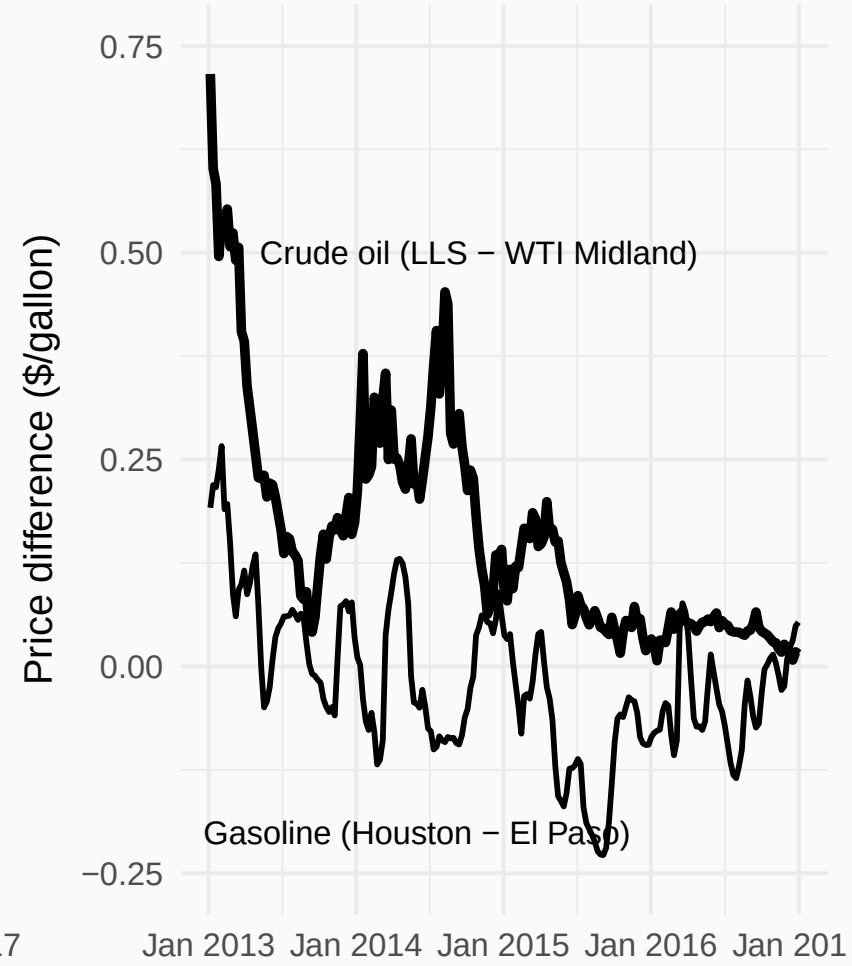
Societal benefits of $1.9 million/day compare to pipeline revenues of $0.3 million/day

Decompose the change in revenues and costs as a result of a hypothetical pipeline expansion

	$ million/day
Higher oil producer revenue	$17.6
Higher oil refinery costs	$2.7
Lower oil shipper profits	$13.0
Lower transportation costs	$0.9
Higher oil production	$1.0

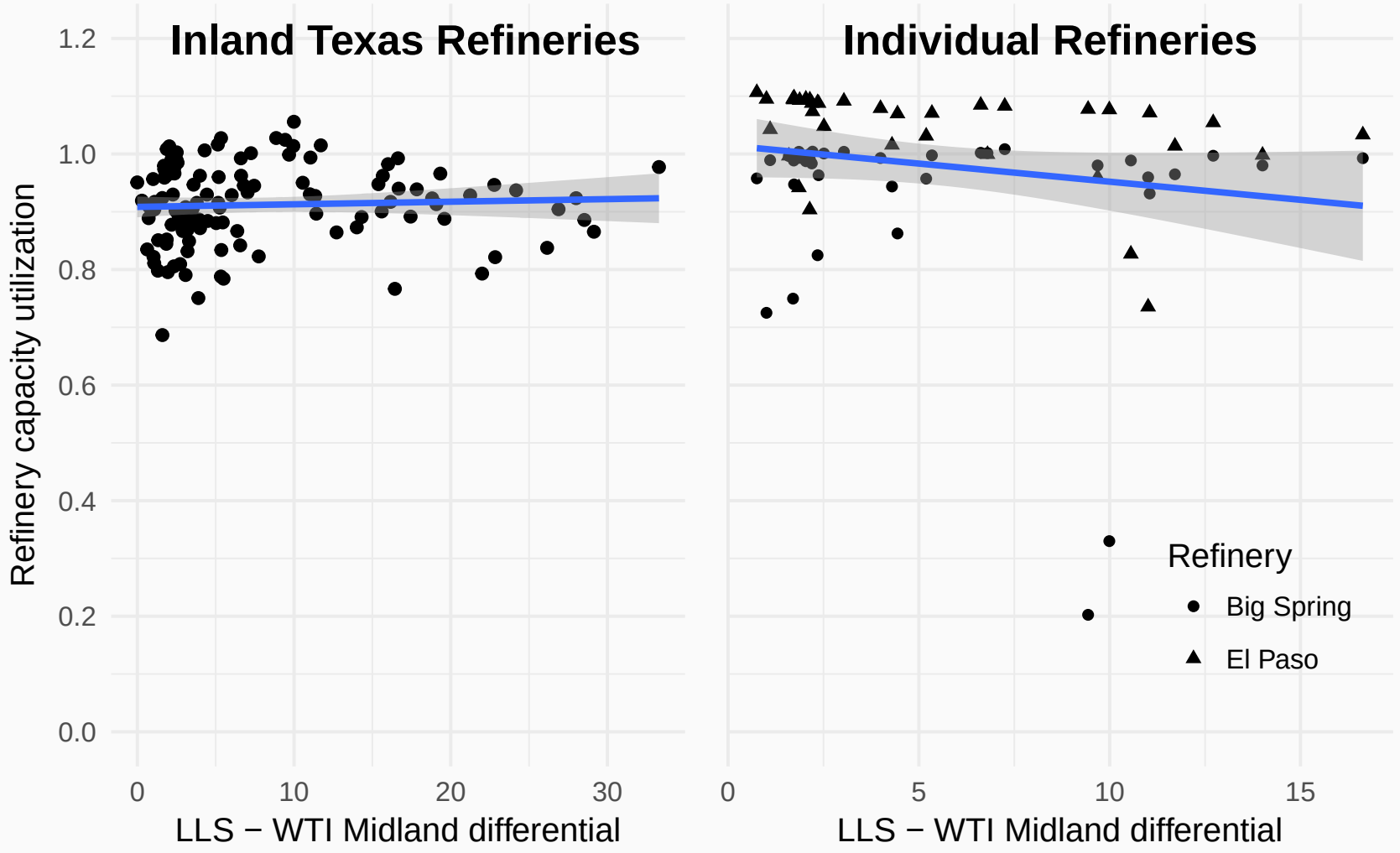
Higher input costs (mostly) reduced refinery profits rather than being passed on to gasoline consumers





Source: GasBuddy.com

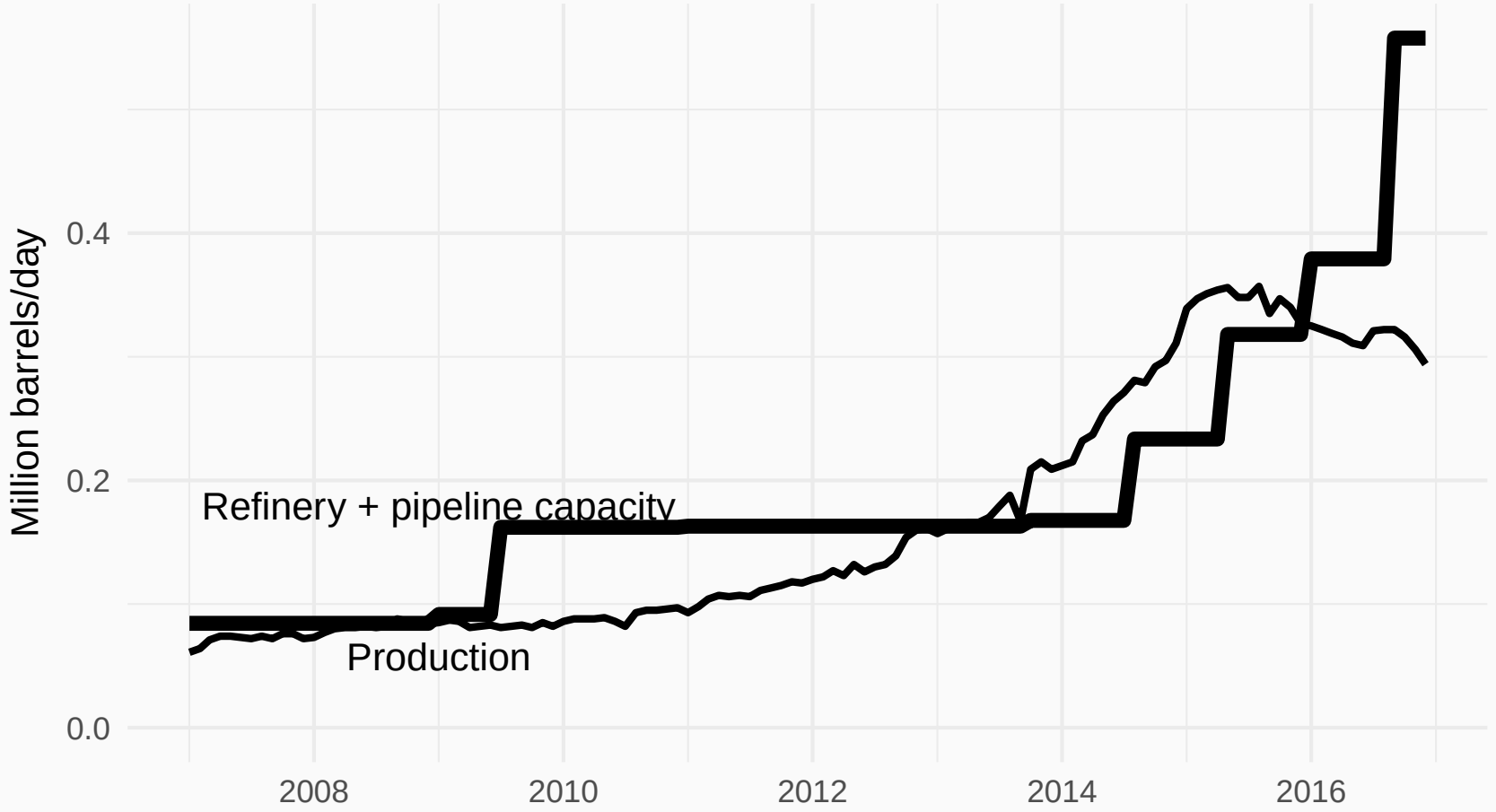
Refinery capacity utilization was already high and did not change as a result of the lower prices



Source: EIA, Texas Railroad Commission

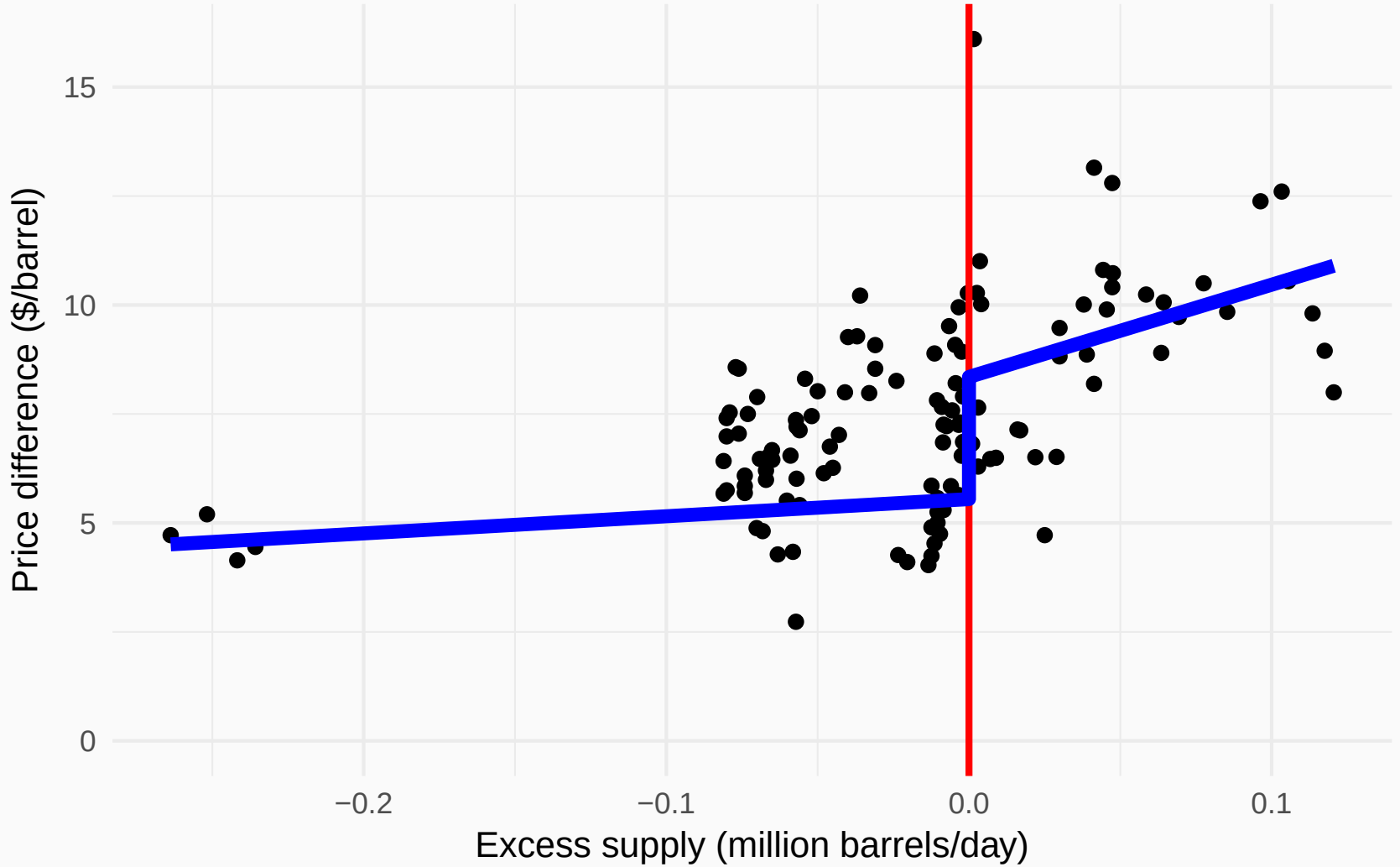
Analysis for other oil producing regions

Colorado: Increase of about 250,000 barrels/day in oil production as well as greater oil pipeline capacity



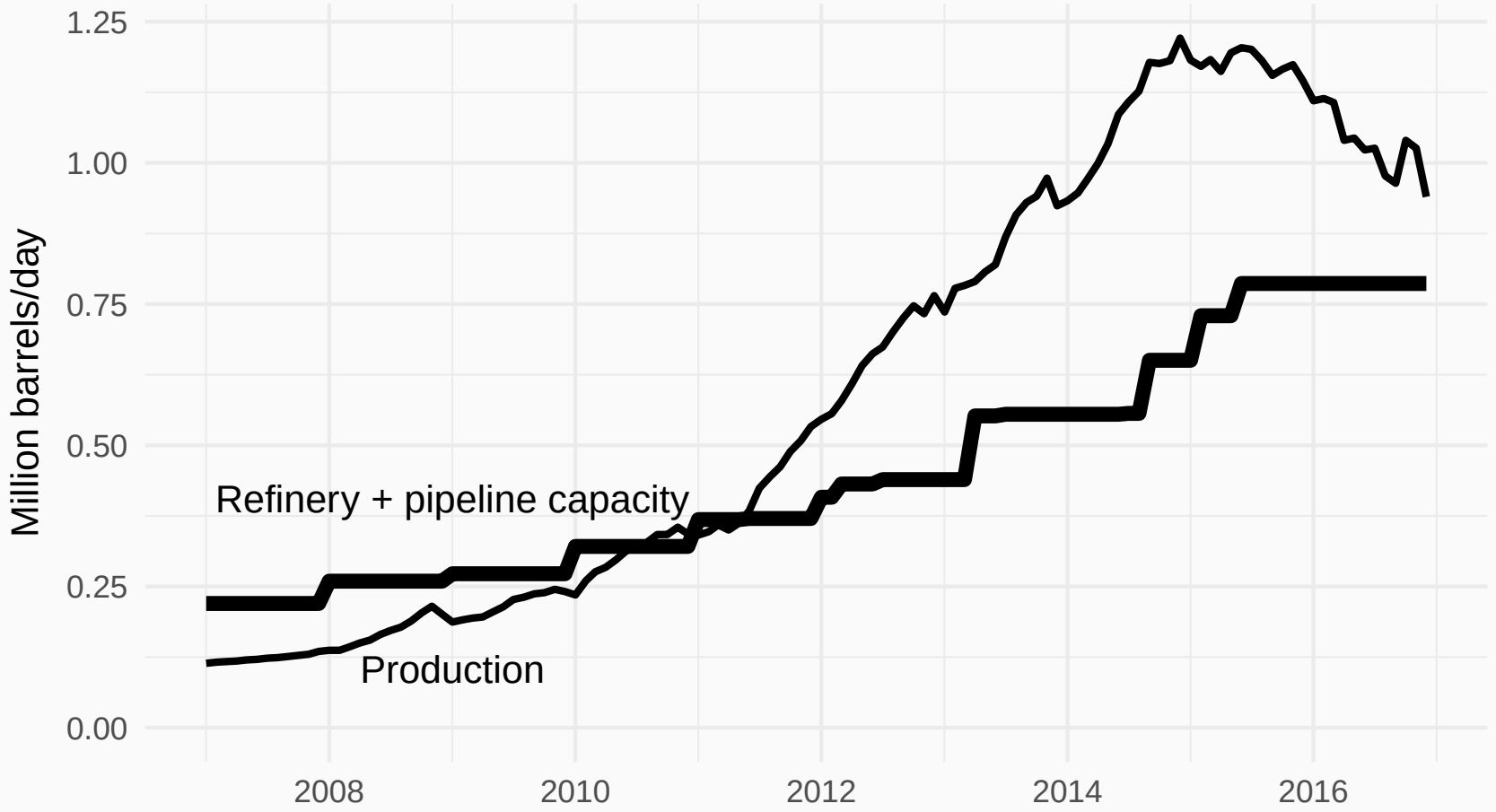
Sources: EIA oil production; EIA refinery capacity utilization; RBN Energy and other news reports

Colorado–WTI Cushing price differentials are higher in periods with shortfall in pipeline capacity



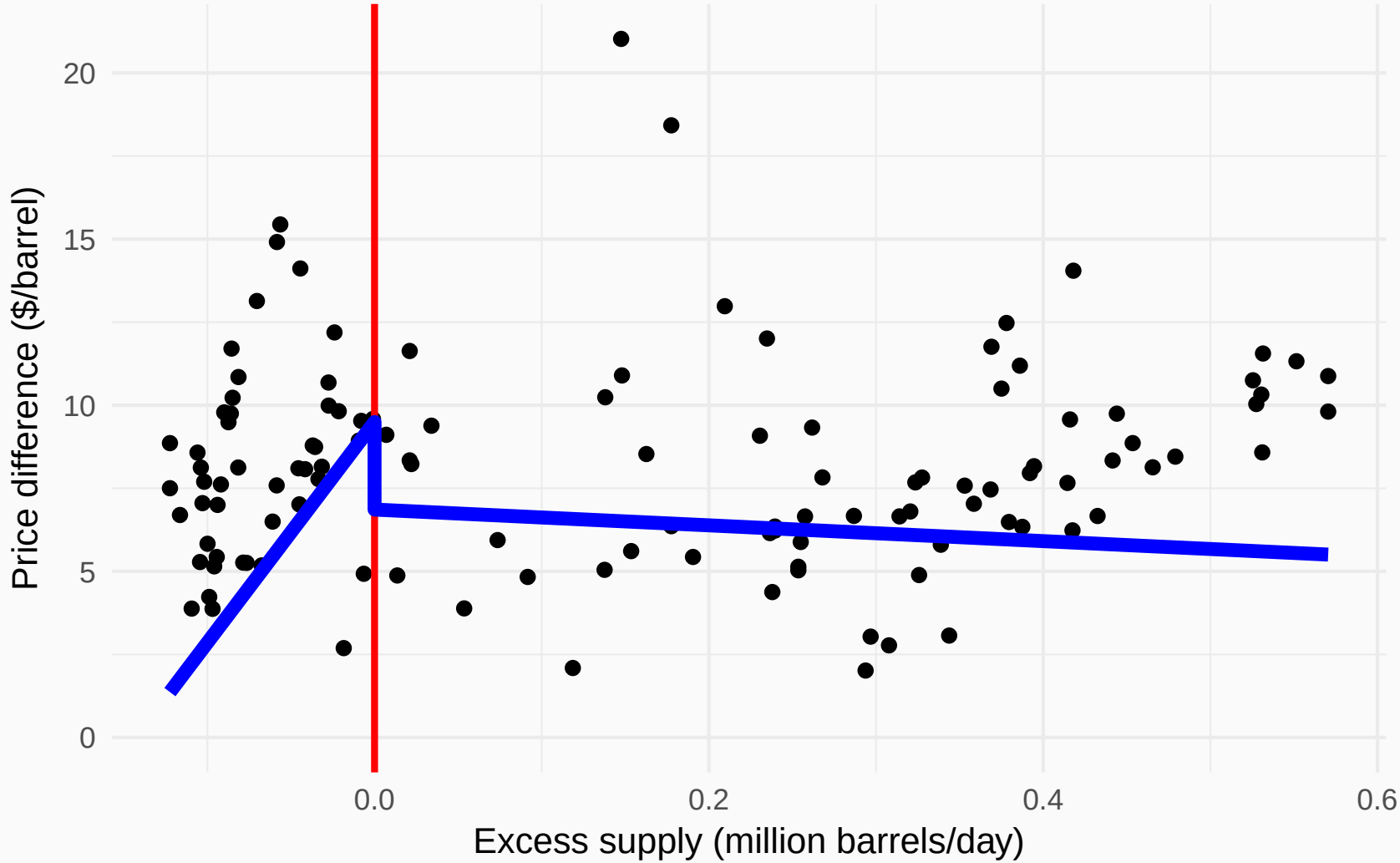
Sources: Excess supply calculation (previous slide); Bloomberg; own calculations

Large increase in Bakken production not matched by additions to pipeline capacity



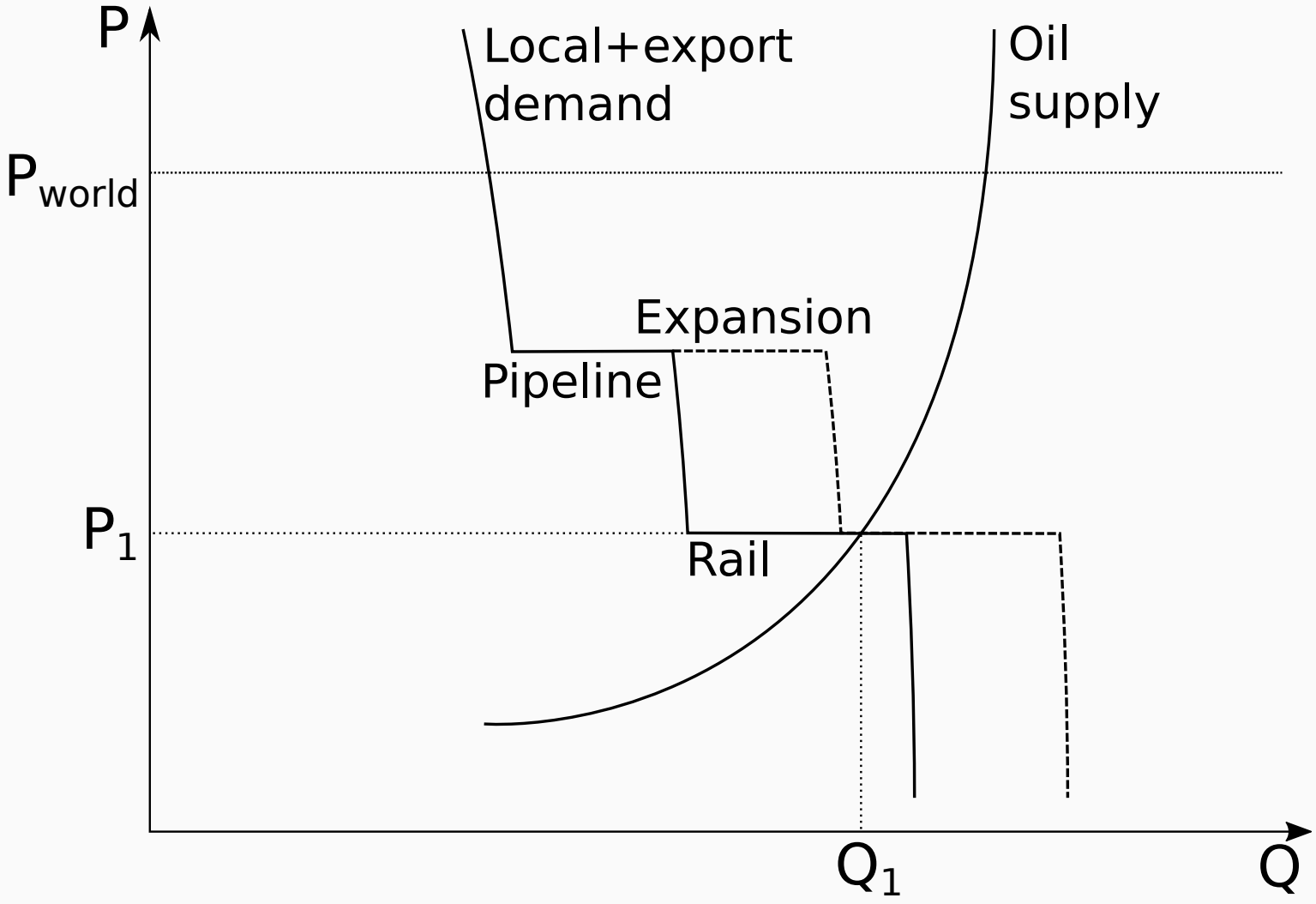
Sources: EIA Drilling Productivity Report; EIA refinery capacity utilization; ND Pipeline Authority and news reports

No obvious relationship between North Dakota–WTI Cushing price differential and excess supply measure



Sources: Excess supply calculation (previous slide); Bloomberg; own calculations

Note the pipeline expansions in North Dakota have been *infra-marginal*—implying no change in local price



Other issues that complicate analysis of effect of pipeline infrastructure investment in other region

- Source of price data: market data vs. monthly average wellhead prices
- Capacity constraints in other parts of pipeline network
- Optimal flows through interconnected network

Conclusion

This paper has studied the economic effects of expansions to the crude oil pipeline network

- Length of crude oil pipeline network has increased by 37% between 2010 and 2016
- Additional pipelines have reduced the variance across regions in oil producer prices
    - Magnitude of reduction depends on whether new pipelines are inframarginal
- Most of the benefits for producers are a transfer from refiners and shippers
- Net welfare benefits are due to reducing cost of shipment and increasing oil production
    - These exceed revenue for pipeline owners