

*Changes in Oil & Gas Prices and E&P Activity: Evidence from U.S. Petroleum Producing States**

Presented by

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Presentation Outline:

- Research Question
- Characterizing U.S. Petroleum Producing States
- Review Trends in E&P Activity Indicator & Oil and Gas Prices by Petroleum Producing States.
- Modeling the Relationship between Industry Indicators and Prices.
- Model Results and Analysis
- Concluding Remarks

Research Motivation

- Previous studies of oil price shocks on the economy focus on national rather than regional with the implicit assumption of regional /state homogeneity
- Economic activities of interest are aggregate output, employment, wages etc, though primary effects are really at industry activity levels especially in oil rich regions.
- Comments on E&P responsiveness to prices seem too trivial with little or no regards to geology, industry structure, and economics & policy incentives among producing states.

Research Question/ Objectives

- Do changes in crude oil and natural gas prices affect the process of petroleum exploration, discovery and development significantly and differently among the U.S. petroleum producing states?
- To test the nature of the relationship thereby providing empirical measures of the responsiveness of petroleum industry activity indicators across petroleum producing states to prices.

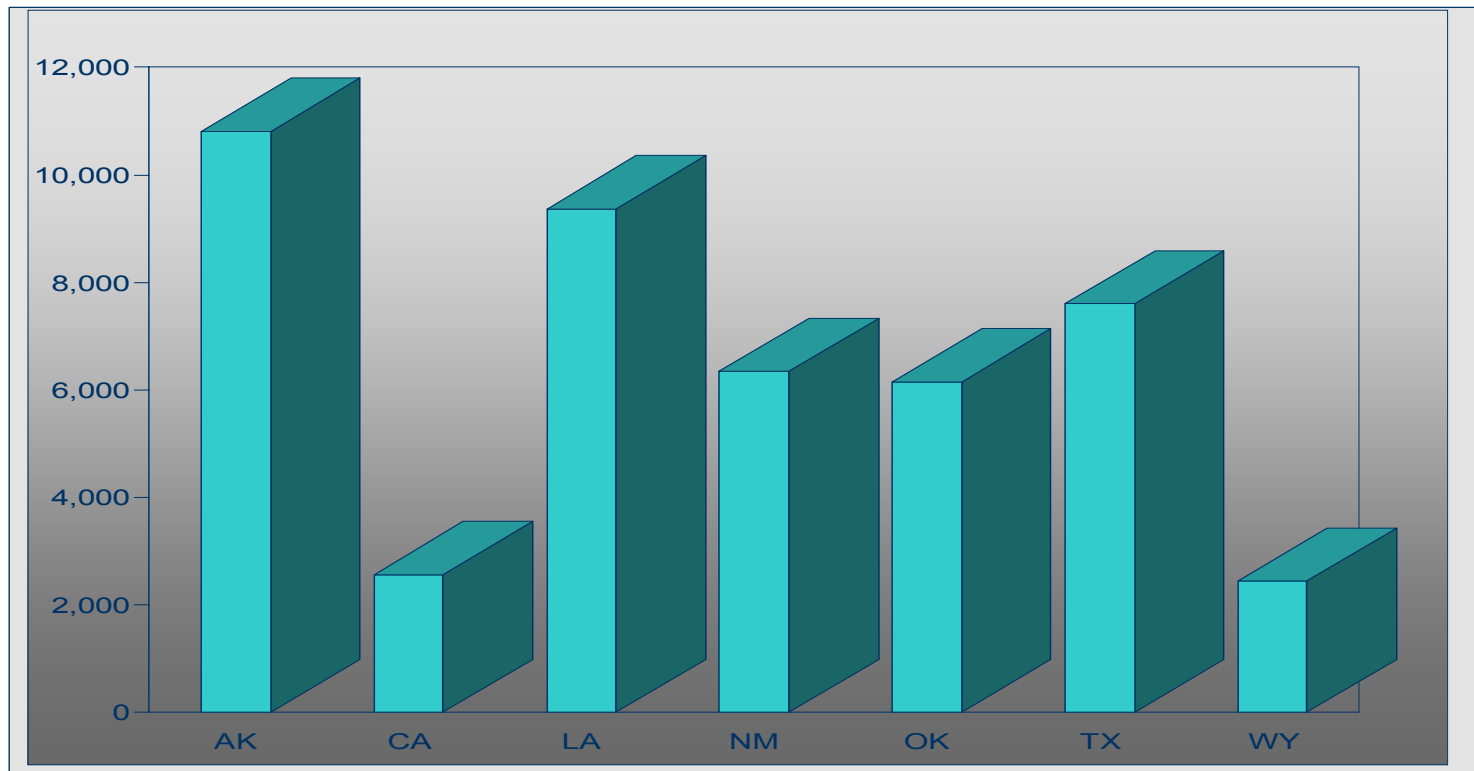
Research Question & Objectives

- Review trends in E&P indicators and petroleum prices in selected U.S. petroleum producing states.
- Estimate an empirical model describing the relationship between drilling indicators and prices subject to a perceived level of resource depletion and drilling dynamics
- Use the model to answer the homogeneity question regarding the responsiveness of E&P industry activity across the US petroleum producing states.

E&P Industry in the U.S. Selected Measures of Activity

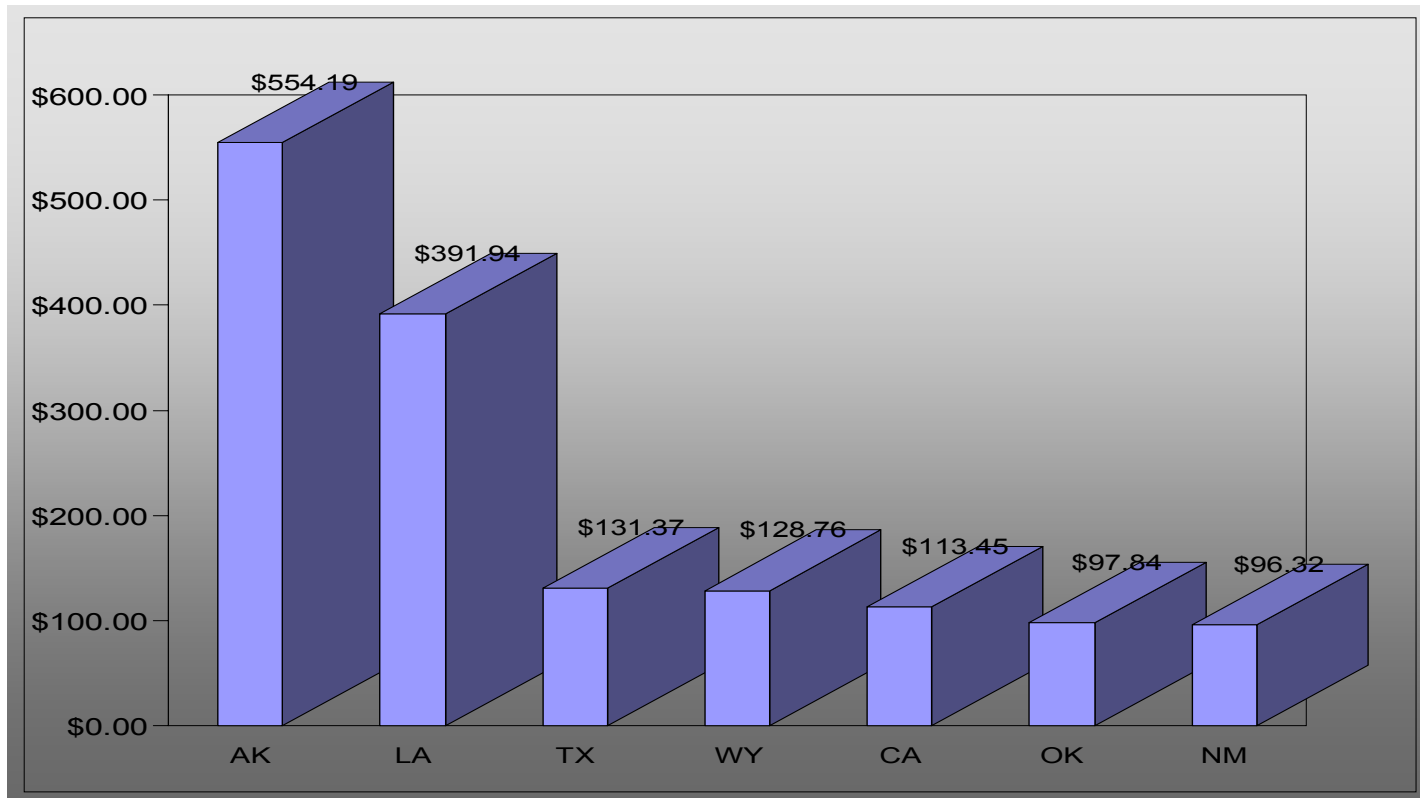
- Efforts:
 - Classification of Effort
 - Exploratory—drilling in search of new resources
 - Wildcat drilling
 - Development—drilling to produce or increase production
 - Type of Effort
 - Oil well –produces predominantly oil
 - Gas well—completed to produce predominantly gas
 - Dry well—produces neither oil nor gas
- Rig Utilization
- Permits to drill

Key U.S. Petroleum Producing States: Average Drilling Depth (ft), 1999-2003



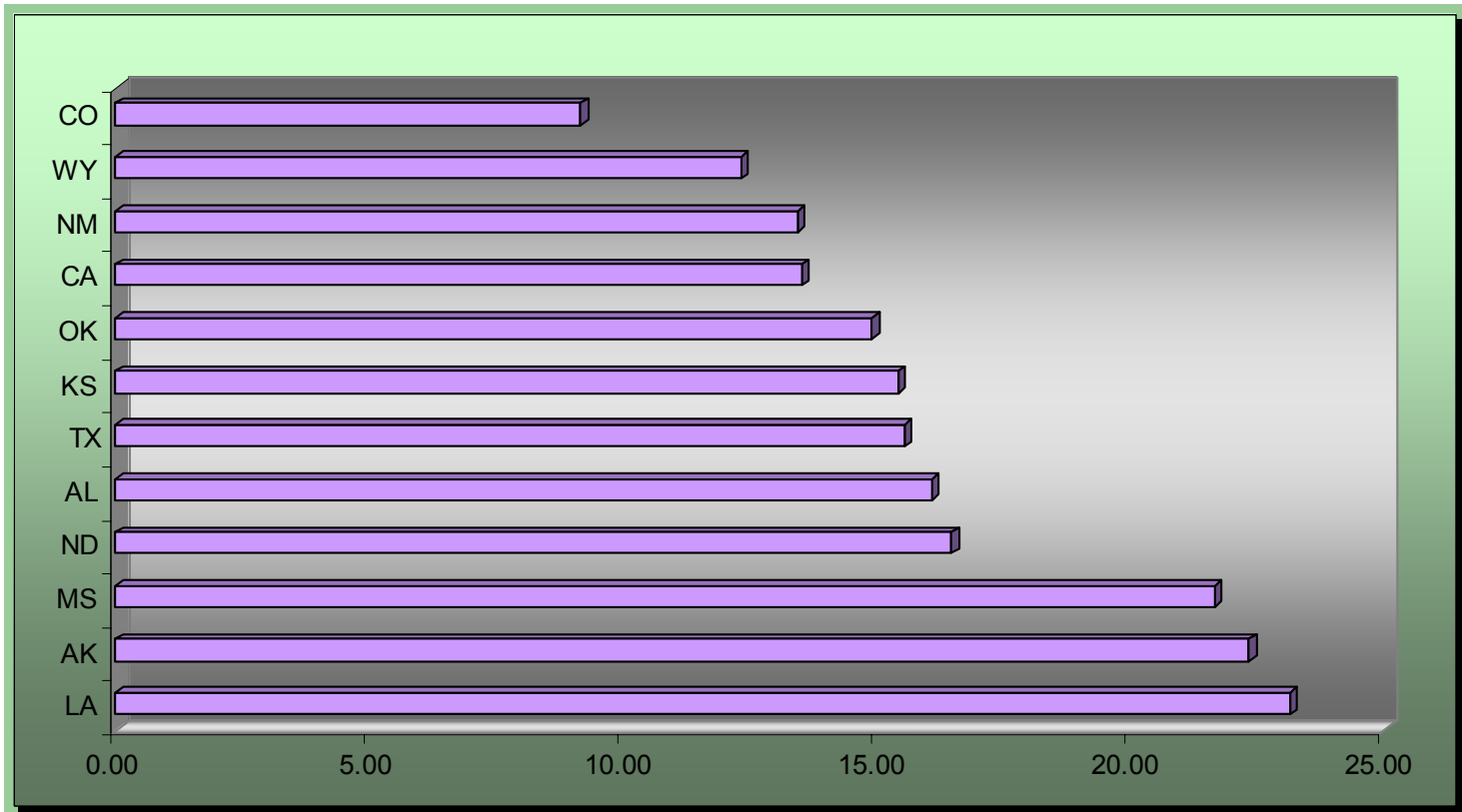
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Key U.S. Petroleum Producing States: Average Drilling Cost Per Foot



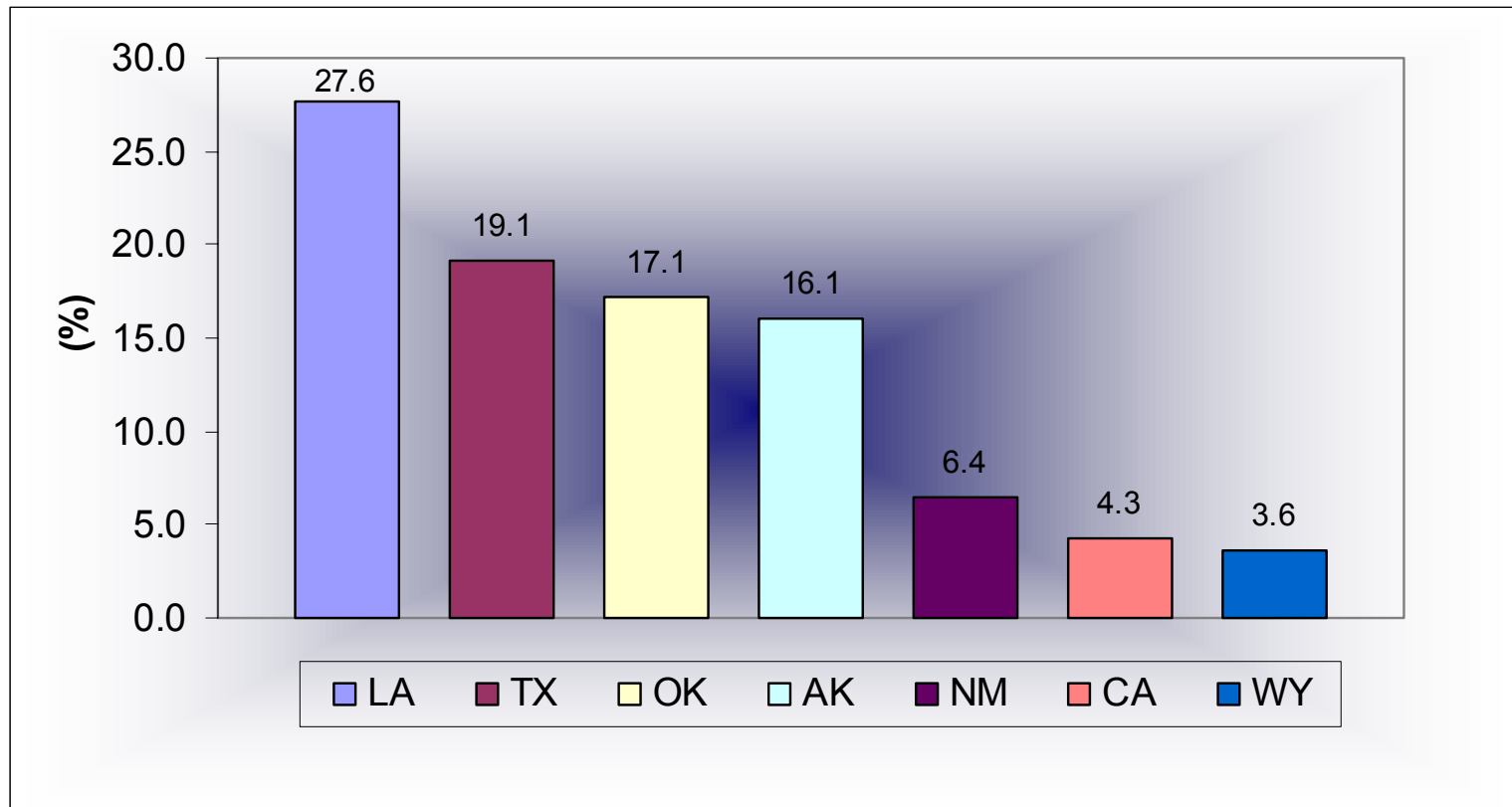
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U.S. Petroleum Producing States: Depletion Index Relative to 1998-01



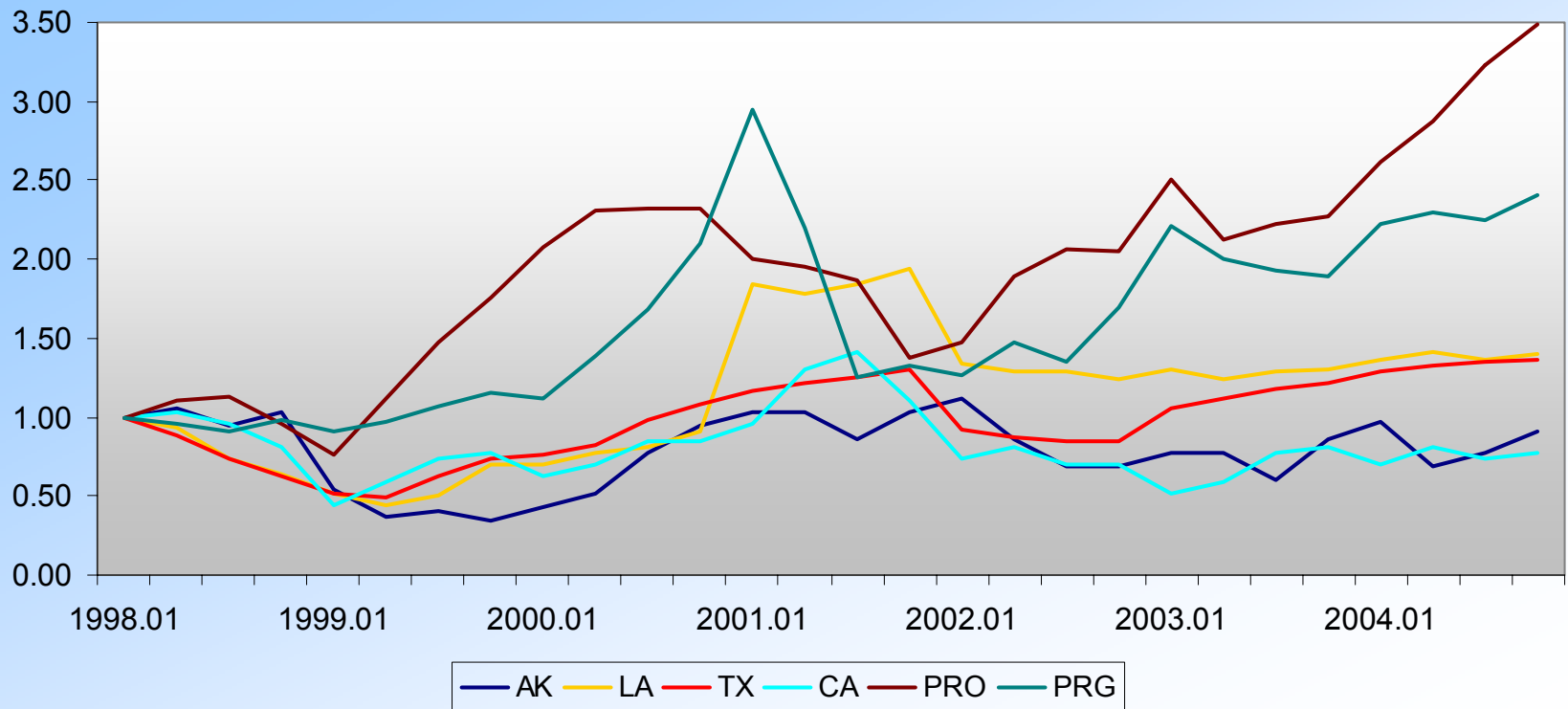
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Key U.S. Petroleum Producing States: Probability of Drilling Failure, 1998-2003

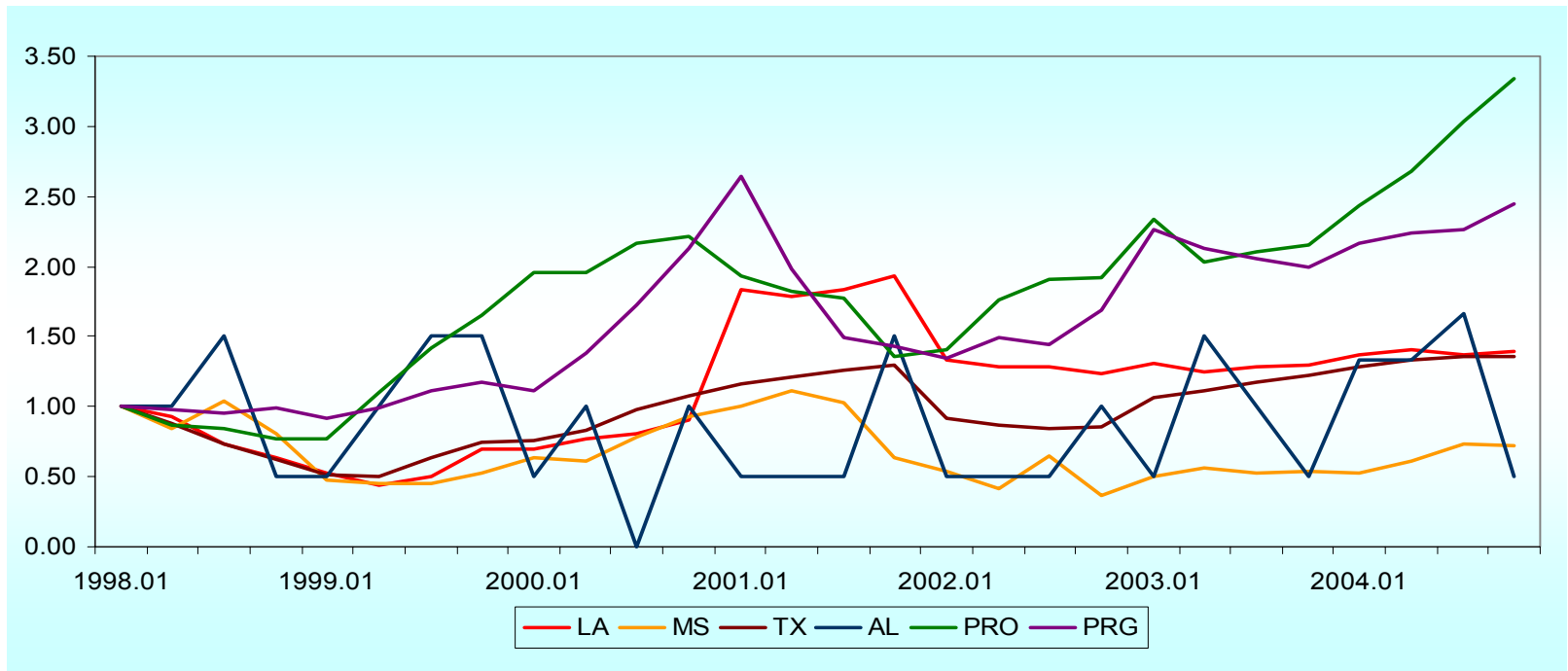


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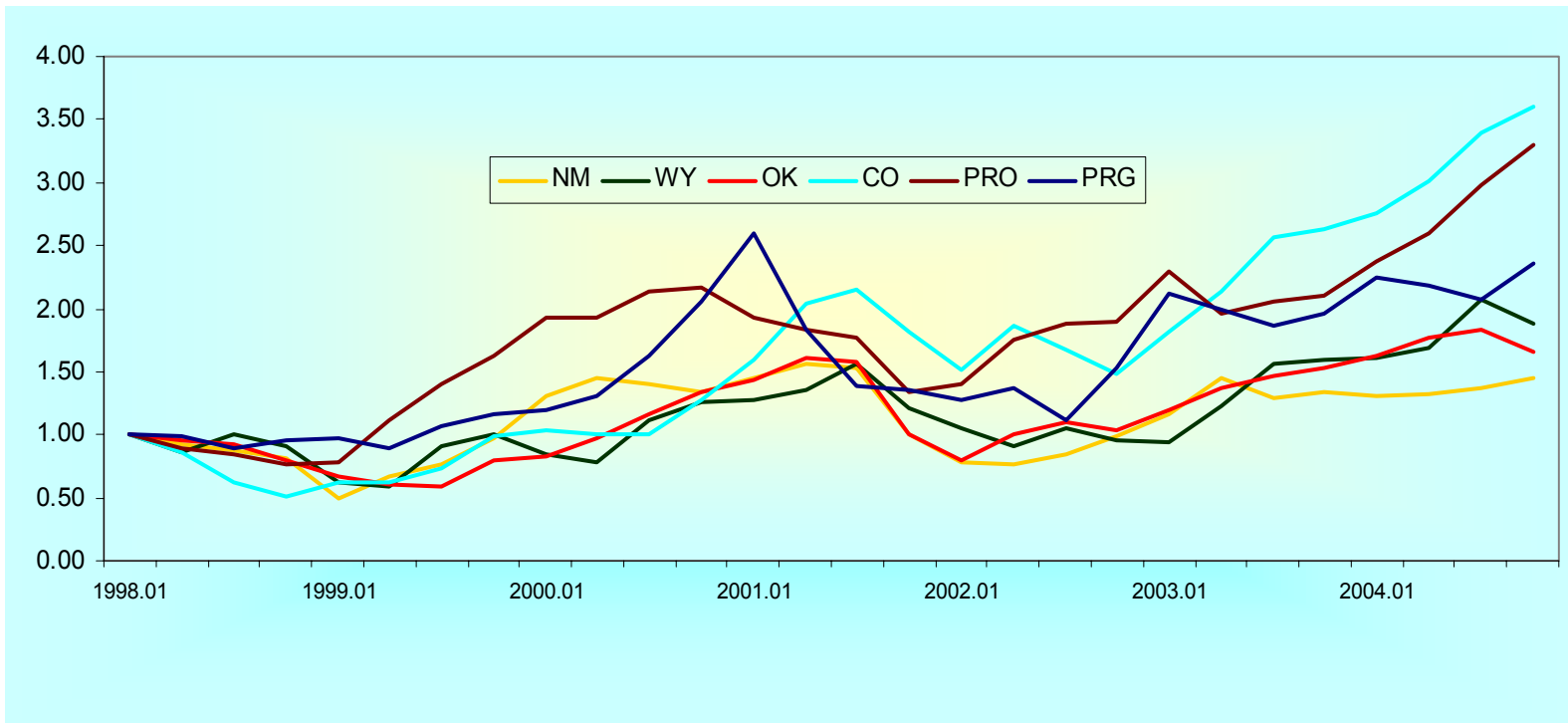
General Trends in Quarterly Rig Counts & Oil and Gas Prices, 1998-2004



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General Trends in Quarterly Rig Counts & Oil and Gas Prices, 1998-2004



Model of Drilling Rig Count in U.S. Petroleum Producing States

- Previous Studies:
- Data availability is a serious issue.
 - Appropriate regional data—daily, quarterly—series are less readily available for regions.
- Most regional data when and where available are annual limiting the span and adequacy for assessing price response and shocks.

Model of Drilling Rig Count in U.S. Petroleum Producing States

- **To circumvent these limitations, we focus on an oil and gas rich regions assuming no prior homogeneity across states.**
- **Panel data is very appropriate—test for homogeneity and data span no longer limiting issues.**

Methodology--Specification

- The model is given as follows:
 - $\log(\text{RIG})_{it} = \log(\text{PRO})_{it} + \log(\text{PRG})_{it} + \log(\text{DPI})_{it} + \log(\text{RIG})_{it-1} + u_{it}$
 - RIG = rig counts
 - PRO= oil price
 - PRG= natural gas price
 - DPI = depletion index since 1998-01
 - U = random error
- The model is empirical using quarterly data.

Methodology--Estimation

- We applied seemingly uncorrelated regression (SUR) to estimate the coefficients in equation (1).
- The SUR allows the error terms to be correlated between equations (states)
- The SUR estimates from feasible generalized least squares (FGLS) are more efficient than the ordinary least squares (OLS) estimates.
- In the future, we can still improve the efficiency of the estimation by allowing heteroskedasticity and autocorrelation within each state as well across states.

Estimated Model Results

State	Intercept	log(PRO)	log (PRG)	DPI	Log(LRIG))
AK	-0.625 (0.60)	0.482 (0.24)**	-0.023 (0.57)	0.007 (0.02)	0.563 (0.16)*
AL	0.398 (1.90)	0.492 (0.91)	-1.090 (0.94)	0.038 (0.05)	-0.104 (0.17)
CA	1.417 (0.74)	0.245 (0.29)	0.533 (0.18)*	-0.043 (0.02)*	0.159 (0.15)
CO	1.406 (0.46)	0.052 (0.18)	0.747 (0.14)*	0.127 (0.027)*	0.032 (0.10)
KS	-3.592 (0.99)	1.891 (0.44)*	0.277 (0.39)	-0.141 (0.03)*	0.344 (0.10)*
LA	1.201 (0.69)	0.222 (0.26)	0.925 (0.24)*	-0.020 (0.01)*	0.372 (0.08)*

Estimated Model Results(contd.)

State	Intercept	log(PRO)	log (PRG)	DPI	Log(LRIG))
MS	-0.571 (0.53)	0.911 (0.25)*	0.762 (0.34)*	-0.077 (0.017)*	-0.062 (0.17)
NM	-0.395 (0.53)	1.867 (0.23)*	0.141 (0.18)	-0.083 (0.015)*	-0.257 (0.14)**
ND	-4.246 (0.9)	2.495 (0.41)*	-0.266 (0.19)	-0.055 (0.03)*	-0.137 (0.08)
OK	0.408 (0.62)	0.820 (0.20)*	0.146 (0.26)	-0.010 (0.01)	0.326 (0.15)*
TX	2.682 (0.38)	0.429 (0.12)*	0.478 (0.09)*	-0.006 (0.01)	0.206 (0.07)*
WY	0.739 (0.64)	0.481 (0.23)*	0.039 (0.07)	0.018 (0.02)	0.378 (0.14)*

Estimated Model Results: Asymmetric Hypothesis

Tests for homogeneity of the elasticity of oil prices aselected states

Null Hypothesis	F-Statistic	P-Value
AK=AL	0	0.9916
CA=LA	0	0.9484
KS=NM=ND	1.51	0.2226
OK=MS	0.1	0.7549
TX=WY	0.06	0.8111

Estimated Model Results: Asymmetric Hypothesis

Tests for homogeneity of the elasticity of gas prices among selected states

Null Hypothesis	F-Statistic	P-Value
CA=TX	0.08	0.7811
CO=MS=LA	0.21	0.8083
KS=NM=OK	0.07	0.9316

Estimated Model Results: Asymmetric Hypothesis

Tests for differences between elasticity of oil price and gas price (F test)

H_0 : The coefficient of log oil price is equal to the coefficient of log gas price.

H_1 : The coefficient of log oil price is not equal to the coefficient of log gas price.

State	F-Statistic	P-Value
AK	0.76	0.3856
AL	0.98	0.3224
CA	0.51	0.4745
CO*	6.5	0.0116
KS*	5.83	0.0167
LA	2.54	0.1124
MS	0.1	0.753
NM*	29.58	0.0001
ND*	31.39	0.0001
OK	3.36	0.0684
TX	0.08	0.7789
WY	3.6	0.0593

* Indicates that the null hypothesis is rejected at 5% for the specific state.

Concluding Remarks

- The Gulf States future prospects in petroleum resource development are not as promising now in the early 1980s
- Every drilling indicators we examined indicates that the cost of drilling is rising because of increasing offshore activities in the 1990s
- There is strong evidence of significant between exploratory, wildcat, and development drilling with average well head price

Concluding Remarks

- A model of drilling activity suggests that:
 - the magnitude of the effects of real wellhead on oil and gas drilling is to some extent significantly inelastic in key U.S. petroleum producing states.
 - Our empirical results suggest, in an overall sense, a significant unsymmetrical response across states, however, some states do response
 - The effect of the direction of economic condition—positive oil price change viz a viz negative oil price change need a re-examination before any conclusion can be drawn
 - We plan to use quarterly data on drilling effort and outcome to improve on our preliminary results.