# *CES* Research Note

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## *Econometric modeling of deepwater petroleum exploration and development operations in the U.S. Gulf of Mexico*

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### Introduction

Petroleum industry analysts once thought that the Gulf of Mexico (GOM) region could no longer attract the big exploration and production (E&P) investors. However, the GOM has re-emerged as the key focal point of oil and gas activity in the world, especially with respect to deepwater operations  The reason for this turnaround has been attributed to several technical advancements in deep offshore drilling and production technology. Because of innovations in technology, areas in the Gulf of Mexico once thought beyond reach in terms of water depth are now explored and developed successfully. Several other factors underlying the turnaround in the attractiveness of the GOM region to E&P investors include the changing structure of the OCS oil and gas industry, government regulatory programs and fiscal incentives, technical progress, and the global market fundamentals resulting in high oil and natural gas prices.

### Methods

A hybrid model of deepwater petroleum exploration and development efforts and outcomes in the Gulf of Mexico OCS region from 1983 to 2005 was used to describe the deepwater reserves generation process. The model consists of three equations that measure a combination of engineering, geological, and geophysical data with economic data.  This hybrid model should limit the shortfalls of using just an engineering or econometric model specification framework.  The model framework applied  assumes that profit maximization subject to a diminishing rate of reserve discoveries over time is the fundamental driving force underlying petroleum exploration and development efforts.

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As firms explored and discovered new hydrocarbon fields, they would drill more wells within proved fields for finding more resources. Firms follow an exploration and development path that maximizes the net present value of returns from future investments. As output price changes, a competitive firm will alter its drilling effort to satisfy an optimality condition. Drillings that successfully find new reserves depend on the quality of geological knowledge collected about the basin, which increases with technological advancement.

**Results**

The three equations together describe the dynamics of the exploration and development process and were applied to estimate the responsiveness of reserves to its determinants in accordance with the functional form adopted to specify and estimate each component of the reserve identity model. The decomposed elasticity estimated from the model equations is presented in Figure 1.

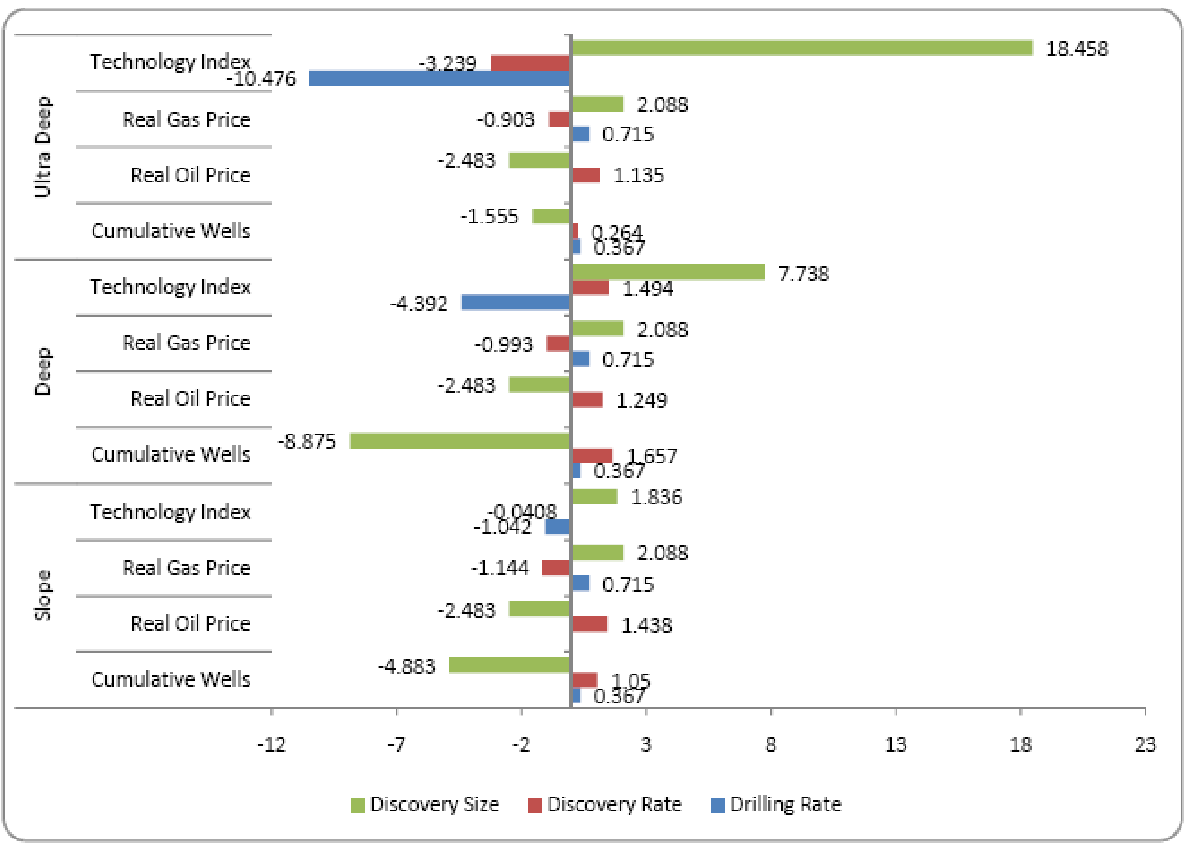


Figure 1. Responsiveness of Discovery Size, Drilling Rate and Discovery Rate to Technology, Economics, and Depletion.

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**Conclusion**

The estimated model results suggest that the drilling rate in the GOM deepwater is positively inelastic in its response to a natural gas price change but shows no evidence of a statistically significant effect of changes in real oil prices on drilling rate. The responsiveness of discovery rate to gas prices is also inelastic but negative, whereas its responsiveness to oil price change is positive and elastic. The responsiveness of the discovery rate to oil and natural gas prices becomes less negatively elastic to natural gas prices and positively elastic to oil prices with water depth in the Gulf of Mexico. In the aggregate sense, the overall reserves discovered were found to respond elastically and positively to natural gas price changes, *ceteris paribus*. The proxy for technology in our model is positive and its importance increases with water depth. In general and taking a bigger picture perspective on the statistical model results, there is enough statistical evidence to suggest that the effects of resource depletion on reserves discovered in the GOM deepwater is at present mitigated by advances in technology.