Balancing Rent Extraction and Project Execution: The Case of Auctions for Oil Leases in Marginal Fields in Mexico

This research models government revenues and project completion under different scoring rules in auctions for oil leases in Mexico.

- Every oil lease has a minimum royalty and work program. Bidders make offers on top of this.
- A formula converts bids into a score. The highest score wins the auction.
- In 2014 (Round 1.3), the government used the following scoring formula:

$S_{ij} = 0.9 \times 3.5 \times$	$\phi_{ij} + 0.1 \times 50 \times$	$(e_{ij})^{1/2}$
Score bidder i	Additional	Additional
for block j	royalty	investment

• By August 2019, 2 of 11 oil projects from Round 1.3 had moved to a development stage. The government argued that it had something to do with the high royalties bid at this auction



Figure 1:Timeline projects. Round 1.3

• In 2015 (Round 2.2 and 2.3), the government changed the formula and set a ceiling for the additional royalty:

$$S_{ij} = \phi_{ij} + \left(7.55 \times \frac{\phi_{ij}}{100} + 1.33\right) \times \underbrace{IF(e_{ij})}_{\text{Investment factor}}$$

- The government wanted to stimulate participation from local firms and avoid large (and potentially inefficient) investment obligations, which motivated the high weight on royalties.
- Auctions on contingent payments (such as royalties) can lead to aggressive bidding, since the project can be treated as a financial option (Kong, Perrigne, Vuong, 2019; Tufano, 1996)

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Figure 2:Production. Forecast and Realized. Round 1.3 Block

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• ML estimation for Gaussian random fields allows to estimate parameters reflecting the spatial dependence of the costs and the shock.

Model and Structural Estimation

uction stage: companies learn the operating c_{ij} nd investment cost γ_{ij} .

the evaluation stage, companies receive a shock (which is not known at the auction stage), that flects infrastructure and geology conditions, for cample, and decide whether to move to a evelopment stage.

[odel estimates the distribution of c_{ij} , γ_{ij} and ϵ_{ij}

$$\begin{array}{c|c} \begin{array}{c} \text{PEMEX} & \text{Evaluation (true } \epsilon_{ij}) \\ \hline 0 & T_{\uparrow P} & T_E & T_D \\ \hline & \text{Auction Development stage} \end{array}$$

der *i* problem is to maximize expected profits from ning block j.

$$\sup_{j,e_{ij}} E_{\epsilon} \left\{ \underbrace{\begin{array}{l} G(\phi_{ij},e_{ij}) \\ \text{Winning} \\ \text{probability} \end{array}}_{\text{investigation}} \left(\underbrace{\underbrace{\epsilon}_{\text{Unrealized}} - \underbrace{I(\gamma_{ij},e_{ij})}_{\text{Evaluation stage}} \\ \text{footnotesize investment} \\ + \underbrace{\pi_{ij}^{DEV}(\phi_{ij},a(\phi_{ij}),c_{ij},.)}_{\text{Development stage}} \right) | \epsilon \geq \epsilon \right\}$$

ere the expectation $E(\epsilon)$ is conditional on ϵ being ater than some value $\underline{\epsilon}$ so that firms will bid. In is model, the realization ϵ_{ij} of the shock is at allows a firm to win the auction but to complete the project.

use bid information, and firm and block naracteristics to estimate $G(\phi_{ij}, e_{ij})$. Ex-post cofit maximization conditions allows identifying c_{ij} . irst order conditions from the bidder problem low identifying the distribution of ϵ and γ_{ij} . $_{i}, \gamma_{ii}$: bivariate stationary Gaussian process, with mmon component model and spatially dependent. is univariate Gaussian, also with spatial dependence.





Findings suggest limitations to the use of royalties or contingent payments as bid dimensions, but also understand better how expectations are formed for bidders. Other energy projects with uncertainty, where bids could be aggressive (low electricity prices, for example), also potentially face shocks that delay project execution.

Results

• Mean c_{ij} : USD 15.5 per barrel

• Mean γ_{ij} : USD 2, 431 per working unit (around USD 8.5 million per exploratory well).

• Mean ϵ_{ij} : USD 10.92 million (between 5% and 21% of ex-post profits). Std. deviation USD 48.2 million

Under the new rules (ceiling on the additional royalty and the new scoring rule, the percentage of execution increases to 70%

• Firms with lowest operating cost only win between 20% and 30% of the blocks.



Simulated government revenues and firm profits under the new rules are more than twice those under the old scoring rule.