Title: An Econometric Analysis of MMS Area-Wide Leasing Versus Tract-Nomination Sales: Does Area-Wide Leasing Result in Lower Government Revenue?

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Abstract. In 1983, US Minerals Management Service (MMS) switched from the Lease Nomination sale format to Area-Wide Leasing (AWL). Since a complete econometric analysis of the effects of AWL on government revenue has not been conducted in almost twenty years, the purpose of this study was to determine the effects of AWL on government revenue. Results indicated that AWL reduced government revenue by $1,170 to $1,308 on a per acre basis, which is consistent with the findings in prior literature.

Keywords: *Area-Wide Leasing (AWL), Outer Continental Shelf (OCS), High Bonus Bids*

[1] The opinion, findings, and results in this paper are solely of the author and do not necessarily represent the views of the Minerals Management Service, Department of the Interior, or any other Federal or State agency.

1.0 Introduction and Purpose

The Outer Continental Shelf (OCS) is thought to have great potential to supplement US long-term energy needs. The US Minerals Management Service (MMS) oversees the leasing and revenue collection for the OCS. For oil and gas specifically, offshore tracts of land are leased to private companies, giving them rights to explore, develop, and produce any petroleum resources. In the lease auctions, the winning cash bid is referred to as the "high bonus bid", and once production begins lessees pay royalties on any production.

In 1983, MMS switched from the Lease Nomination sale format to Area-Wide Leasing (AWL). In the Lease Nomination sale design, companies nominate tracts in the OCS and request that MMS put the respective tracts up for auction. Tracts identified by companies would subsequently be evaluated by MMS officials for resource viability and, in most cases, would be offered in a future sale. In contrast, the Area-Wide Lease sale design offered very large areas such as the entire Gulf of Mexico, and companies would bid on the tracts of interest.

Proponents of AWL in 1983 suggested that the program would increase the overall supply of oil in the US. However, critics also suggested that by increasing the supply of leases in a given sale, lease prices would decline and government revenue would fall. In fact, the US Governmental Accountability (US GAO, 1985) Office estimated that Area-Wide Leasing resulted in an annual loss of seven billion dollars to the federal government. However, MMS officials did not agree (US GAO, 1986) that revenue fell due to ALW, as the notable drop in lease prices after 1983 was due to the world wide decline for petroleum.

Another contentious issue as a result of AWL was the unintended effects on states; critics indicated that the newly adopted lease design would cause the revenue of coastal producers to fall. Since coastal states receive a share of the revenue of offshore oil and gas production, an additional consequence of AWL may be that states such as Louisiana would lose revenue. Although several reports by US Governmental Accountability Office supported the notion that AWL

resulted in a decline in revenues to the federal government and coastal states, Moody et al. (1990) examined the welfare effects of switching from the tract-nomination sale process to area-wide leasing in 1983. The discrete choice two-stage probit analysis showed that the 1983 change to AWL, which increased the number of tracts offered, resulted in a higher supply of petroleum on the world market. However, the authors also noted that the increased supply caused oil prices to drop- resulting in a transfer of wealth from coastal to offshore producers. Also noted was the substantial reduction in government revenues.

Since a complete econometric analysis of the effects of AWL on government revenue in the Gulf of Mexico has not been conducted in almost twenty years, the purpose of the present study was to determine the effects of MMS policy on OCS offshore domestic oil and gas production, government revenues, and substitute coastal producers between 1979 to 2006. Specifically, I address whether AWL results in lower government revenue and high bonus bids in the Gulf of Mexico. As noted, in OCS lease auction the "high bonus bid" is the winning cash bid for the respective lease. I apply an econometric model to a large, recently-developed spatial data set and examine factors that influence leasing such as royalty rates, policy, and exogenous land characteristics. Corresponding changes in welfare are calculated based on variations in the policy.

The plan of this research paper is as follows. First, I address the recent literature that investigates the influence of AWL. Next, a conceptual model is developed and is used to specify the econometric bonus bidding model. I follow with a description of the data. Next, I use multiple regression analysis to identify the isolated effect of AWL on government revenue. Model results are subsequently presented, and implications for policy are discussed.

2.0 Background and Prior Literature

Very little research has addressed the effects of AWL. However, I summarize the notable studies that have implications for this analysis.

With the surge in worldwide oil prices in the seventies, several studies emerged to bridge our understanding of optimal fiscal policy and OCS leasing. Importantly, the Government Accountability Office (GAO, 1985) reported that the switch to AWL resulted in $3 to $7 billion in annual losses to the federal government.

A few years later, Farrow (1987) used an econometric model to estimate effects of AWL on bonus bids. The author used a two-stage equation, where the first stage was the number of bids and the second stage was high bonus bid. The model also used dummy variables for various types of OCS leases such as Drainage, Wildcat, and Proven leases. Farrow (1987) found, based on his sample, that AWL did not have a statistically significant effect on bonus bids.

Moody et al. (1990) subsequently examined effects of AWL with the most robust econometric analysis of AWL to date. In contrast to Farrow (1987), the authors noted the significant drop in bonus bids from AWL. Moody[2] et al. (1990) also expressed concern about the effect of AWL on coastal states in the Gulf of Mexico (GOM):

"*Lower lease prices could result in a transfer of wealth to the oil companies bidding on OCS leases. Tracts owned by coastal states are substitutes for OCS tracts. These tract values can be expected to decline with OCS lease prices, representing a significant loss of revenue to states with offshore deposits, especially Texas and Louisiana (p.30)*".

Clearly, AWL was a very controversial policy decision. In fact, White (1984) noted that the governor of Texas had a particular objection to the MMS policy and indicated that the decline in lease prices due to AWL caused massive losses to the state. The governor also expressed concern that AWL would result in a windfall gain to oil producers, clearly a concern in a current era of record high oil prices where a given barrel of crude petroleum exceeds one hundred dollars per barrel, even after correcting for inflation.

According to Moody et al. (1990), MMS officials disagreed that AWL resulted in a decline in lease prices and government revenue. In fact, MMS officials stated that there was no evidence to suggest that MMS was receiving less for a given block as a result of AWL (US Department of the Interior, 1984). Instead, MMS officials contended the drop in lease prices after 1983 was a reflection of the overall worldwide drop in petroleum resources worldwide. MMS also argued that many tracts in AWL had previously been picked over and were tracts that were reoffered from prior sales. Also, MMS suggested that many tracts in AWL were in deeper water. Given the increased of drilling and exploration risks in tracts in deeper water in the OCS, the decrease in lease prices via AWL was a result of the decreased demand for deepwater tracts (US Department of the Interior, 1984, 13).

In order to econometrically estimate the changes in bonus bids as a result of AWL, Moody et al. (1990) used a two stage model. The first stage of the model was the number of bids, and the second stage was the bonus bid. The two stage model was used to take into account the endogeneity of number of bids in the bonus bids model.

The authors used panel data to reflect the information from multiple bids occurring over time; there were many sales in each year, and each sale had tracts with unique characteristics. Results from the econometric analysis were fairly conclusive. Based on the sample, AWL was statistically significant in lowering bonus bids and lease prices. As such, the isolated effect of AWL on bonus bids was unambiguously negative based on the sample. For example, the authors estimated that the switch to AWL resulted in a loss of 2.6 billion dollars in annual federal revenue, approximately $1337 per acre- even in 1986 when oil prices had surged to an all time high (p. 37).

Next, IIedare (2004) et al. quantified the empirical determinants of high bonus bids for oil and gas leases in the OCS. The authors used the log of high bonuses as the dependent variable with multiple regression, as explained by number of bids[3], oil price, location, bidding arrangement (i.e.,

[3] It is worth noting that IIedare (2004) used number of bids as an independent variable to explain high bonuses. However, Moody et al. (1990) and Farrow (1995) used two stage least squares to account for number of bids as an endogenous

joint or single bid), firm size, water depth, and dummy variables that represent Wildcat, Development, and Proven leases. The results of the regression indicate that approximately 34% of the variation in the dependent variable (high bonus bid) is explained by the variation in the explanatory variables. IIedare's (2004) model utilized data subsequent to the implementation of AWL and is therefore not directly applicable in explaining impacts of AWL on government revenue. However, the regression model is useful for our purposes in determining an appropriate specification for this analysis.

Over a decade passed before Hurricane Katrina generated a renewed interest in AWL. Recently, Nebresky (2007) showed that the quantity of oil and gas leases increased significantly with the implementation of AWL on Alaska's North Slope in 1998. Using Two Stage Least Squares (2SLS), the author estimated the change in bonus bids per acre from AWL. Similar to Moody et al. (1990) and Farrow (1987), the first stage of the model was number of bids, and the second stage was high bonus. Explanatory variables included oil prices, endogenous firm costs, location, resource viability, etc. The authors found that the decline in bonus bid per acre with AWL dropped $1136 per acre[4] (p.170).

The implications of the prior studies are as follows. First, Two Stage Least Squares is most likely the preferred econometric estimator to explain effects of AWL on high bonus, since bidding variables are often endogenous. Secondly, prior literature tells us that the following variables are commonly used to explain high bonuses: number of bids, oil price, location, bidding arrangement (i.e., joint or single bid), firm size, water depth, and dummy variables that represent Wildcat, Development, and Proven leases. Lastly, over the range of the data for the prior studies, AWL has been found to be a statistically significant variable and has an inverse effect in determining high bonuses. However, the results from the prior studies are not conclusive. For example, although Moody et al. (1990) and

variable. Number of bids cannot be used as an explanatory variable in this regression and the results from IIedare (2004) are, by definition, biased and inconsistent,

[4] Specifically, on page 170 the author indicates that the price per acre under AWL was $55 and the price under the tract nomination system was $1191 per acre. The approximate loss in bonuses was therefore $1136/acre ($1190-$55).

Nebresky (2007) found that AWL decreases bonuses, Farrow (1987) found that AWL had no significantly significant effect on high bonuses.

The following conceptual framework illustrates the effects of AWL on bonuses. I used simple Laws of Supply and Demand, as applied to OCS leases, to generate a hypothesis that will be tested econometrically in the empirical context of this analysis.

3.0 Conceptual Framework

Following Moody et al. (1990) closely, the market for OCS leases can be expressed as functions of Supply and Demand in Figure 1. The vertical axis represents the price of a given OCS lease, as determined by winning high bonus bid in an OCS lease sale. The horizontal axis is the quantity of OCS leases, as determined by MMS. Initial Supply (S_0) of OCS leases is perfectly inelastic, since MMS determines quantity. OCS producers face a downward sloping initial Demand function (D_0), due to the Law of Demand. Initial equilibrium price (P_0) and quantity of (Q_0) OCS leases are also shown in Figure 1. Equilibrium price and quantity represent the point where the market for OCS leases "clears," where the quantity demanded of OCS leases equals the quantity of OCS leases awarded by MMS.

The introduction of AWL resulted in a massive increase in the number of awarded leases in the OCS. For example, IIedare et al. (2004) noted that the average number of tracts per sale under the nomination system was about 300, while the average number of tracts awarded under AWL averaged 5000 (p.240). Given that OCS Supply of leases are the individual sum of horizontal Supply curves, the Supply function would therefore, by definition, shift rightwards under AWL. The new equilibrium lease price and quantity is now P_1 and Q_1.

Moody et al. (1990) noted that MMS officials disagreed that AWL results in a drop in OCS bonuses (p. 30, 31). Instead, MMS believed that the lower resulting bonuses after 1982 corresponded to the worldwide drop in the demand for petroleum resource, as expressed by D_1. The resulting new

Figure 1. Supply and Demand of OCS Leases: Effects of Area-Wide Leasing

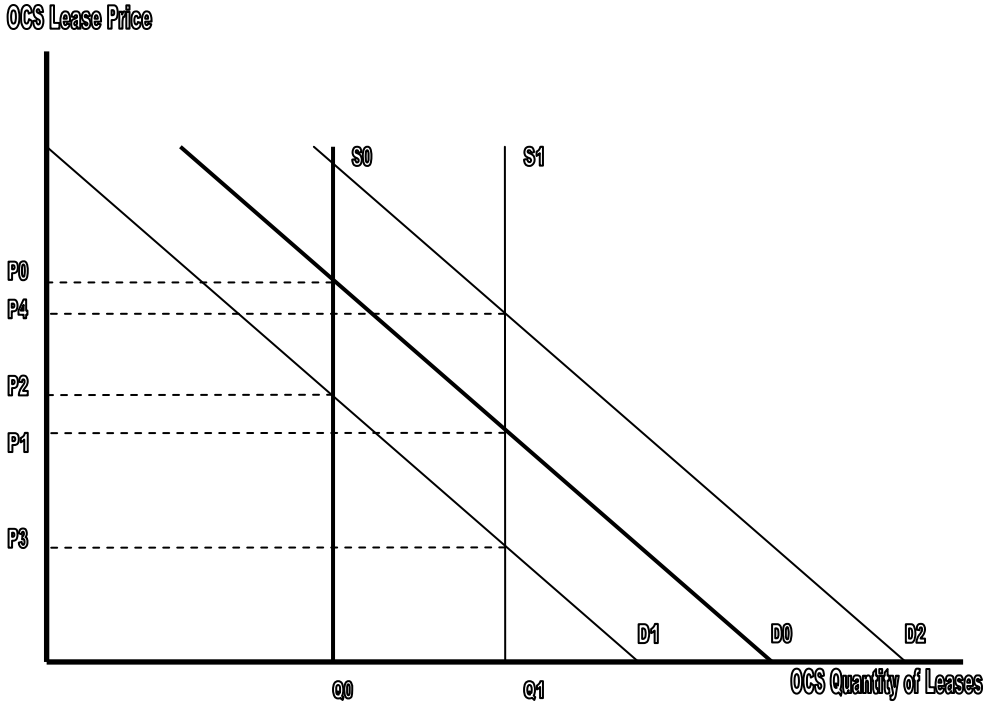

Figure 1. The vertical axis represents the price of a given OCS lease, as determined by winning high bonus bid in an OCS lease sale. The horizontal axis is the quantity of OCS leases, as awarded and determined by MMS. Initial Supply (S_0) of OCS leases is perfectly inelastic. OCS producers face a downward sloping initial Demand function (D_0), due to the Law of Demand. Moody et al. (1990) noted that MMS officials disagreed that AWL results in a drop in OCS lease prices and lower bonuses (p. 30, 31). Instead, MMS believed that the lower resulting bonuses after 1982 corresponded to the worldwide drop in the demand for petroleum resource, as expressed by D_1. The resulting new equilibrium price and quantity from the lower demand D_1 are expressed as P_2 and Q_0. In reality, the lower lease prices and bonuses subsequent to 1982 were probably the result of a combination of AWL and the fall in the world wide demand for petroleum, as given by P_3 and Q_0. However, in a time of soaring gas prices, it is unlikely that the demand for OCS remains at D_1. Clearly, the demand function D_2 and equilibrium price and quantity P_4 and Q_1 are more representative of the current market for petroleum resource.

equilibrium price and quantity from the lower demand D_1 are expressed as P_2 and Q_0. In reality, the lower lease prices and bonuses subsequent to 1982 were probably the result of a combination of AWL and the fall in the world-wide demand for petroleum, as given by P_3 and Q_1.

However, in the current era of soaring gas prices, it is unlikely that the demand for OCS remains at D_1. Clearly, the demand function D_2 and equilibrium price and quantity P_4 and Q_1 are more representative of the current market for petroleum resources. Based on the simple Laws of Supply and Demand, the isolated effect of an *increase* of leases from AWL would force lease prices and bonuses

to *fall*. However, given that OCS leases are a Factor Demand (i.e., land) for oil producers, Demand for leases should rise. If the shift in Demand is greater than the shift in Supply, bonuses will increase after AWL. However, if shift in Demand is less than the shift in Supply, bonuses will increase after AWL. Given the massive increase in number of awarded leases, I hypothesize that bonuses will fall with the implementation of AWL. The following section discusses the data.

4.0 Data Structure

I utilize publicly available data for OCS issued leases from the public MMS website[5], sold in 1979-1996. Data include various tract characteristics such as location, water depth, royalty rates, proven tracts, and any prior leasing or development at the same location. A spatial database with distances to the nearest active lease is also included[6]. Table 1 provides definitions and summary statistics for parameters used in this analysis. The following is a description of the data as well as each variable's expected relationship with high bonus bid:

1. **N_Bids.** N_Bids is the variable that represents the number of bids associated with each lease sale. A positive and statistically significant sign is anticipated for N_Bids, as the number of bids in a respective sale is likely to push up the winning bonus bid.

[5] Data was obtained from the public MMS website. The "Swiler" report with information on bonus bids and other statistics are available at: http://www.gomr.mms.gov/homepg/lsesale/swiler/Table_1.PDF .

[6] The spatial database was created by existing MMS databases contain explicit data such as Lease Boundary Vertices, Lease Effective Date, Lease Status Code, etc. As an example block boundary vertices can be used to compute the center of the block. Using the center of the blocks then inter block distances were computed. Then using lease effective date and lease expiration data a temporal dimension of the database were generated. Block vertices are available for download http://www.gomr.mms.gov/homepg/pubinfo/repcat/arcinfo/index.html. Data such as tract depth, royalty rates, lease status, and lease type are available at: http://www.gomr.mms.gov/homepg/pubinfo/freeasci/leasing/freeleas.html

Table 1. Variable Definitions

Variable	Definition
1. Dependent Variable:	
High_Bid	High winning bonus bid
2. Independent Variables:	
N_Bids	Number of bids
OilPrice	Inflation adjusted real price of a barrel of oil
Depth	Water depth of tract
Risk	Economic risk associated with the tract
Produced	Whether tract has produced in the past
Reoffered	If tract was not sold in prior sale, reoffered in this sale
Acres	Acres of particular tract
Area-Wide	Dummy variable for AWL (=1 after 1982; =0 prior to 1983)
Geol	Evidence that the given tract has petroleum resources
L12	Number active leases within 12 mile radius
L30	Number active leases within 30 mile radius
Wildcat	Lease that has never been drilled
Drainage	Lease near proven area and shares similar characteristics
Proven	Lease proven to have petroleum resource
Development	Lease that has been drilled but is yet to produce
Royalty Rate	Royalty rate for lease

2. **OilPrice.** Due to the Law of Supply, the real price of a barrel of oil should clearly have a significant and direct relationship with bidding decisions.
3. **Depth.** The water depth associated with the particular lease is expected to have an inverse relationship with high bonus bid since tracts in deeper water offer more elements of risk to oil producers.
4. **Risk.** The parameter for risk is an index of the variability associated with Net Income of oil companies; the standard deviation of net income to oil producers is used to proxy economic

risk. The expected sign for this variable is ambiguous and is determined by the individual producer's level of risk aversion.

5. **Produced.** Whether the tract has produced in the past, and is anticipated to have a positive effect on bidding.
6. **Reoffered.** Reoffered is the variable that represents whether a tract was not leased in a previous sale, and it has been reoffered in the current sale. It is anticipated that this variable will be inversely related to high bonuses, since tracts that are reoffered were not leased in the prior sale are indication that the given tract was not desirable to OCS producers.
7. **Geol.** Geol is a variable to represent evidence that the given tract has petroleum resources, and is expected to have a direct relationship with high bonuses.
8. **L12.** L12 is the number of active leases within a twelve mile radius, which is expected to be positively related to high bonus bid. The radius of twelve miles was used for this variable since this radius would encompass all abutting tracts to the given tract.
9. **L30.** L30 is the number of active leases within a 30 mile radius, and is anticipated to be expected to be directly related to the high bonus bid. The 30 mile radius includes all active leases that are "*abutting the abutting"* leases to the given tract; L30 is actually the outer ring of active leases, and that does not include L12 leases.
10. **Acres.** Acres is the variable that represents the number of acres on the respective OCS tract, and is expected to positively related to bidding.
11. **Wildcat.** The Wildcat variable represents a lease that is known to have petroleum resources, but has yet to be leased or actually produced. The expected sign for this variable is positive.
12. **Drainage.** Drainage leases are abutting proven tracts and share similar geological characteristics. It is very likely that the regression will yield positive and statistically significant results to explain bonus bids.

13. **Development.** Development leases have been drilled but have yet to produce petroleum resources. We would expect that the isolated effect of a development lease on bidding to be positive.
14. **Proven.** Proven leases have been shown to have petroleum resources. The isolated effect of this variable on bidding is positive.
15. **Royalty Rate.** Royalty is the amount paid to the federal government for the leasing of land in the OCS, and is defined as a percentage of gross production. *Ceteris Paribus*, due to the Law of Demand, the isolated effect of increased royalty should decrease bidding, since royalty is a function of the Input Demand function for OCS producers.
16. **Area-Wide.** Area-Wide is our main policy variable and is a dummy variable that indicates the switch to AWL in 1983. Clearly, from theory, historical evidence, and prior literature we would expect that the influence of AWL on high bonus bids to be negative, *Ceteris Parabis.*

The following section describes the econometric specification used in this analysis. I subsequently present results and implications for policy.

5.0 Econometric Specification, Results, and Policy Implications

Econometric Specification

In order to econometrically test[7] the effect of AWL on high bonus bids, I used multiple regression analysis. Since the data for this analysis takes the form of multiple lease sales from 1979 to 1996[8], several panel data models were tested in regression to explain bonus bids. First of all, I considered the Fixed Effects (FE) model. The FE model would be useful for our purposes because it allows for unique intercepts across panels and increases statistical efficiency. However, one limitation

[7] I employ various hypothesis tests in order to ensure regression estimates are consistent, efficient, and unbiased If the estimator is found to be inconsistent, inefficient, or undbiased, MLR will not provide reliable predictions on the influence of the explanatory variables on the dependent variable.

[8] I used data between 1979 to 1996 because creation of the Spatial Database eliminated most observations before 1979 and subsequent to 1996.

of the FE model is that it only accounts for variation within panels. As such, the FE model could not be used in this analysis because it ignores variation across panels and our policy variable for AWL could not be included in the model.

The Random Effects (RE) model was also used to estimate high bonuses various regressions. The advantage of the RE model is that variation across panels as well as within panels is included in the regression. Unfortunately, the unique Variance-Covariance matrix in RE makes is subject to inconsistency of the model due to independent variables being correlated with the error term. In the RE model, the "composite" error term is often correlated with explanatory variables and is often inconsistent. Hypothesis tests revealed that the RE model of bonus bids is inconsistent at the 99% confidence level, and is therefore not appropriate for this analysis.

The preferred estimator is 2SLS with a pooled Generalized Least Squares (GLS) regression model, since N_Bids is an endogenous variable. Using a variant of the Hausman Specification test, the null hypothesis of exogeneity of N_Bids was rejected at the 99% confidence level. The test indicates that if we had assumed N_Bids was exogenous, OLS would have returned biased and inconsistent regression estimates. Similarly, using the Breusch Pegan test, the null hypothesis of constant variance was soundly rejected at the 99% confidence level. In this case, if we had used OLS regression estimates would have been inefficient and standard errors would have been inflated.

Lastly, I tested for the presence of omitted variables in the regression specification. I rejected the null hypothesis of no omiited variables at the 99% significance level. Clearly, it is not surprising that there are omitted variables present in a model that explains bonus bidding in the OCS since there are so many unknown factors that could influence bidding.

I used the Box-Cox method to evaluate alternative functional forms for the regression function. This method transforms the dependent variable, independent variables, or both, to identify the appropriate nonlinear transformation. Pindyck and Rubinfeld (1991, pp. 240-243) define the Box-Cox model as:

(4) $$\frac{y^{\lambda_1}-1}{\lambda_1}=\beta_0+\sum_i \beta_i\left(\frac{x_i^{\lambda_2}-1}{\lambda_2}\right)+\varepsilon$$

where y is the dependent variable, x_i is the ith independent variable, the β's are regression parameters, ε is a stochastic error term, and the λ's are Box-Cox parameters. If $\lambda_1 = \lambda_2 = 1$, equation (4) is equivalent to the linear form $y-1=\beta_0+\sum_i \beta_i(x_i-1)+\varepsilon$. If $\lambda_1 = \lambda_2 = 0$, then (in the limit) equation (4) becomes the double log form $\ln y=\beta_0+\sum_i \beta_i \ln x_i+\varepsilon$. A third possibility is $\lambda_1 = 0$ and $\lambda_2 = 1$, where (4) is equivalent to the semi-exponential form $\ln y=\beta_0+\sum_i \beta_i x_i+\varepsilon$. Various models were fit with alternative values of λ_1 and λ_2, and the results were compared based on overall goodness-of-fit. These comparisons suggested the most appropriate of the three models for our bidding equation was the linear functional form ($\lambda_1 = \lambda_2 = 1$).

Results

Table 2 shows results for the regression analysis of high bonuses. Only the second stage of the 2SLS models are shown. Four models are used to estimate the effects of exogenous influences[9] on high bonuses on OCS leases including a Base Model, Lease Model, Spatial Model, and Combined Model.

The Base Model includes a set of exogenous variables that were found to be statistically significant in most regression tests, and also includes the main policy variables such as OilPrice and Area. The lease model includes all the variables in the Base Model, plus dummy variables for Drainage, Proven, and Wildcat Leases. Development leases were excluded to avoid a dummy variable trap.

The Spatial Model includes all the variables for the Base Model plus the spatial variables L_12 and L_30. Recall that L_12 is the number of active leases in a twelve mile radius and is hypothesized to directly affect bonuses. Similarly, L_30 is the number of active leases in a 30 mile radius and is

[9] In all models, Following Moody et al. (1990) N_Bids is an endogenous variable, and is instrumented by the geological viability of the OCS tract.

Table 2[Ψ]: Two Stage Least Squares Regression Results

Variable	Base Model	Lease Model	Spatial Model	Combined Model
Constant	2767887	776415.1	2.28e+07*	3.22e+07*
N_Bids	1723532	2554914***	-1378896	-1245582
OilPrice	91544***	91141***	289305***	330828.8 ***
Depth	-1613 ***	-1609***	-------	-------
Risk	39984 *	22859	3291609***	3645359*
Viability	-767	-1764	-152903	-183490*
Reoffered	-1.03e+07***	-9837914***	-------	-------
Acres	78.00	59.00	-------	-------
Area-Wide	-7544483***	-6740769***	-3.42e+07***	-3.46e+07 ***
L12	-------	-------	38081.99	35816.99
L30	-------	-------	21806*	17037.72
Wildcat	-------	-------	-------	-------
Drainage	-------	1586464***	-------	6928404
Proven	-------	1203873	-------	1.85e+07
Development	-------	-1099430	-------	-8832049
Royalty	-------	-------	-------	-790560*
Observations	6890	6890	428	428
F-Statistic	72.55	64.55	9.39	6.28
Prob > F	0.0000	0.0000	0.0000	0.0000
Adj R-squared	0.2639	0.2971	0.3578	0.3733

[Ψ] *** indicates 99% level of confidence, ** indicates 95% level of confidence, * indicates 90% level of confidence

expected to have a positive effect on leasing. The Combined Model includes the variables in the Base model plus leasing dummy variables, spatial variables, and the variable for royalty rate.

Results in the base model indicate that OilPrice, Depth, and Reoffered are statistically significant and have the expected sign according to our hypothesis from theory. For example, OilPrice is positive indicating that the isolated effect of an exogenous increase in real oil prices has a direct effect on bonuses. Also, reoffered is negative and significant, which is consistent with our hypothesis since these are tracts that were not sold in prior sales and therefore are less desirable to OCS producers. Also, the influence of increased depth on bonuses is negative; the isolated effect of an increase in water depth causes a reduction in bonuses for the firms in this sample. Several other variables in the Base

Model were either insignificant or an unexpected sign. Given that our prior hypothesis tests indicated the presence of omitted variables at the 99% confidence level, the sign reversals in this model are not surprising.

The most profound result in the Base Model is the coefficient on Area-Wide. The parameter is significant at the 99% confidence level, and yields a negative sign. Assuming that an average OCS tract is 5760 acres, the average amount that an AWL reduces bonuses[10] is approximately $1309.80 per acre (=$7,544,483/5760). The result is comparable to Moody et al. (1990) and Nebresky (2007), which found that AWL drops bonuses by $1337 and $1136 per acre, respectively.

The Lease Model provides similar results for signs and statistical significance of parameters. More importantly, the model indicates over the given sample that the reduction per acre as a result of AWL is approximately $1170 (=$6,740,769/5,760).

Although the Spatial and Combined Model produce interesting results, a significant amount of observations were lost in creation of the spatial variables. As such, the Spatial and Combined models are probably not as reliable for policy interpretation. For example, notice the massive loss in observations in the Base and Lease Model from over 6000 observations to less than 500 observations in the Spatial and Combined Model. In addition, although the F-Statistics in the Spatial and Combined models are significant, the drop in magnitude in the F-Statistic is of concern.

Policy Implications

Based on lease sales over 1979 to 1996, the exogenous influence of AWL for this sample of leases is negatively related to high bonus bids. The most robust models in the present analysis showed that AWL causes a fall of bonuses between $1170 to $1309, per acre. Prior literature has yielded similar results.

It is important to note that the regression models in this analysis have significant limitations for policy. First, the data only consists of lease sales between 1979 and 1996 and may or may not be

[10] All results are unadjusted for inflation.

transferable to the current time period. However, out-of-sample tests could be used to examine whether the results of this analysis are applicable to policy decisions about AWL in the current era.

It is also worth noting that this analysis has only considered the loss of bonuses as a result of AWL. I did not consider the positive effects of AWL, such as an increase in oil supply. For example, if the exogenous influence of AWL caused an increase in oil produced, the isolated effect of an increase in oil supply would reduce oil prices paid to consumers. Clearly, whether or not to use AWL in OCS lease sales is a complicated policy decision that has many considerations.

4.0 Conclusions

The OCS is thought to have great potential to supplement US long-term energy needs. MMS oversees the leasing and revenue collection for the OCS. Since a complete econometric analysis of the effects of AWL on government revenue in the Gulf of Mexico has not been conducted in almost twenty years, the purpose of this study was to determine the effects of AWL on government revenue. Specifically, I estimated the welfare effects of switching from the tract-nomination sale process to Area-Wide Leasing in 1983.

Regression results are identified characteristics that influence measures of OCS leasing, e.g., how many tracts are leased and how much is paid for them. Royalties, tract characteristics, resource potential, water depth were found to significantly influence leasing.

The most significant finding in this analysis is that on a per acre basis, AWL reduces bonus bids by $1170 to $1308. The result is strikingly similar to Moody et al. (1990) and Nebresky (2007), which found that AWL drops bonuses by $1337 and $1136 per acre, respectively.

It is also important note that this study did not simply duplicate the results of Moody et al. (1990) and Nebresky (2007). In fact, the beauty of this study is that my findings were generated with a different time period and econometric specification.

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