A Comment on 'Rewarding Impatience'

Ben Goodrich

In Lisa Blaydes's article, "Rewarding Impatience: A Bargaining and Enforcement Model of OPEC," (*International Organization*, Spring 2004), the oil production of members of the Organization of Petroleum Exporting Countries (OPEC) depends on the extent to which they discount future gains.[1] This comment discusses computer-related errors in the original article and determines how the results change when the errors are rectified. I then add country fixed effects and some additional control variables to the corrected models.

Overall, the empirical results are less persuasive than originally claimed. There is evidence for Blaydes's hypothesis in a cross-sectional model, but there is virtually no evidence for Blaydes's hypothesis in fixed-effects models, which rely exclusively on temporal variation in the data. Thus future research on this topic should seek additional control variables and new proxies for OPEC members' discount rates in order to resolve these discordant findings.

Blaydes's Predictions

Blaydes's theoretical model is an extension of Fearon's model where the bargaining and enforcement stages are distinct.[2] In Blaydes's model, the production quota for each OPEC member is bargained over in the first stage and in the second stage, each OPEC member decides whether to exceed its negotiated quota. Following Fearon, Blaydes's main theoretical point is that OPEC members consider the probability of defection in the second stage when negotiating quotas in the first stage.

I would like to thank Lisa Blaydes for data and helpful discussions and to thank Jim Alt and Mike Kellerman for comments on previous drafts. All remaining errors are my own.

1. Blaydes 2004.
2. Fearon 1998.

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Let δ_{it} be the discount rate for country *i* at time *t*, which is bounded between 0 and 1. An OPEC member that discounts future payoffs more heavily (in the sense that its δ_{it} is closer to 0) is more likely to defect in the enforcement stage of a repeated prisoner's dilemma game. This credible threat to defect is a source of strength in the bargaining stage. Hence, the more impatient an OPEC member, the more that country is rewarded with a generous production quota in a negotiated agreement among cartel members. Blaydes claims support for this general hypothesis in a wide variety of empirical specifications.

Nothing in this comment should be taken as a criticism of Blaydes's theoretical model. I am no expert on OPEC, so I will confine my comments to the methodology and to computer-related errors. Blaydes's data span the eleven OPEC members and cover the years from 1960 to 1995. The dependent variable is the natural logarithm of the annual crude oil production for country *i* at time *t*. The only "control" variable is the natural logarithm of proven oil reserves (LN PROVEN RESERVES), aside from a lagged dependent variable, which Blaydes intended to include in some specifications.

The following variables are put forward by Blaydes as proxies for δ_{it}, which is the key causal variable: the natural logarithm of per capita proven reserves (LN PER CAPITA RESERVES), the natural logarithm of per capita proven reserves squared (SQUARED LN PER CAPITA RESERVES), a dummy variable indicating Saudi Arabia (SAUDI ARABIA DUMMY), a dummy variable indicating the years after 1986 (POST-1986 DUMMY), the interaction of Saudi Arabia and post-1986 variables (INTERACTION), a dummy variable indicating a regime transition (UNSTABLE) in country *i* and year *t*, the total number of past regime transitions (STTR) in country *i* through year *t*, and STTR squared (SQUARED STTR).[3]

These proxies for δ_{it} deserve further explanation. Holding total reserves constant, an increase in per capita reserves implies a decrease in population. Blaydes contends that such circumstances would take some population pressure off the regime and make it more patient. Thus LN PROVEN RESERVES should be negatively related to present oil production. Blaydes's theoretical model also predicts that this effect could be nonlinear, necessitating SQUARED LN PER CAPITA RESERVES. Briefly, when oil prices are higher, the benefits to cooperation increase for patient states, but the temptation to cheat increases for impatient states. Thus a ratcheting up dynamic could occur.

The SAUDI ARABIA, POST-1986, and INTERACTION variables are used by Blaydes to rebut the hypothesis that Saudi Arabia achieved relative gains as a result of its decision to flood the market with oil in late 1985 and 1986, which depressed oil prices.[4] In Blaydes's view, Saudi Arabia has a long time-horizon (in the sense that its δ_{it} is closer to 1) and could not credibly commit to a sustained predatory strat-

3. I use Blaydes's variable abbreviations.
4. This hypothesis was made in Alt, Calvert, and Humes 1988.

egy that would threaten the survival of the cartel. Thus Blaydes believes that INTERACTION should be insignificantly different from 0.

Finally, Blaydes makes the straightforward argument that countries experiencing regime transitions have short time-horizons at time *t*. A new regime should be eager to collect rents while it can or to cement its hold on power by producing more oil. Thus the coefficient for UNSTABLE should be positive. Furthermore, OPEC members with a history of regime transitions can credibly contend that more generous production quotas would help prevent future regime transitions.[5] Thus STTR should be positive. Again, the effect of past regime transitions is predicted to be nonlinear, necessitating SQUARED STTR.

A Reanalysis of Blaydes's Results

This section replicates and corrects some of Blaydes's specifications. Blaydes has four basic specifications, respectively focusing on LN PER CAPITA RESERVES (and SQUARED LN PER CAPITA RESERVES), INTERACTION, UNSTABLE, and STTR (and SQUARED STTR). For each of these four specifications, Blaydes usually runs each model with and without the squared terms and runs each with and without a lagged dependent variable.

I have reanalyzed every specification Blaydes presents, although not every reanalysis is presented here for space reasons.[6] I present corrections only for models that include both lagged dependent variables and squared terms. The reasons for this selection are as follows. First, Blaydes, in practice, did not actually include a lagged dependent variable in any model because of problems with the computer code. When the correct lagged dependent variable is included, the squared terms are always insignificant, and excluding the squared terms makes no substantive difference to the corrected results.

Second, for the models without lagged dependent variables, Blaydes reported panel-corrected standard errors (PCSEs) based on ordinary least squares (OLS) rather than generalized least squares (GLS) estimates. PCSEs are biased in the presence of autocorrelation, but one does not know the direction of the bias. Thus researchers should either include a lagged dependent variable or use GLS in order to eliminate autocorrelation before calculating PCSEs.[7] For this and other rea-

5. Blaydes derives this hypothesis from Przeworski et al. 2000.

6. Stata code to reanalyze each of Blaydes's specifications is available at ⟨http://www.people.fas.harvard.edu/~goodrich/Research/PE/OPEC.do⟩. Accessed 22 December 2005.

7. See Beck and Katz 1995, 638: "Any serial correlation of the errors must be eliminated before the panel-corrected standard errors are calculated." Beck and Katz 1996, however, shows that the GLS approach and the lagged dependent variable approach are both special cases of a more general model.

sons, these estimates should not have been used for inference in the original.[8] However, I have reestimated these models using GLS, and the results were qualitatively similar to the results presented in this section.

One might ask, if the GLS results are similar, why focus on models with lagged dependent variables?[9] It is easy to include country fixed effects in models with lagged dependent variables, which is done in the next section. Although it is also easy to include fixed effects in GLS models, the Stata algorithm for calculating PCSEs does not handle the fixed effects properly, in my opinion, when GLS is used.[10] Thus determining whether country fixed effects are important is not practical in GLS models, so the results from lagged dependent models are presented here as a prelude to the next section.

Table 1 replicates four models (using Blaydes's model numbers) and shows how the results change when the intended specification is estimated. Essentially, only Model 3 is supportive of the original findings. In Blaydes's Model 3, the lagged dependent variable was the lag of crude oil production, rather than the lag of the dependent variable—the natural logarithm of crude oil production.[11] Although SQUARED LN PER CAPITA RESERVES is insignificant when the correct lagged dependent variable is included in Model 3, LN PER CAPITA RESERVES remains negative and significant.

The fact that the (short-run) effect of LN PER CAPITA RESERVES shrinks in magnitude when the correct lagged dependent variable is included is to be expected. The long-run effect of LN PER CAPITA RESERVES (about -0.06) can be calculated by dividing the short-run effect by the quantity 1 minus the coefficient of the lagged dependent variable.[12] This long-run elasticity indicates that if reserves were held constant and a country's population were cut in half, one would expect that country's production to be only 6 percent lower (ignoring SQUARED LN PER CAPITA RESERVES) in the long run.[13] To me, this effect seems substantively small.

8. Among the other reasons include the finding in Kristensen and Wawro 2003 that PCSEs perform more poorly when unit fixed effects are excluded from the model. Kristensen and Wawro generally prefer clustered standard errors to PCSEs. However, only PCSEs are appropriate for a small *N*–large *T* application. Goodrich 2005 shows that the pooled OLS estimator implicitly downweights the temporal variation in the sample and the resulting standard errors are incorrect unless the implicit weights are accounted for.

9. Beck and Katz 1996 offers tests of whether the lagged dependent variable approach or the GLS approach is reasonable. I have performed these tests for the fixed-effects models in the next section and found that neither approach is well supported by the data. However, a more general model does not provide additional support for Blaydes's hypothesis.

10. The essential characteristic of fixed-effects models is that the residuals have a mean of zero for every country. This property does not hold for Stata's PCSE algorithm if the GLS option is chosen.

11. Blaydes clearly intended to include the lag of the dependent variable in logarithmic form. "Model 3 builds on Model 2 and is expanded to included a lagged dependent variable term to check the robustness of the model. I use a logarithmic transformation of the variables to correct for skewness and avoid the problem of heteroskedasticity." See Blaydes 2004, 229.

12. The standard error of a long-run estimate can be calculated using the delta method approximation. The delta method involves a Taylor-series expansion but can be calculated automatically in Stata.

13. If the effect of SQUARED LN PER CAPITA RESERVES were taken into account, the estimate would be more negative but less precise.

TABLE 1. *Replication and correction of selected models in Blaydes 2004*

	Model 3		*Model 6*		*Model 8*		*Model 12*	
Variables	*Blaydes*	*Correct*	*Blaydes*	*Correct*	*Blaydes*	*Correct*	*Blaydes*	*Correct*
LN PROVEN RESERVES	0.461	0.141	0.837	0.141	0.699	0.072	0.682	0.077
	(0.038)	(0.022)	(0.049)	(0.023)	(0.039)	(0.026)	(0.032)	(0.026)
LN PER CAPITA RESERVES	−0.078	−0.016	−0.135	−0.020				
	(0.014)	(0.008)	(0.021)	(0.008)				
SQUARED LN PER CAPITA RESERVES	−0.013	−0.003	−0.011	−0.003				
	(0.004)	(0.002)	(0.005)	(0.002)				
ONE-YEAR LAG LN CRUDE PRODUCTION	0.000	0.734	−0.055	0.723	0.016	0.820	0.046	0.813
	(0.000)	(0.024)	(0.046)	(0.023)	(0.046)	(0.032)	(0.044)	(0.032)
SAUDI ARABIA DUMMY			0.116	0.121				
			(0.106)	(0.057)				
POST-1986 DUMMY			−0.337	−0.099				
			(0.128)	(0.045)				
INTERACTION SAUDI ARABIA POST-1986			0.137	0.111				
			(0.116)	(0.072)				
UNSTABLE					0.348	0.113		
					(0.061)	(0.204)		
CUMULATIVE REGIME TRANSITIONS							0.405	0.040
							(0.100)	(0.080)
CUMULATIVE REGIME TRANSITIONS SQUARED							−0.102	−0.015
							(0.045)	(0.038)
Constant	2.237	0.581	−0.597	0.678	0.151	0.637	0.030	0.629
	(0.354)	(0.118)	(0.403)	(0.142)	(0.421)	(0.216)	(0.374)	(0.211)
Observations	385	385	385	385	175	174	176	175
R^2	0.715	0.922	0.633	0.925	0.681	0.930	0.696	0.931

Note: Dependent variable is logged crude oil production. Panel-corrected standard errors in parentheses. "Blaydes" results for Model 12 are not quite identical to the original.

In Models 6, 8, and 12, the lagged dependent variable was in natural logarithm form, but the data were not sorted when it was created. Thus the values for the lagged dependent variable corresponded to arbitrary years rather than the year before. When the correct lagged dependent variable is included as Blaydes intended, STTR and SQUARED STTR are unambiguously insignificant in Model 12.

There was an additional mistake in the original Model 8. Blaydes misinterprets UNSTABLE from Przeworski et al. 2000 as indicating that a regime transition occurred in year *t*.[14] In fact, UNSTABLE equals 1 for all years if a country ever experienced a regime transition between 1950 and 1990. Thus Nigeria (regime transitions in 1966, 1979, and 1983) and Venezuela (regime transition in 1959) are coded as 1 on UNSTABLE in all years and Algeria, Indonesia, Iran, and Iraq are coded as 0 for all years.

Kuwait, Libya, Qatar, Saudi Arabia, and the United Arab Emirates are not included in Przeworski et al.'s data set but presumably would always be judged autocratic.[15] An event is considered to be a regime transition only if a country goes from an autocracy to a democracy or the reverse; transitions that remain autocratic (notably Iran in 1979) or democratic do not count as regime transitions. One avenue for further research on OPEC would be to relax this rather conservative definition of instability because of regime transitions.

The instability variable Blaydes intended for Model 8 happens to be equivalent to the first difference of STTR, which is included in Table 1 along with the correct lagged dependent variable. The effect of the revised UNSTABLE variable is insignificant. This finding ought not be surprising (or definitive) because the only regime transitions in the sample are the three for Nigeria.

The remaining specification in table replication is Model 6, which focuses on Saudi Arabia and its decision to flood the market with oil in late 1985 and 1986. According to Alt, Calvert, and Humes, Saudi Arabia's predatory pricing strategy was intended to establish a reputation for toughness within OPEC. According to Blaydes, Saudi Arabia has an especially long-time horizon and could not credibly commit to an indefinite pricing strategy that would threaten the survival of OPEC. To test these possibly competing hypotheses, Blaydes includes a dummy variable indicating Saudi Arabia, a dummy variable that equals 1 after 1986 for all countries, and the interaction of these two variables.

Blaydes interprets the insignificance of INTERACTION as support for the latter hypothesis, and INTERACTION remains insignificant when the correct lagged dependent variable is included. However, when there are interaction terms in a model,

14. See Blaydes 2004, 232. "Models 7 and 8 test the effect of the Przeworski et al. variable, UNSTABLE; in years where this variable is coded 1, regime transitions took place." In fairness, the codebook for Przeworski et al.'s data set could have been clearer for the UNSTABLE variable.

15. This presumption is supported by Cheibub and Gandi 2004, which uses similar coding rules to extend Przeworski et al.'s sample to additional countries, including the five excluded here. Both data sets are available from Cheibub's Web site at ⟨http://pantheon.yale.edu/~jac236/DATASETS.htm⟩. Accessed 22 December 2005. Including these five countries does not affect inferences about UNSTABLE, STTR, or SQSTTR.

TABLE 2. *Interpretation of variables in multiplicative models*

Variables	*Interpretation of coefficient, all else constant*
SAUDI ARABIA DUMMY	Δ in production by Saudi Arabia through 1986, relative to baseline
POST-1986 DUMMY	Δ in production by OPEC members excluding Saudi Arabia after 1986, relative to baseline
INTERACTION	Δ in production by Saudi Arabia after 1986, relative to SAUDI ARABIA
INTERACTION (minus) POST-1986 DUMMY	Δ in relative production by Saudi Arabia after 1986, which can be interpreted as the gain by Saudi Arabia to flooding the oil market
	Long-run estimate of Δ in relative production
From Table 1, Model 6	0.758 (0.370)
From Table 3, Model 6a	0.525 (0.373)
From Table 3, Model 6b	0.098 (0.213)

Note: The baseline is “unexplained” production by OPEC members excluding Saudi Arabia through 1986. Panel-corrected standard errors are in parentheses and are calculated via a Taylor-series expansion. Long-run estimates are calculated by dividing the difference between the coefficient on the interaction term and the coefficient for the POST-1986 DUMMY VARIABLE by the quantity 1 minus the coefficient of the lagged dependent variable.

care must be taken when interpreting the coefficients.[16] Dummy variables must always be interpreted relative to a baseline, which in this case is the unexplained oil production by OPEC members besides Saudi Arabia through 1986. Ceteris paribus, the coefficient for SAUDI ARABIA indicates the difference in Saudi Arabian production through 1986 relative to the baseline. The coefficient for INTERACTION indicates the change in Saudi Arabian production after 1986 relative to SAUDI ARABIA. The coefficient for POST-1986 indicates the change in non–Saudi Arabian production after 1986 relative to the baseline.

Table 2 summarizes these interpretations and illustrates that the quantity of interest is not the coefficient for INTERACTION but rather the difference between the coefficient for INTERACTION and the coefficient for POST-1986. This difference indicates how the relative production gap between Saudi Arabia and its OPEC counterparts changed after 1986. In other words, it is a difference-in-difference estimate; the difference between Saudi Arabia and other OPEC members in the change in each’s oil production in the post-1986 era relative to the pre-1986 era. Although the positive coefficient for INTERACTION is (borderline) insignificant in Table 1, the coefficient for POST-1986 is significant and negative. Thus the difference between these two coefficients is positive and significant in the long run, indicating that Saudi Arabia made relative gains in production (presumably at higher

16. For general articles on interaction terms, see Friedrich 1982; Braumoeller 2004; Brambor, Clark, and Golder 2006; Franzese and Kam 2005.

prices), holding other factors constant.[17] However, this result does not hold up in the next section.

In summary, this section has shown that Blaydes's conclusions are generally not supported by the intended models. In particular, SQUARED LN PER CAPITA RESERVES, UNSTABLE, STTR, and SQUARED STTR are insignificant. INTERACTION remains insignificant but its coefficient is not the correct quantity of interest for analyzing the Saudi Arabian case. The only support for Blaydes's hypothesis is the negative and significant estimate for the effect of LN PER CAPITA RESERVES, and this conclusion is questioned in the next section.

Alternative Estimates

In unpublished work, I defend the strong claim that pooled OLS models should never be used for time-series cross-section data, and thus I do not endorse even the corrected estimates in the previous section.[18] Although the justification for this claim is too long and technical to be included here, I maintain that pooled OLS models are likely to produce biased coefficients and biased standard errors in time-series cross-section models. This section investigates how the corrected models fare when country fixed effects are added to Blaydes's models. I then add additional control variables.

In linear models, fixed effects render coefficient estimates unbiased, and a strong justification would be needed to favor the pooled OLS estimator, whose coefficients are usually biased by omitted country-specific effects.[19] Although not a general rule, adding fixed effects often pushes the coefficient estimates toward 0. Blaydes cites Kennedy's textbook as justification for using neither a fixed-effects nor a random-effects estimator in this case.[20] However, the particular sentence in Kennedy's textbook seems inconsistent with common practice.[21] In Blaydes's case, the traditional criteria would favor a fixed-effects estimator: (1) the dependent variable is continuous, (2) there are thirty-six years of data for each country, and (3) the eleven OPEC members are the population (rather than a sample) of OPEC.[22]

17. I would especially like to thank Jim Alt for emphasizing this aspect of the results for Model 6.

18. Goodrich 2005.

19. See Green, Kim, and Yoon 2001 for one example of this well-known result. Goodrich 2005 illustrates the same problem in a different way.

20. Blaydes 2004, fn. 27.

21. See Kennedy 1998, 231: "Fixed and random effects models are usually employed when the number of cross-sectional units is large and the number of time periods over which those units are observed is small." Kennedy's statement seems accurate for random-effects models only; fixed-effects models are often employed when the number of cross-sectional units is small and the number of time periods is large.

22. In contrast to Kennedy's odd statement in the previous footnote, Kennedy also correctly states, "If the data exhaust the population (say observations on all firms producing automobiles), then the fixed effects approach, which produces results conditional on the units in the data set, is reasonable." Ibid., 227.

The only well-accepted reason to omit country fixed effects that is applicable in this case is that the covariates of interest do not change that much over time, making it difficult to obtain precise estimates. For example, 94 percent of the variation in LN PER CAPITA RESERVES is cross-sectional, and what temporal variation there is may reflect random fluctuations in proven reserves rather than genuine shifts in a country's patience. However, only 37 percent of the variation in the dependent variable is cross-sectional. Thus whatever does explain temporal variation in oil production probably can be estimated with reasonable precision.

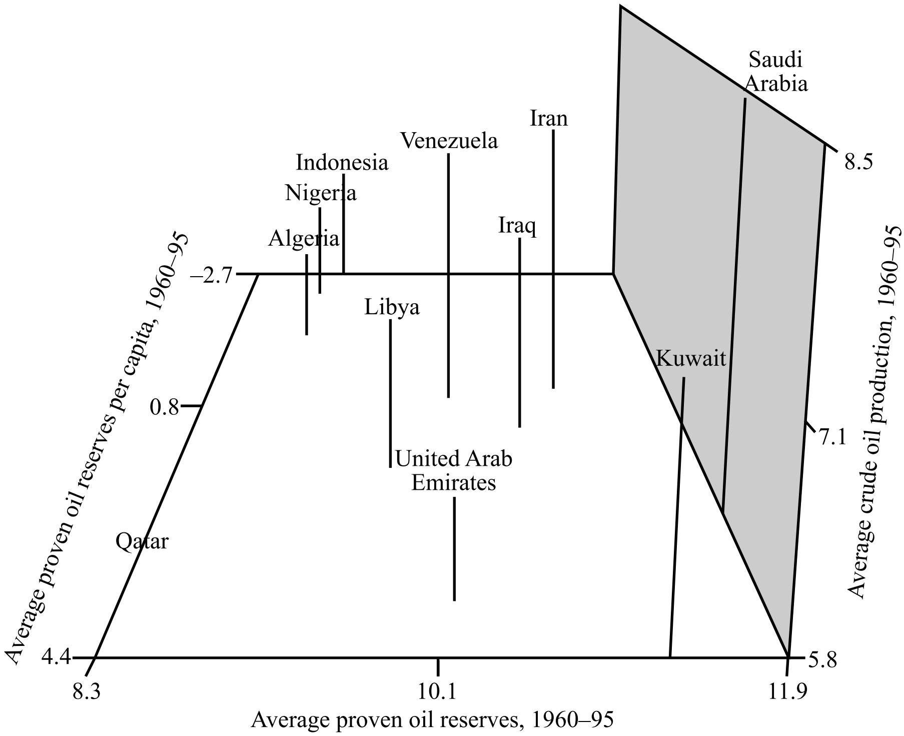
It is true that the fixed-effects estimator discards all the cross-sectional variation in the data. However, the fixed-effects estimator can be supplemented with a between estimator. The between estimator is simply a cross-sectional regression where the country-means of the dependent variable and independent variables are used in a linear regression. Thus the average of logged crude oil production for each OPEC member over the thirty-six sample years is regressed on its average LN PROVEN RESERVES, average LN PER CAPITA RESERVES, and so on. The between estimator is a complement to, and the antithesis of, the fixed-effects estimator because it discards all the temporal variation in the sample.

The data for the between estimator are graphed in Figure 1. The dependent variable is on the vertical axis and the key causal variable—the country-means of LN PER CAPITA RESERVES—is on the depth axis. The general pattern is exactly how Blaydes describes it. Indonesia, Nigeria, and Algeria have approximately the same average reserves in the sample period but different population sizes, and the same relationship is true for Venezuela versus the United Arab Emirates and for Iran versus Kuwait. Although the relationship appears linear, logged reserves per capita does appear to be negatively related to production.

All the evidence for Blaydes's hypothesis is encapsulated in Figure 1 and whether the evidence is persuasive depends on how far one is willing to push conclusions about discount rates with eleven observations on a proxy variable. Holding reserves constant, countries with more people tend to produce more oil. Blaydes's theoretical model provides one way to interpret this stylized fact.

However, when the data are graphed over time as in Figure 2, there does not seem to be a consistent relationship between logged crude oil production and LN PER CAPITA RESERVES—controlling for LN PROVEN RESERVES and country dummies. Blaydes's hypothesis seems plausible over time only for Indonesia and, to a lesser extent, for Algeria, Iraq, Kuwait, and Venezuela in the earlier part of the sample. However, there are countertrends for other countries and countertrends for these same countries in later sample periods. Figure 2 also strongly suggests that one should control for the Iranian Revolution, the Iran-Iraq War, the Persian Gulf War, and the subsequent sanctions on Iraq. I do so with four dummy variables, which I dub the "conflict variables."[23]

23. These four dummy variables are respectively coded as 0, except for Iran in 1979, Iran and Iraq between 1980 and 1988, Iraq and Kuwait in 1990 and 1991, and Iraq from 1992 onward.

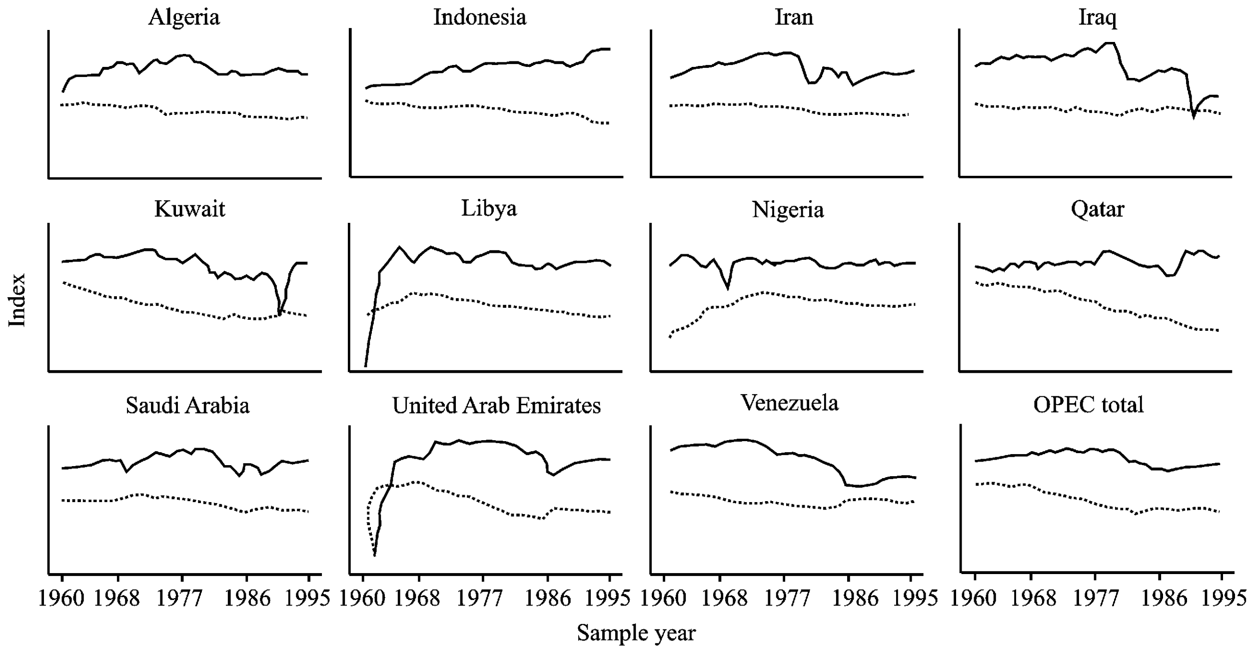


Note: All variables were in logarithmic form before country averages were taken.

FIGURE 1. *Graphical representation of data for a between estimator*

Also, the last panel in Figure 2 indicates that for OPEC as a whole, oil production (controlling for LN PROVEN RESERVES and country dummies) trended upward until 1980, downward until 1986, and slowly upward thereafter. One could criticize Blaydes's models because they do not attempt to model the demand for oil production. Clearly, the supply side pertains directly to Blaydes's theoretical model, but the demand side may explain the upward trends in oil production and should be incorporated into the control variables. The simplest way to do so is to include a dummy variable for each sample year (except one), which controls for changes in world demand for oil relative to the excluded baseline year. When including these year fixed effects, I take 1986 as the baseline.

The evidence in Table 3 merely formalizes what is already obvious in Figures 1 and 2. The first column is a between estimator version of Blaydes's Model 3. In an initial test, the country means of SQUARED LN PER CAPITA RESERVES were insignificant, and SQUARED LN PER CAPITA RESERVES is excluded from the between estimator. With this not entirely justifiable exclusion, LN PER CAPITA RESERVES is



Crude oil production ——— Proven oil reserves per capita ············

Note: Both variables condition on proven oil reserves and country dummies. All referenced variables are in natural logarithmic form. The Y-axis is scaled so that the mean of each variable is constant across countries.

FIGURE 2. *Graphical representation of data for a fixed-effects model*

TABLE 3. *A between estimator and fixed-effects models based on Blaydes 2004*

Variables		*Based on Model 3*		*Based on Model 6*	
LN PROVEN RESERVES	0.715	0.015	0.187	0.021	0.185
	(0.097)	(0.052)	(0.094)	(0.069)	(0.095)
LN PER CAPITA RESERVES	−0.138	0.079	−0.029	0.073	−0.028
	(0.046)	(0.042)	(0.079)	(0.057)	(0.079)
SQUARED LN PER CAPITA RESERVES		−0.003	0.001	−0.003	0.001
		(0.005)	(0.006)	(0.005)	(0.006)
ONE-YEAR LAG LN CRUDE PRODUCTION		0.734	0.667	0.732	0.667
		(0.025)	(0.025)	(0.026)	(0.025)
SAUDI ARABIA DUMMY				0.170	0.166
				(0.099)	(0.090)
POST-1986 DUMMY				−0.020	
				(0.056)	
INTERACTION SAUDI ARABIA POST-1986				0.121	0.040
				(0.072)	(0.064)
IRANIAN REVOLUTION DUMMY			−0.522		−0.523
			(0.194)		(0.194)
IRAN-IRAQ WAR DUMMY			−0.067		−0.066
			(0.067)		(0.067)
PERSIAN GULF WAR DUMMY			−1.144		−1.141
			(0.169)		(0.169)
SANCTIONS ON IRAQ DUMMY			−0.506		−0.502
			(0.128)		(0.129)
Constant	0.102				
	(0.957)				
Fixed effects?	No (between estimator)	*Countries only*	*Countries and years*	*Countries only*	*Countries and years*
Observations	11	385	385	385	385
R^2	0.872	0.932	0.957	0.932	0.957

Note: Dependent variable is logged crude oil production. Fixed effects are not reported. Panel-corrected standard errors are in parentheses, except for the OLS standard errors reported for the between estimator. A between estimator is a cross-sectional regression using the eleven country-means of log crude oil production as the dependent variables as the dependent variable and the eleven country-means of log proven reserves and log proven reserves per capita as the independent variables.

statistically significant (despite having only eleven observations) and has the expected negative sign.

However, there is no support for this hypothesis in the second column of Table 3 because LN PER CAPITA RESERVES has a positive sign and is borderline significant when country fixed effects are included. The sign of LN PER CAPITA RESERVES becomes negative again but remains substantively and statistically insignificant when one includes year dummy variables to control for oil demand and includes the conflict variables. The coefficients for the year variables are not shown in Table 3 but are generally significant before 1986 and usually insignificant thereafter, as would be predicted from the last panel of Figure 2. The effect of the Iran-Iraq war is insignificant, but all four of the conflict variables have large negative effects on oil production.

The same procedure is applied to Blaydes's Model 6, which focuses on Saudi Arabia. When country fixed effects are included, the effects of INTERACTION and

POST-1986 shrink in magnitude relative to those in Table 1. As was noted in Table 2, the difference between the coefficient for INTERACTION and the coefficient for POST-1986 is now insignificant. Calculating the quantity of interest is more difficult when the year dummy variables (and the four conflict dummy variables) are added because POST-1986 is perfectly collinear with the year dummy variables. The last row in Table 2 reflects the average difference between INTERACTION and the nine-year dummy variables after 1986, divided by 1 minus the coefficient of the lagged dependent variable. It is insignificant and small in magnitude.

Thus the evidence in Table 1 for the predatory hypothesis seems to be driven by the absence of fixed effects but perhaps more so by the latter part of the Iran-Iraq War, the Persian Gulf War, and the sanctions imposed on Iraq, all of which coincide with the post-1986 era.[24] This finding provides weak support for Blaydes's hypothesis. However, when fixed effects are included, UNSTABLE, STTR, and SQUARED STTR remain unambiguously insignificant (not shown in Table 3).

In summary, this section has shown that even LN PER CAPITA RESERVES, the variable Blaydes identifies as most central, is insignificant when country fixed effects are added to the model. On the other side, a between estimator finds clear support for the hypothesis that patience is negatively related to oil production, and Saudi Arabia's predatory pricing strategy—whatever its intent—does not seem to have had a significant effect on relative production shares.

Conclusions

This comment has substantially reduced the empirical support for Blaydes's original hypothesis, which is that as impatience increases, oil production increases. Impatience was theorized to increase the probability of defection in the enforcement stage; thus impatient countries should be able to use this fact to their advantage and bargain for a larger production quota in OPEC negotiations.

However, the variables UNSTABLE and STTR do not produce significant results when the specifications Blaydes's intended are estimated, and the predicted nonlinear effects of patience are not found. When fixed effects are included, LN PER CAPITA RESERVES is insignificant. On the plus side, Saudi Arabia's strategy of flooding the oil market in late 1985 and 1986 apparently did not produce significant relative gains, which provides weak support for Blaydes's hypothesis. But the results regarding Saudi Arabia and regime transitions should not be considered conclusive because the variables used to operationalize these hypotheses are rather crude.

The between estimator indicates that there is a significantly negative linear relationship between average LN PER CAPITA RESERVES and the average logarithm of oil production for each country. This finding is the strongest support for Blaydes's hypothesis but is disputed by the fixed-effects model. In other words, there is sup-

24. In a personal communication June 2005, Jim Alt argued that the conflict variables are not entirely exogenous to oil markets and OPEC decisions.

port for the hypothesis that a country's average patience over the period from 1960 to 1995 is negatively related to its average oil production. However, there is little evidence for the temporal hypothesis that as a country's discount rate increases over time, its current oil production decreases.

I do not use pooled models, in part, because they obscure this tension, which is often revealed when the cross-sectional and temporal variation are modeled separately. The divergence between the cross-sectional and temporal estimates for LN PER CAPITA RESERVES may genuinely reflect an interesting phenomenon but more likely is because of some omitted variable or measurement error. Although the cross-sectional evidence seems compelling, with only eleven units of observation any hypothesis regarding OPEC members' behavior will have difficulty responding to the criticism that the variation is "just country X's uniqueness"—unless the same hypothesis can be supported controlling for country fixed effects. The main point to take away is that the cross-sectional and fixed-effects estimates for LN PER CAPITA RESERVES appear inconsistent, and there is no obvious explanation for this divergence.

Fixed-effects models have stronger statistical theory behind them, but one does not have a good theoretical model to explain the (rather large) variation in oil production over time for OPEC members. Most of the variation can be explained, but only with ad hoc variables such as year dummies, a lagged dependent variable, and idiosyncratic events such as the conflict variables. None of these variables are particularly interesting, and hopefully future research will be able to add to this list. In particular, researchers might want to model the demand for oil explicitly, rather than rely on year dummy variables. Another research strategy might use production quotas, rather than production, as the dependent variable. Blaydes states that production quotas are not measured well, but production quotas would bear more directly on hypotheses about the OPEC bargaining process. In general, future research should look for additional control variables that may affect oil production and should seek other proxies for discount rates. Despite the fact that the empirical evidence is much weaker than originally claimed, it should be noted that Blaydes's theoretical model is plausible and future research may uncover stronger and more consistent evidence for the hypothesized relationship.

References

Alt, James E., Randall L. Calvert, and Brian D. Humes. 1988. Reputation and Hegemonic Stability: A Game Theoretic Analysis. *American Political Science Review* 82 (4):445–66.

Beck, Nathaniel, and Jonathon N. Katz. 1995. What to Do (and Not to Do) with Time-Series–Cross-Section Data. *American Political Science Review* 89 (3):634–47.

———. 1996. Nuisance vs. Substance: Specifying and Estimating Time-Series–Cross-Section Models. *Political Analysis* 6 (3):1–36.

Blaydes, Lisa. 2004. Rewarding Impatience: A Bargaining and Enforcement Model of OPEC. *International Organization* 58 (2):213–37.

Brambor, Thomas, William Roberts Clark, and Matt Golder. 2006. Understanding Interaction Models: Improving Empirical Analyses. *Political Analysis* 14 (1):63–82.

Braumoeller, Bear F. 2004. Hypothesis Testing and Multiplicative Interaction Terms. *International Organization* 58 (4):807–20.

Cheibub, Jose, and Jennifer Gandi. 2004. Classifying Political Regimes: A Sixfold Classification of Democracies and Dictatorships. Paper presented at the 100th Annual Meeting of the American Political Science Association, Washington, D.C., September. Available at ⟨http://pantheon.yale.edu/~jac236/⟩. Accessed 22 December 2005.

Fearon, James D. 1998. Bargaining, Enforcement, and International Cooperation. *International Organization* 52 (2):269–305.

Franzese, Robert J., and Cindy Kam. 2005. Modeling and Interpreting Interactive Hypotheses in Regression Analysis: A Brief Refresher and Some Practical Advice. Unpublished book manuscript, University of Michigan, Ann Arbor. Available at ⟨http://www-personal.umich.edu/~franzese/Kam Franzese.Interactions.UMP.final.pdf⟩. Accessed 22 December 2005.

Friedrich, Robert J. 1982. In Defense of Multiplicative Terms in Multiple Regression Equations. *American Journal of Political Science* 26 (4):797–833.

Goodrich, Ben. 2005. Problems with and Solutions for Two-Dimensional Models of Continuous Dependent Variables. Unpublished manuscript, Harvard University, Cambridge, Mass. Available at ⟨http://www.people.fas.harvard.edu/~goodrich/Research/Methods/TSCS/⟩. Accessed 22 December 2005.

Green, Donald P., Soo Yeon H. Kim, and David Yoon. 2001. Dirty Pool. *International Organization* 55 (2):441–68.

Kennedy, Peter. 1998. *A Guide to Econometrics*. 4th ed. Cambridge, Mass.: MIT Press.

Kristensen, Ida Pagter, and Gregory Wawro. 2003. Lagging the Dog? The Robustness of Panel Corrected Standard Errors in the Presence of Serial Correlation and Observation Specific Effects. Paper presented at the 20th Annual Meeting of the Society for Political Methodology, University of Minnesota, Minneapolis, July. Available at ⟨http://polmeth.wustl.edu/retrieve.php?id=54⟩. Accessed 22 December 2005.

Przeworski, Adam, Michael E. Alvarez, Jose Antonio Cheibub, and Fernando Limongi. 2000. *Democracy and Development: Political Institutions and Well-Being in the World, 1950–1990*. Cambridge: Cambridge University Press.