5-2016

Corporate Structure and Regulatory Risk in the Oil & Gas Industry

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Honors Thesis

05/30/16

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Abstract

Whether or not a publicly traded corporation's individual oil and well facility had committed an environmental violation from 2010 to 2015, was examined against measures of financial liquidity constraints for its corporate owners, namely the ratio of capital expenditures to total assets, and free cash flow to total assets, through a logistic regression. Its purpose was to identify whether or not extra cash might lead to oil and well facilities acting against shareholders best interests by committing environmental violations in the context of agency theory. It was found that when corporations have more cash on hand, through increased free cash flow or capital expenditures relative to total assets, a corporation is less likely to have environmental violations. As such, it is advisable that regulatory agencies such as the Environmental Protection Agency, who are faced with limited resources to investigate environmental behavior, when looking at publicly traded corporation's oil and well facilities, look towards the ones that have lower than average capital expenditures or free cash flow to total assets. I would like to thank Kenneth Gerow and Benjamin Gilbert for their support for writing this thesis.

Introduction

As of late April, 250,000 jobs have been cut globally in the oil field services industry. According to one Capital One analyst, breaking even as far as profits is the "new up" (Wethe, 2016). Yet as the oil and gas industry cuts down on employees, and shut down production from oil and well facilities, one wonders what will happen when oil production becomes more profitable, and facilities reopen.

As an extractive industry, oil and gas production can have adverse effects on the environment and society's welfare as a whole. With the turmoil of such a cyclical industry, stopping, closing, and then reopening the facilities might mean room for error, or committing an environmental violation at some oil and well facility. Whether it is in the form of oil spills, pollution, or governance corruption, it is important to find practices within a company, or regulations, which protect and promote the best interests for all involved. By identifying these practices, we can maximize the benefit of production while optimally minimizing the risk that comes with natural resource extraction. Increasingly, this has grown important to shareholders who wish for more environmental and socially conscious business choices (EY, 2016). It might seem oxymoronic, even in the oil and gas industry (Hall, 2016), socially responsible investing and sustainability has been important to their shareholders. Shareholders have even attempted to add, unsuccessfully, an environmental expert on the boards of oil giants such as Exxon Mobil and Chevron Corp, in hopes that the expert would offer insights on promoting cleaner practices for extraction (Vittoria, 2016).

So how does one balance the needs of the shareholders with the growth of the company? This is a common problem within finance known as the agency theory. It is a balancing act of the

needs of the principals, or shareholders, with the agents of the principals, or corporate executives. In this tricky juggling act, conflict can arise, which causes hidden costs, such as corporate executives encouraging actions that might not be in the shareholders best interests. In real life, this might be fostering a business environment that encourages oil and well facilities to commit violations in order to get ahead, or maintain efficient profits.

Yet having extra cash on hand might help corporations, and the oil and well facilities adjust to changing market conditions. Schlumberger CEO Kibsgard recently said that "The decline in global activity and the rate of activity disruption reached unprecedented levels as the industry displayed clear signs of operating in a full-scale cash crisis" (Wethe, 2016). This means that free cash flow or capital expenditures relative to total assets, might be alarmingly decreasing. It is possible that having a high free cash flow or capital expenditures relative to total assets, means that in volatile times, these companies are likely to bounce back faster, change strategies, while avoiding accumulating environmental violations. If an oil and well facility starts and stops, because of market pressure, it is possible that more mistakes could be made. This is why a good business practice might actually be encouraging businesses to keep free cash flow and capital expenditures higher, in order to not encourage oil and well facility violations.

Looking at just publicly traded companies, I hope to bridge what the agency theory means in the context of higher free cash flow and capital expenditures to total assets to violation behavior at individual wells. My original thought is that these individual production facilities from the reach of shareholders than the corporate executives, and as such this might gauge how corporation behave. My findings are that the ability for a corporation to have more cash on hand, through increased free cash flow or capital expenditures relative to total assets, means that a corporation is less likely to have environmental violations. This finding is in contradiction to

agency theory, implying that something else might be balancing firm and oil and well facility behavior.

Literature Review

One of the trickiest parts about studying oil and well violations, but potentially beneficial to society, is that there is not a steady stream of documented violations. John Pendley attempted to document the environmental performance of individual corporations in the Marcellus Shale region. While he focused solely on land location, there are similarities in the difficulties of obtaining good data. Pendley sums up the difficulty with, "State regulatory data is the main measure of environmental performance for oil and gas exploration and production. Other measures of environmental performance that are available for other industrial activity (such as the Toxics Release Inventory) are not produced for oil and gas drilling." (Pendley, 2016). As a result, this limits what I can measure for environmental performance on the oil and gas industry individual wells.

As a general rule, enforcement and regulation rules are commonly used to ensure environmental compliance of an industry. While not an oil and gas facility, one study found that compliant energy plants typically have pollution discharges below the legal level. Once non-compliant plants were caught, they reduced their pollution discharges well beyond the society accepted level (Shimshack, Ward 2008). However, with the right disincentives, to not break the rules such as penalties, the oil and gas firms should act the same.

Past research emphasizes environmental performance in relation to corporate governance, through ownership, boards, and their overall management structure. Board leadership has proven consistently significant in explaining the environmental performance of a firm, particularly with

governance independence (Walls, Berrone, & Phan, 2011). However, while I would have liked to have been able to contribute more to that, and identify actionable insights into what can be done, obtaining accurate data on oil and well facilities is particularly difficult. Instead, I focus on the agency theory problem and how it affects corporation and shareholder relationship in perspective of cash flow.

Agency theory concerns itself with the problems of conflict of interests between the shareholders and the corporate managers. In general, the agency theory says that agency costs, or internal costs, occur when owners and managers, like shareholders and executives, have conflicting interests (Jensen and Meckling, 1976). This can be remedied through corporate governance. However, certain findings in the literature suggest that high free cash flow and high capital expenditures, can be reported tangibles that lead to conflicts in the agency.

For free cash flow, the agency theory might suggest that firms can go and spend money or use it in different ways, in order to gain more control without the shareholders knowledge. Typically, as free cash flow to assets total ratios increase, this is seen as a financially riskier move (Bates, Kathlee, Stulz 2006). Typically this increase signals that the company is emphasizing more on research and development with fewer inventories and stock, which could be oil reserves in this case. In the literature, there has been no consistent evidence that agency costs increase because of the increase in free cash flow (Bates, Kathlee, Stulz 2006). This might also be because in the oil industry, agency costs and conflicts could be resolved because of debt financing or stock surplus, which was the case of the oil industry during the 1980s when there was a high level of free cash flow (Byrd 2010).

As an extension of free cash flow, capital expenditures would be what that money could be spent on, such as capital infrastructure. The oil and gas industry is very capital intensive with

billions spent by contractors and owners on their projects (Chuong, Yuteck 2007). With environmental regulation, the largest, and most polluting firms, have the most incentive to spend more on capital expenditures (Haller, Murphy, 2012). However, a conflict that can arise if corporate executives use it to gain more control with capital expenditures for the company, and giving shareholders less power. Increased capital expenditures can be seen as benefitting or hurting shareholders financially, and higher capital expenditures don't necessarily mean it would be spent on better or more sustainable equipment on the field and not elsewhere.

Methodology

In this section, I will discuss how I compiled the data and merged it with the financial data, and I will provide a description of my data. It is my hope that this will allow others to replicate my results and expand on them. While it was tricky to get this data, it is not impossible to reproduce.

In order to compile the data, I first identified the population. The population that I chose was all publicly traded companies with United States of America oil and well facilities. I received this and whether or not they had a penalty in the last five years on the Environmental Protection Agency (EPA) database. I pulled this in late February or early March in 2015. With that, I ran some diagnostics on the population. For example, the true rate of violations in the past year that were reported was between 3-4.3%, depending on if I allowed states with less than 5 facilities or not.

With these insights, I took a sample of 100 randomly selected facilities, the majority of which were non-violators. I then randomly selected 50 facilities among those which had a violation and looked for the corporate match for all facilities in my sample. Each oil and well

facility is assumed to be independent of the other oil and well facilities, and mutually exclusive so that the behavior of one oil and well facility was not determined by another. I found that with non-violators, I was able to match 60 of them to a corporate owner. As for violators I was able to only match 16. What was tricky about this is that financial data is only available for publicly traded companies. Companies that aren't growing and developing, I was unable to identify or receive information from them in this context. I did my best effort to match these facilities to their corporations, and I would read individual leasing terms and contracts that were on the state's Department of Environmental Quality database. I sometimes would use oil and well facility big data databases online that looked up the corporation that owned the oil and well facility through their address.

A struggle that I had was the naming system of the oil fields. In some cases, EPA would cut off part of the name due to constraints in the database on name. Sometimes facilities would have one word of a corporation in their name, like Anadarko. Yet the records would say that it hadn't been owned by them in over 10 years. It could also vary from state to state. I would often have to verify the place and the corporation by looking at where the oil and well facility was placed. Oil and well facilities also seem to change hands frequently. If I could not reasonably conclude that it was in the ownership of a corporation at the time the penalty happened, then I would reject it.

At the end, I had my sample and my dependent variable. My dependent variable was measured on a dichotomous scale, with a formal penalty being a "yes" and those without "no" based on the EPA's database formal penalty count. With the corporation, I was then able to connect my data to the Compustat financial database for each firm. I pulled the free cash flow and capital expenditures to total asset ratios from this database. That way, I received the financial

and economic data of that firm, connected to their oil well facility. I also know that, from general knowledge that Gulf States, as identified by the Energy Information Administration, tend to produce more, and are different in other ways as well. As such, I created an indicator variable on whether it was located in the gulf state region, as identified by the Energy Information Administration, or not.

My other possible independent variables could be continuous, like the amount of the penalty, or dichotomous as well for certain governance procedures. There were many variables of interest. However, due to the sample size and time constraint, it was difficult to delve deep into corporate governance. Therefore I settled on my measures of financial liquidity as independent variables: the ratios of capital expenditures to assets total and free cash flow to assets total.

In order to make the estimated effect sizes comparable, I rescaled both ratios to range from -1 to 1. Capital expenditures to assets total is how much of total assets was spent on capital gains, like new equipment. However, while in theory capital could decrease into the negatives, this is very unlikely. Free cash flow to assets total is an efficiency index and determines how quickly cash can be generated. If it is negative, there would be a lot of investment within the corporation. The higher this ratio, the better the investment usually is. Yet from the literature, it could also signal interagency conflicts. The assets total is key to keeping perspective of the company in mind, so that a big company who is spending relatively little but more money on capital or generating free cash, is not like a company that is spending pretty much all of the assets total on capital or free cash flow expenditures.

Analysis

Using a logistic regression in Stata, scaled free cash flow to assets total and capital expenditures to assets total were significant in predicting whether or not a penalty was levied against an oil or well facility. It was found that the less constrained or cash strapped a firm is, the less violations there are.

In the appendix, I included the free cash flow to total assets and capital expenditures to total assets descriptive statistics, for those with penalties and those without. Those with penalties tend to have smaller mean ratios of free cash flow and capital expenditures than those oil and well facilities without it. My hypotheses were:

H_0: A corporation's free cash flow to assets total ratio does not affect individual oil well environmental performance

H_a: A corporation's free cash flow to assets total ratio does affect individual oil well environmental performance

And

H_0: A corporation's capital expenditures to assets total ratio does not affect individual oil well environmental performance

H_a: A corporation's capital expenditures to assets total ratio does affect individual oil well environmental performance

I believe that there is a relationship, and that it will be negative. A more constrained firm will have less cash, and may be trying to expand and get bigger. I believe that bigger firms will be less likely to have individual well facilities shut down and restart, or take unnecessary risks in order to achieve optimum efficiency.

My models that I ran are below, as well as the marginal effects of my chosen models. I've put more information, including the log likelihood, in the appendix. My top choices for models were 3 and 4 based on their log likelihoods. It seemed reasonable to only have up to two variables since I had less than 20 violators, and while model 5 and model 6 had slightly higher log likelihoods, I did not think for the extra variable, it was worth it. For model 3, I looked at the effect of capital expenditures to assets total on the likelihood that an oil or well facility is a violator. The logistic regression model was statistically significant at $\chi 2(3) = 10.79$, $p = .01$. The model explained 14% (pseudo-R2) of the variance in oil and well facility violations. Its log likelihood was -34.22. Model 4 estimates the effect of capital expenditures to assets total on the likelihood that an oil or well facility is a violator. The logistic regression model was statistically significant at $\chi 2(2) = 11.05$, $p = .01$. The model explained 14% (pseudo-R2) of the variance in oil and well facility violations. Its log likelihood was -35.37.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Constant	-0.08	-0.28	-0.56	-0.31	-0.03	-0.15
Std error	0.30	0.25	0.28	0.33	0.60	0.47
Capx_at	-4.41			-4.19		-4.29
Std Error	1.68			1.68		1.73
FCF_at		-8.00	-7.33		-9.54	
Std error		3.47	3.53		4.33	
dt_at					-1.43	-0.53
Std error					1.42	1.08
Gulf state = 1			0.86	0.66	0.93	0.70
Std error			0.38	0.36	0.39	0.37

Marginal Effects

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Capx_at	-1.21			-1.13		-1.15
Std Error	0.44			0.12		0.44
FCF_at		-2.34	-2.07		-2.64	

Std error	0.99	0.98		1.15	
dt_at				-0.40	-0.14
Std error				0.39	0.29
Gulf state = 1		0.28	0.20	0.30	0.21
Std error		0.13	0.12	0.14	0.12

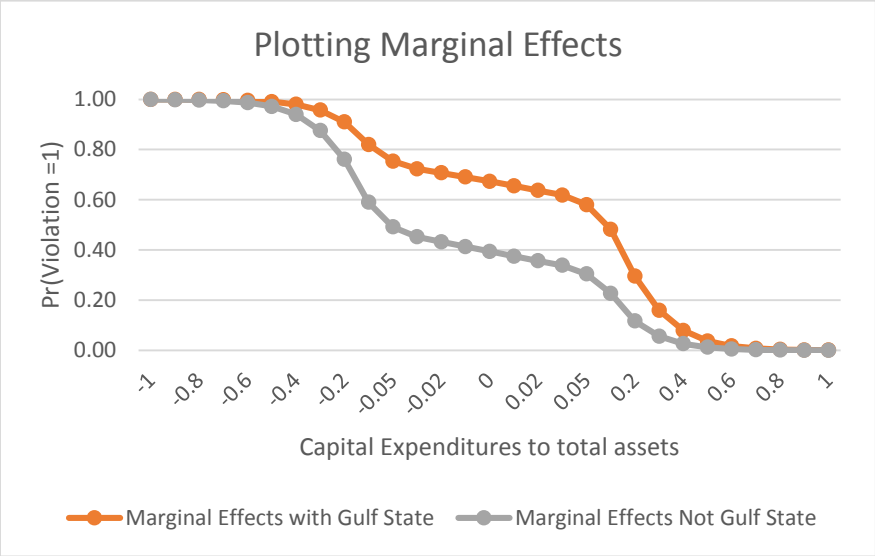
Discussion

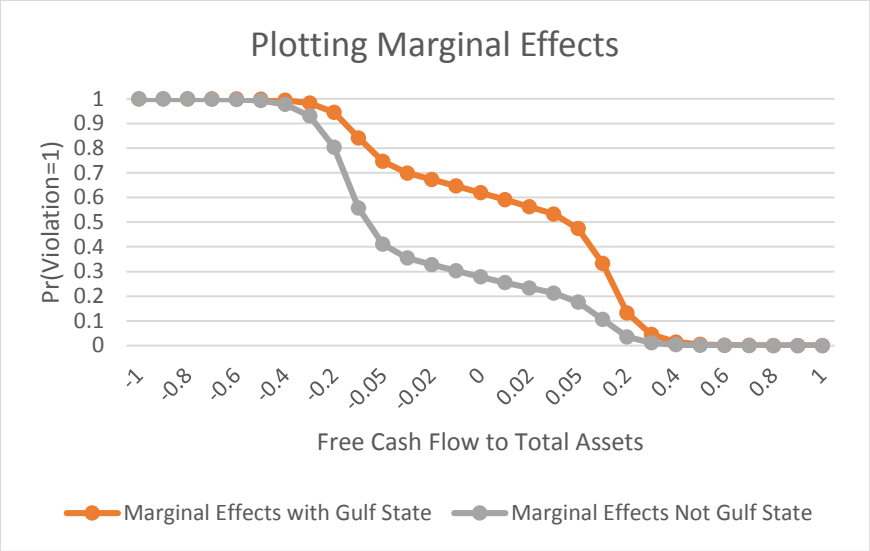
If this had been a multiple regression analysis, I would try to interpret the slopes. However, my dependent variable is only on a binary scale, and in this format, I can't really interpret what is or is not a violator or how my slopes relate. As such, I will interpret the marginal effects in order to explain how free cash flow or capital expenditures to total assets and being a gulf state relates predicts a marginal change in the probability ofto a well facility committing an environmental violation.

Below are the graphs for the marginal effects. Marginal effects measure the instantaneous rate of change, or the derivate of the probability of a violation with respect to the independent variable. For both models, whether or not an oil or well facility is in a gulf state, causes a shift in the line for the marginal effects. For each unit increase, being a gulf state means you are less more likely to have an environmental violation against you. A unit increase would mean here the total assets getting smaller or the free cash flow or capital expenditures getting larger, each in millions of dollars. I also find that if you have two oil facilities not located in a gulf state, they are more affected by the ratios in their probabilities than similar counterparts in Gulf States.

The marginal effects for every unit ratio decrease of free cash to total assets or capital expenditures to total assets, the probability of an oil or well facility being a violator also goes up, however not uniformly. Having two very low free cash flow or capital expenditure to total assets,

the slightly lower ratio has a much smaller effect on the probability of being a violator, since that probability would be so high already. The opposite is true for very high ratios, where the probability is already so low to have environmental violations. In both models -.1 to .1 to .2, there seems to be a lot of marginal effect variation for unit change for the probability to change. This might be because we have more information and variation in that area though. I have also attached the probabilities to the appendix, and they repeat a similar story. The higher a ratio, the less probable it is to have an environmental violation.





At first glance, this might not seem intuitive with the agency theory, which says that having extra cash on hand might encourage corporations to act against shareholders free interests. However the oil and gas industry is unique and very volatile. Having extra cash on hand might help corporations, and the oil and well facility adjust to the changing market, especially in light of Schlumberger CEO Kibsgard's recent comments that the industry is having a "cash crisis". According to some oil and gas analysts, the recent development in tough times is causing firms to cut back on the capital expenditures the most (Ausick, 2016). As such, this means that free cash flow or capital expenditures to total assets, is decreasing at an alarming rate. My belief is that in the oil and gas business, capital expenditures would be like the oil and gas equipment, and one would expect that if you are purchasing more and have a higher spending on it, you would be replacing things quicker to avoid environmental penalties.

As we head through the oil cash crisis, I would recommend that EPA, and any other state regulator that wants to keep an eye on oil and well facilities owned by publicly traded companies to look at those with lower capital expenditures and free cash flow to the national average once productions picks up. These facilities might have a harder time coming back, and be prone to

more error. I would also encourage investors to not be put off by bigger companies with higher free cash flow or capital expenditures to total assets. While it might seem like they have power, it could be similar to the 1980s that the corporations are trying to avoid penalties. Recall during the 1980s agency costs and conflicts could be resolved because of debt financing or stock surplus, even though there was excess cash.

There are many ways that this project can grow to become more conclusive and useful for the industry and regulators. First, the sample size of those with penalties is relatively small with only 16. This limits how many variables I can put in, and I do believe that a bigger sample could mean investigating corporate governance behavior and other variables of interest. Also, while I am assuming that each oil and well facility is different, there are only nine unique corporations in those who have a penalty. I believe that by varying this, and the oil and well facilities without penalties, more conclusive research could be done. I also believe that honing into one area, like John Pendley did, might not give us a general perspective on the United States, it would be highly useful for individual states to understand what sort of penalties are happening at their oil and well facilities and what to expect from the corporations that are running them.

For future research I would suggest focusing in on one area as a sampling frame. This also might lead to insight, if cooperation can be achieved, into what kind of penalties are being levied and ensure accuracy of the corporation identification. With that, I would then focus more in on the corporate governance behavior itself rather than the size of the overall company. I would also suggest for future research to keep in mind a variable to factor the size of the corporation, and to repeat the logistic regression.

Overall, capital expenditures or free cash flow to assets total each have their own part of the story in predicting whether or not an oil or well facility will be a violator. Even though oil and well facility violation occurances are not high, it is still important to ensure that there is motivation to not let them become common. The ability for a corporation to have more cash on hand, through increased free cash flow or capital expenditures when compared to total assets, means that a corporation is less likely to have environmental violations, and which means that something else might be balancing firm and oil and well facility behavior.

Appendix

Descriptive statistics

Scaled Free Cash Flow to assets total

	Mean	Standard Deviation
Violators	.04	.04
Non-Violators	.07	.05

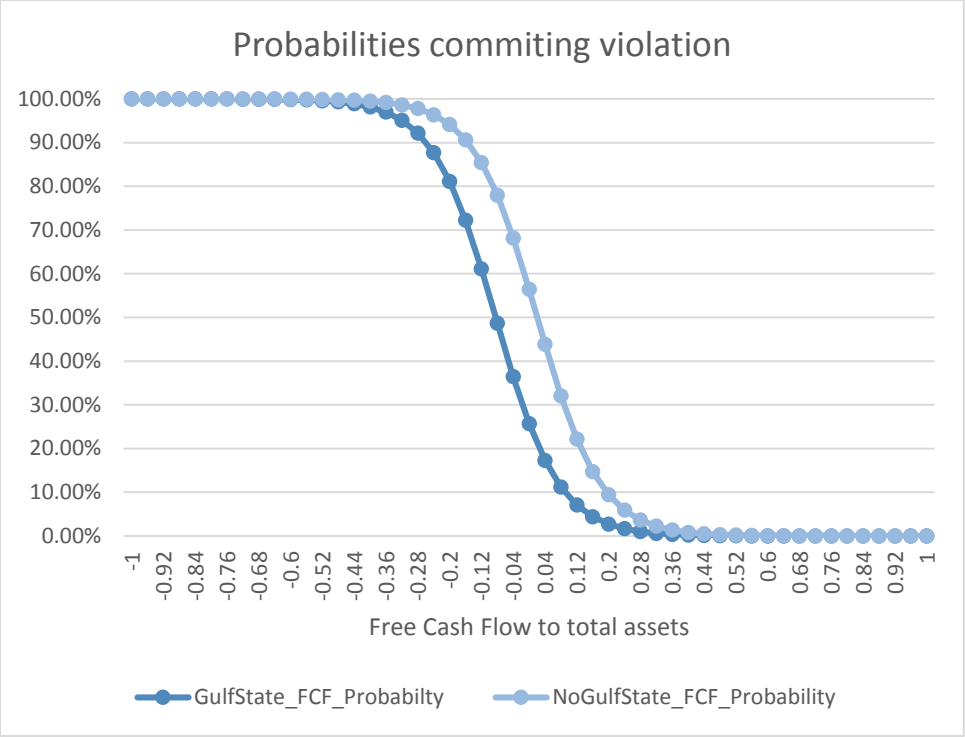
Scaled Capital Expenditures to assets total

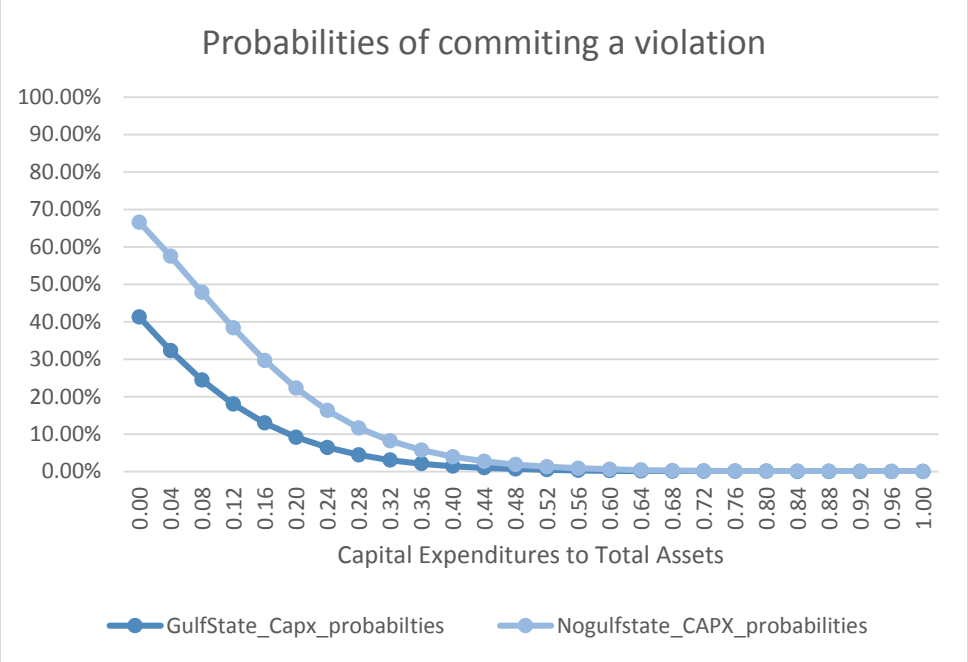
	Mean	Standard Deviation
Violators	.12	.10
Non-Violators	.20	.11

All proposed models information

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Constant	-0.08	-0.28	-0.56	-0.31	-0.03	-0.15
Std error	0.30	0.25	0.28	0.33	0.60	0.47
Capx_at	-4.41			-4.19		-4.29
Std Error	1.68			1.68		1.73
FCF_at		-8.00	-7.33		-9.54	
Std error		3.47	3.53		4.33	
dt_at					-1.43	-0.53
Std error					1.42	1.08
Gulf state = 1			0.86	0.66	0.93	0.70
Std error			0.38	0.36	0.39	0.37
Marginal effects dF/dx						
Capx_at	-1.21			-1.13		-1.15
Std Error	0.44			0.12		0.44
FCF_at		-2.34	-2.07		-2.64	
Std error		0.99	0.98		1.15	

dt_at					-0.40	-0.14
Std error					0.39	0.29
Gulf state = 1			0.28	0.20	0.30	0.21
Std error			0.13	0.12	0.14	0.12
Significance						
Capx_at	-2.62	-2.31		-2.49		-2.49
pr>abs(Z)	0.01	0.02		0.01		0.01
FCF_at			-2.08		-2.20	
pr>abs(Z)			0.04		0.03	
dt_at					-1.01	-0.49
pr>abs(Z)					0.31	0.62
Gulf State = 1			2.29	1.82	2.39	1.87
pr>abs(Z)			0.02	0.07	0.02	0.06
constant	-0.26	-1.31	-1.99	-0.95	-0.06	-0.31
pr>abs(Z)	0.80	0.26	0.05	0.34	0.95	0.75
Model information						
X^2 (DF= number of coef -1)	7.76	5.55	10.79	11.05	11.88	11.29
n	78.00	73.00	73.00	78.00	73.00	78.00
p-value	0.01	0.02	0.00	0.00	0.01	0.01
Pseudo R^2	0.09	0.07	0.14	0.14	0.15	0.14
log likelihood	-37.01	-36.84	-34.22	-35.37	-33.68	-35.25


Probabilities commiting violation
100.00%
90.00%
80.00%
70.00%
60.00%
50.00%
40.00%
30.00%
20.00%
10.00%
0.00%
-1
-0.92
-0.84
-0.76
-0.68
-0.6
-0.52
-0.44
-0.36
-0.28
-0.2
-0.12
-0.04
0.04
0.12
0.2
0.28
0.36
0.44
0.52
0.6
0.68
0.76
0.84
0.92
1
Free Cash Flow to total assets
GulfState_FCF_Probabilty
NoGulfState_FCF_Probability


Probabilities of commiting a violation
100.00%
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0.72
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0.84
0.88
0.92
0.96
1.00
Capital Expenditures to Total Assets
GulfState_Capx_probabilties
Nogulfstate_CAPX_probabilities

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