Quantifying the Risk and Price Impact of Energy Policy Events on Physical Natural Gas Markets Using R

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"Energy Policy Events"

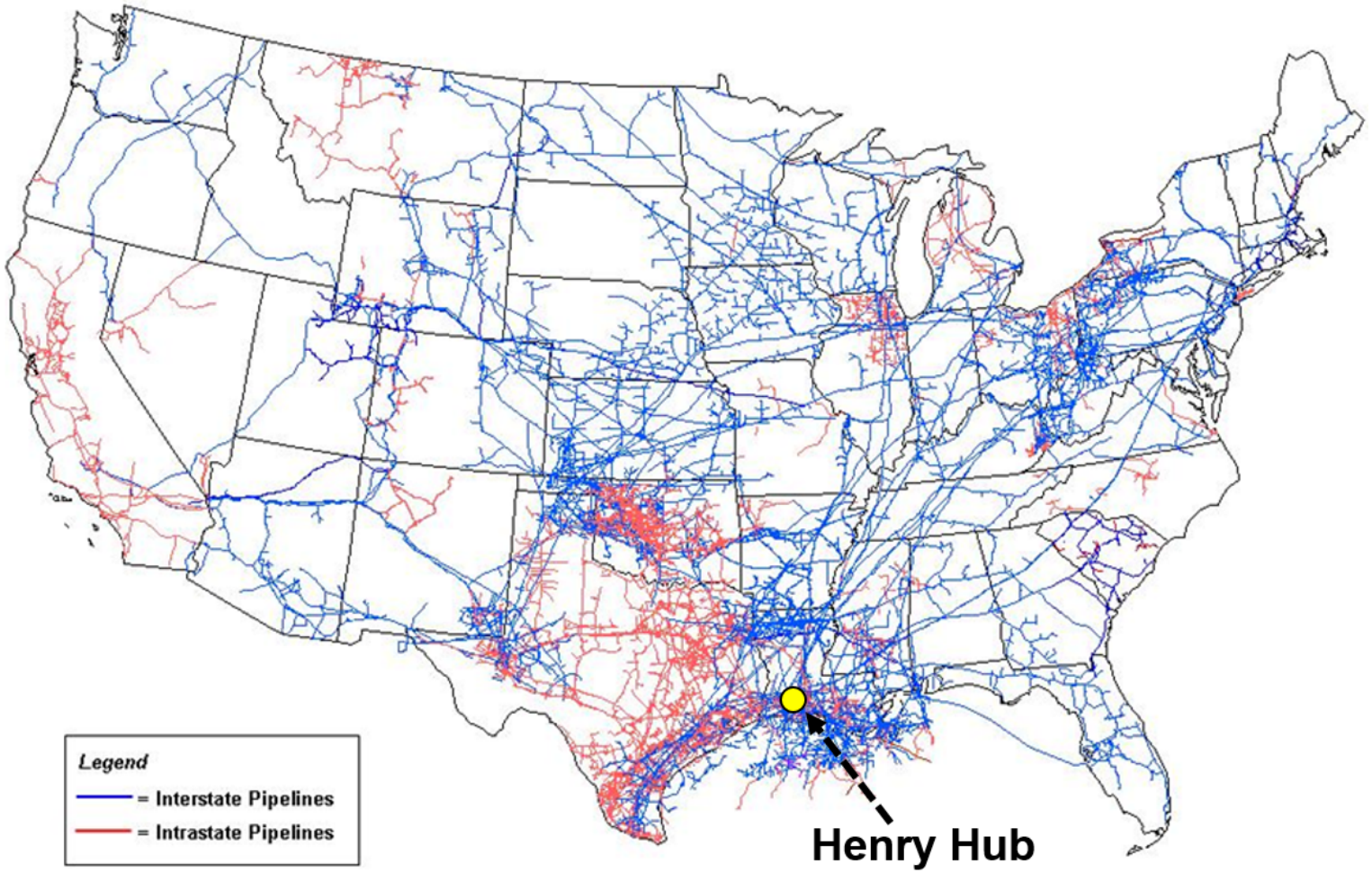
- There are hundreds of federal, state, and local government offices in the US

Energy Policy Maker Considered: FERC

- Under the Natural Gas Act (NGA), FERC has jurisdiction over:
  - transportation and sale of natural gas;
  - approval of new pipelines.

  FERC is also responsible for preventing fraud and manipulation on energy markets.

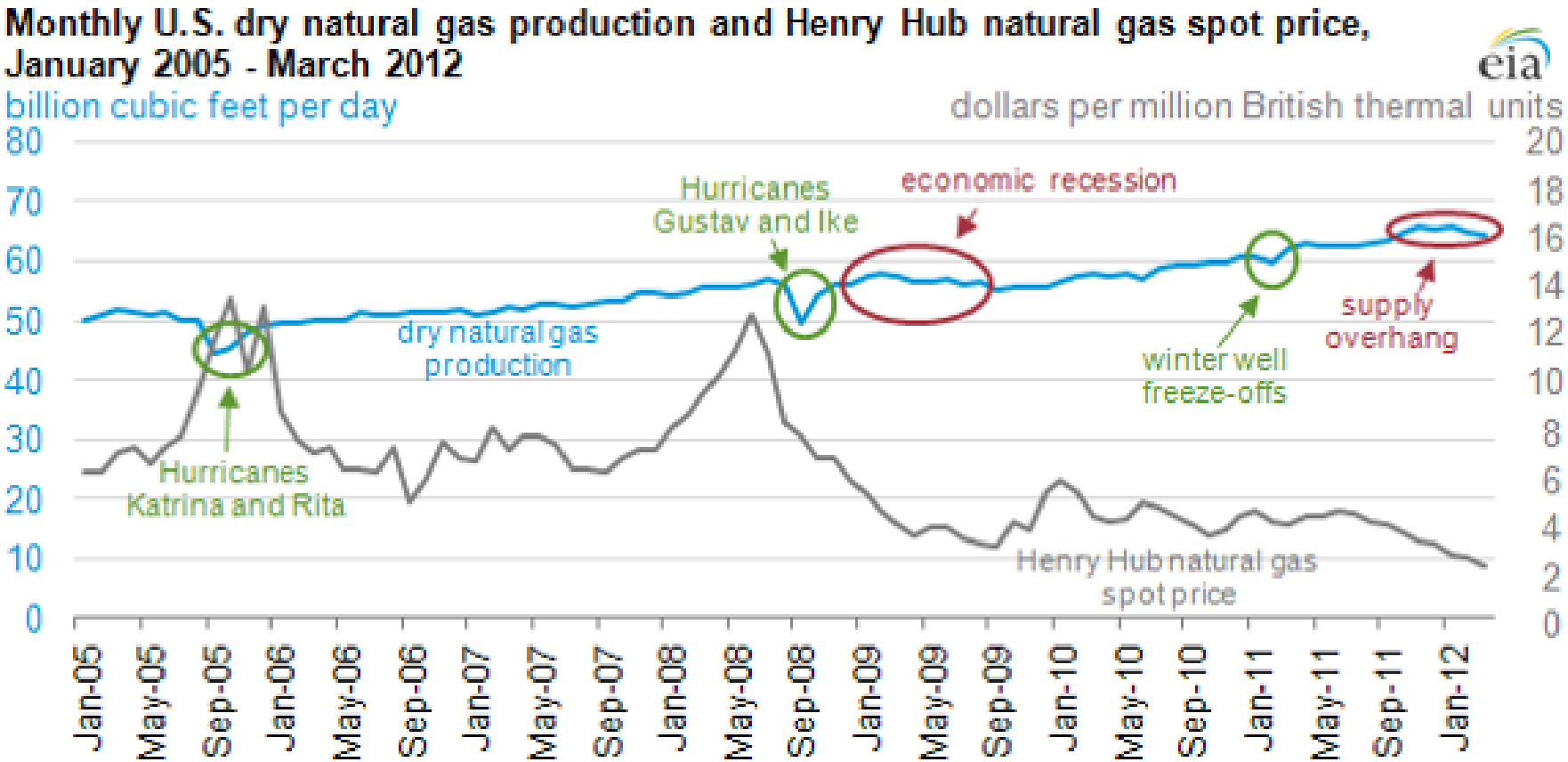
"Natural Gas Markets"



- Henry Hub Natural Gas Price is the industry benchmark price

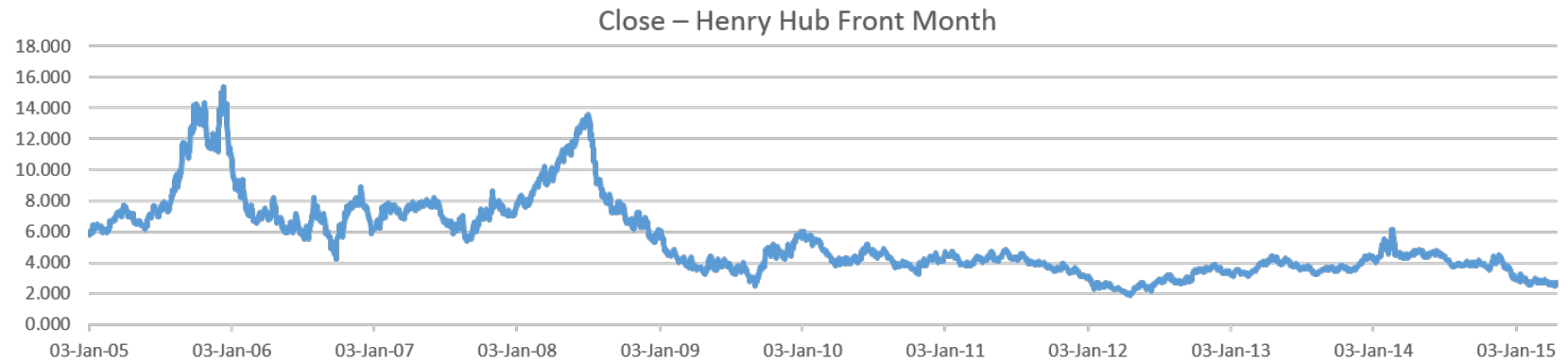
Drivers of Natural Gas Prices

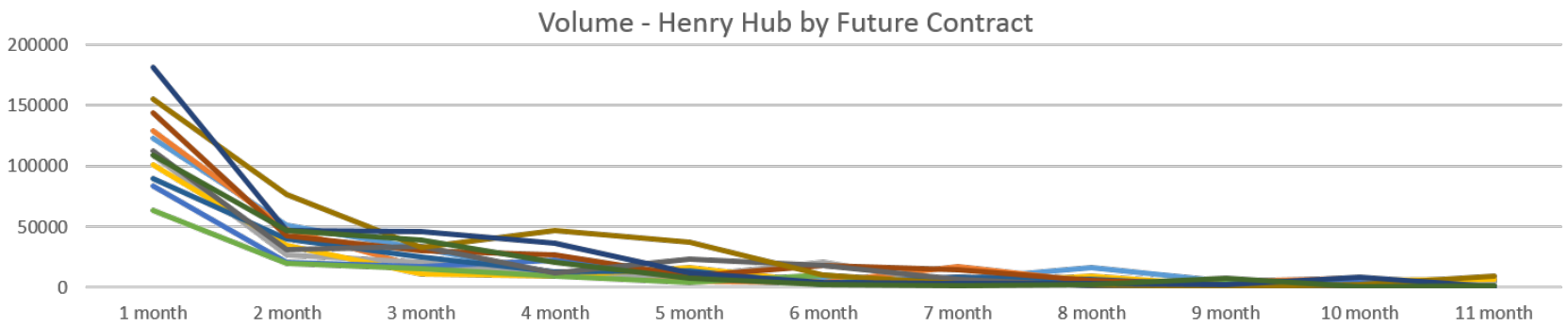
Price Impact



- Natural Gas is primarily driven by weather events and commercial and residential demand

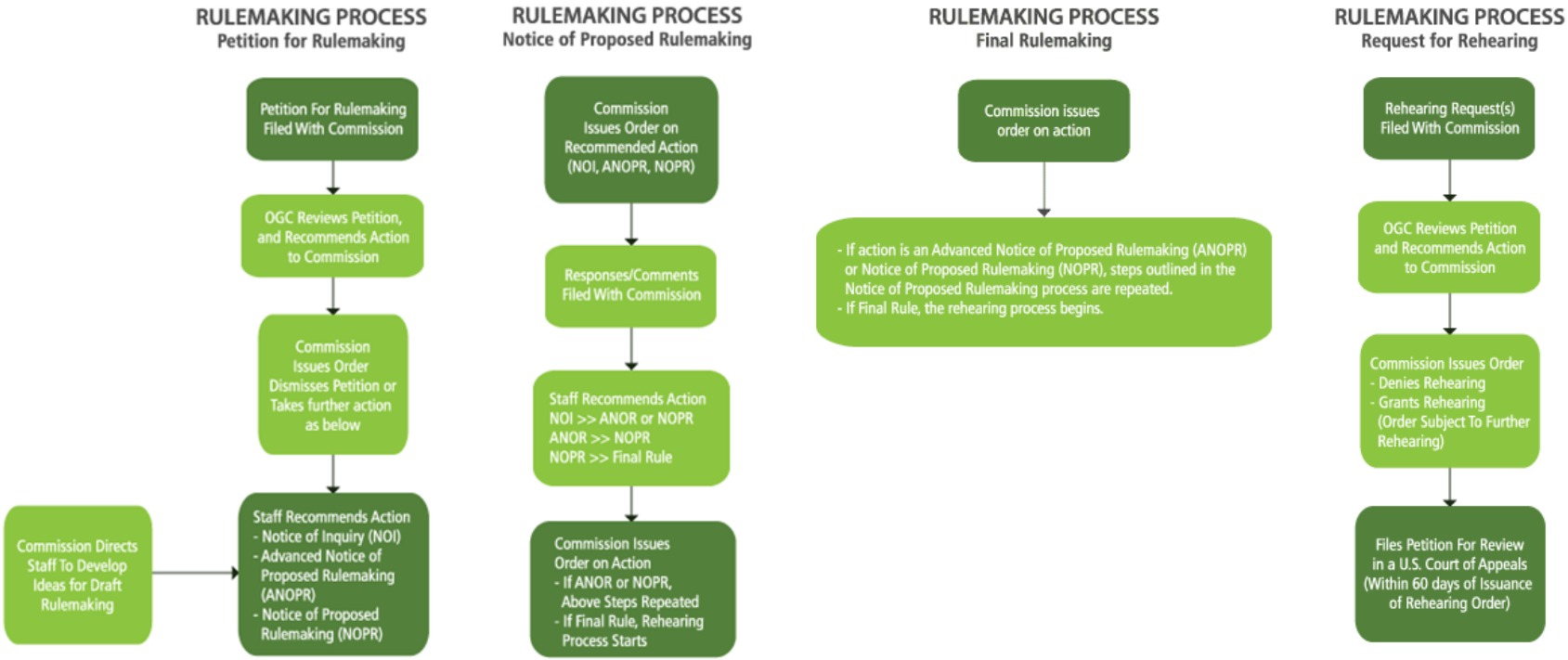
Henry Hub Nat Gas Prices Considered





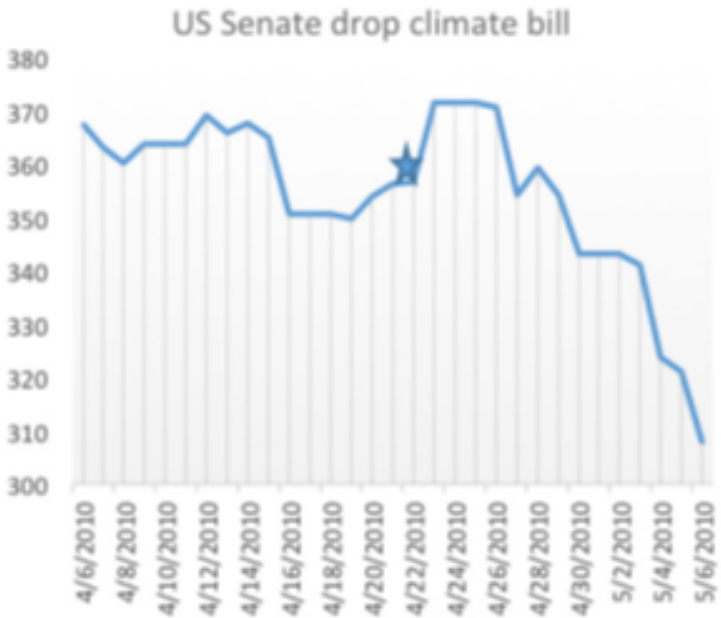
- There are several Henry Hub future contracts available on NYMEX. In this study we consider future contracts up to 12 month because policy events i.e. new pipeline approvals will not impact immediate contracts.

FERC Rulemaking Process



- There are several steps in FERC rulemaking process. In this study we only consider the following events: (1) rule is announced (NOI/NOPR); (2) rule is made final (Final); (3) rule is made effective (Effective).

Our Goals with this project



1. Identify significant policy events from FERC that can have a potential impact on natural gas demand and supply.
2. Estimate the expected magnitude market movement using Henry Hub futures curves
3. Derive a sentiment from the policy type to indicate the market impact direction

Henry Hub returns summary statistics

Historical prices from May 2010 to May 2015

Contract	Mean	Standard Deviation	Skewness	Kurtosis
NG1	-0.028	2.736	0.309	2.395
NG2	-0.03	2.598	-0.206	5.531
NG3	-0.031	2.304	0.294	1.543
NG4	-0.032	2.133	0.055	2.394
NG5	-0.034	1.959	0.175	1.031
NG6	-0.038	1.882	0.363	2.295
NG7	-0.041	1.817	0.411	3.062
NG8	-0.042	1.737	0.138	1.264
NG9	-0.041	1.667	-0.134	1.951
NG10	-0.041	1.569	-0.212	2.846
NG11	-0.043	1.493	-0.36	4.939
NG12	-0.043	1.446	-0.181	5.361

Henry Hub volatility summary statistics

Historical prices from May 2010 to May 2015

Contract	Mean	Standard Deviation	Skewness	Kurtosis
NG1	2.071	1.788	2.002	7.394
NG2	1.951	1.714	2.793	19.85
NG3	1.785	1.456	1.716	5.674
NG4	1.654	1.347	2.024	9.638
NG5	1.539	1.212	1.537	4.353
NG6	1.457	1.191	2.009	8.795
NG7	1.402	1.157	2.237	11.912
NG8	1.353	1.09	1.663	4.55
NG9	1.287	1.059	1.922	7.09
NG10	1.206	1.003	2.204	10.753
NG11	1.14	0.965	2.682	19.763
NG12	1.094	0.947	2.846	19.726

Event Study Design

- We break out our event study into the three policy types that Vincenzo explained: (1) rule is announced (NOI/NOPR); (2) rule is made final (Final); (3) rule is made effective (Effective)
- Define time range: events between 8/31/2010 and 3/31/2015
- Define the event window: -20 to +20 days relative to the FERC announcement.
- Establish criteria for selection
- Calculate normal and abnormal returns for each of the contracts: use OLS with the estimation window of -20 to -80 days relative to the FERC announcement.
- Estimate model parameters with data for each contract
- Conduct significance test and present results
- Interpret results and draw inferences and conclusions

Event Study Methodology

We used one of the most popular models in practice to calculate abnormal returns for each of the natural gas contracts with R_{mt} as the index return:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \epsilon_{it} \tag{1}$$

$$E[\epsilon_{it}] = 0 Var[\epsilon it] = (\sigma^2)_{\epsilon_i} \tag{2}$$

$$AR_{it} = R_{it} - frac(E(R_{it}, \Omega_{t-1}) \tag{3}$$

where AR_{it}, R_{it} and frac(E(R_{it}, Ω_{t-1}) are the abnormal, actual and normal expected return at time t. Ω_{t-1} is the conditional information provided in period t. The linear model above follows assumed joint normality of returns.

Event Study Methodology

Daily Abnormal returns can be calculated in numerous ways but for this study we are going to focus on the market model. We are using the historical S&P GSCI Natural Gas Index Excess Return historically as the response variable in the regression because it has stronger historical correlation to the natural gas markets. We estimate our normal returns based on the equation below.

$$E(NGret_T) = b_0 + b1 * E(SPGSNGPIndex) \tag{4}$$

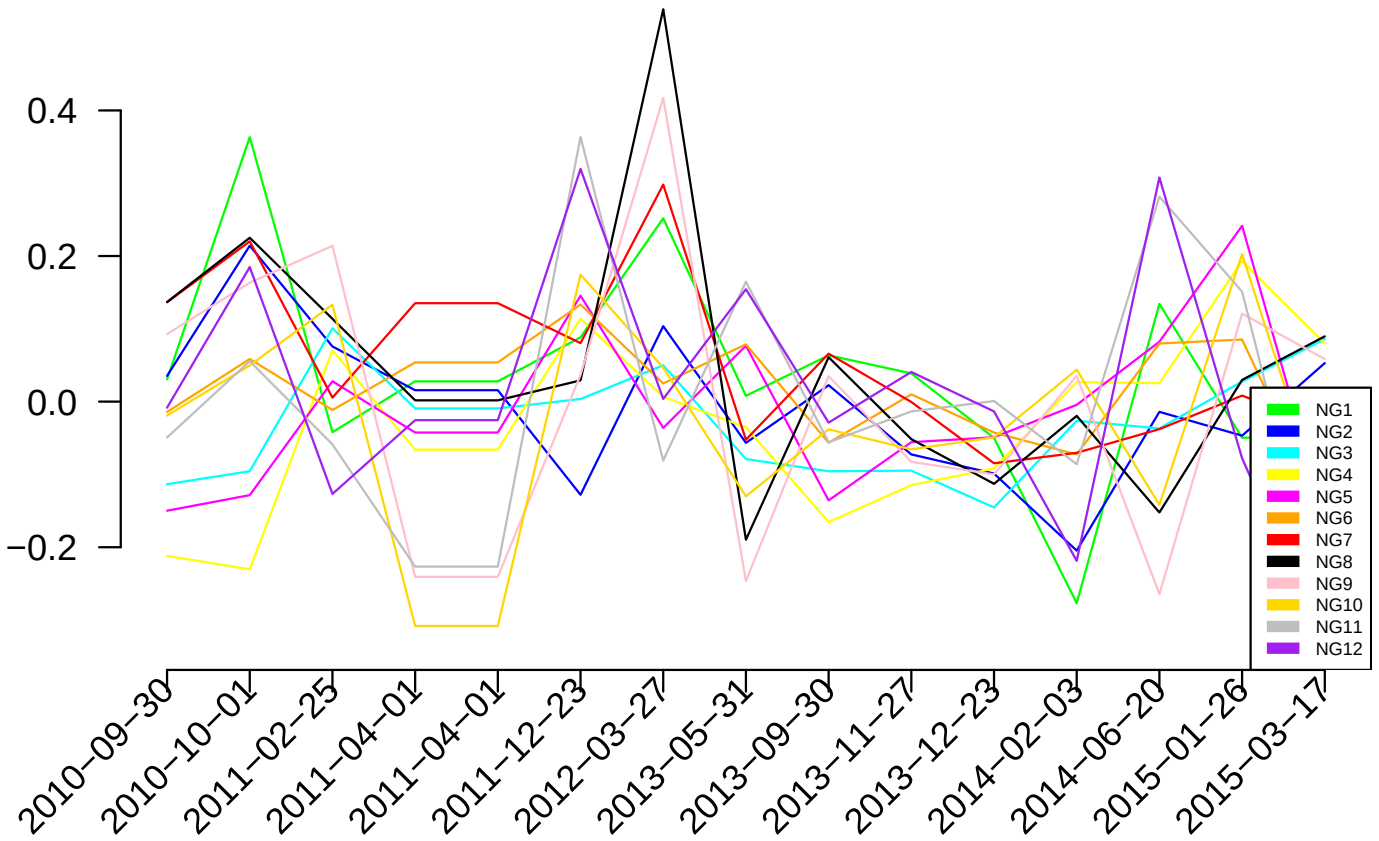
Testing for Significance

Here we are compute a test statistic to measure whether the average abnormal return for each contract for each event type is statistically different from zero at 5% level bounded by + or -1.96 for the t-stat level.
Results follow.

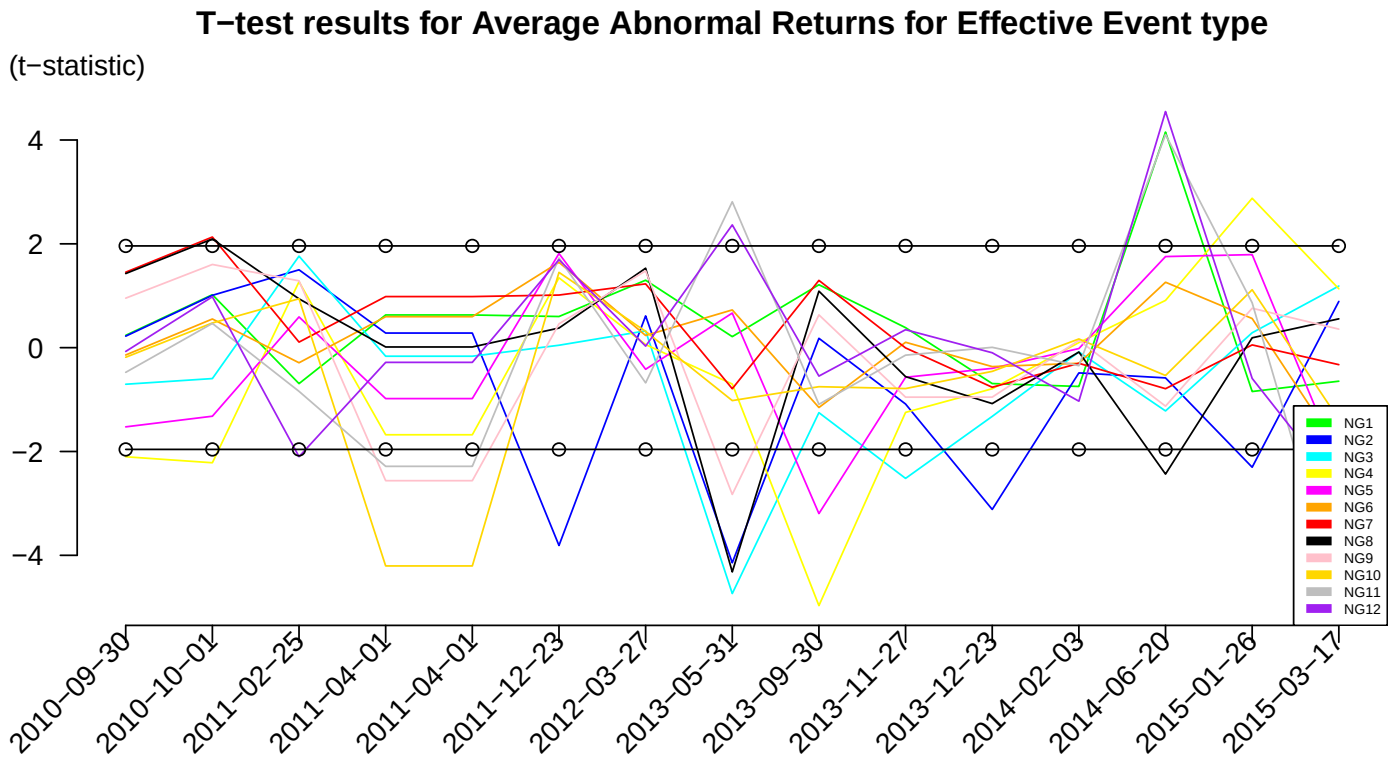
Average Abnormal Returns results-Effective

Average Abnormal Returns by Natural Gas contract for Effective events

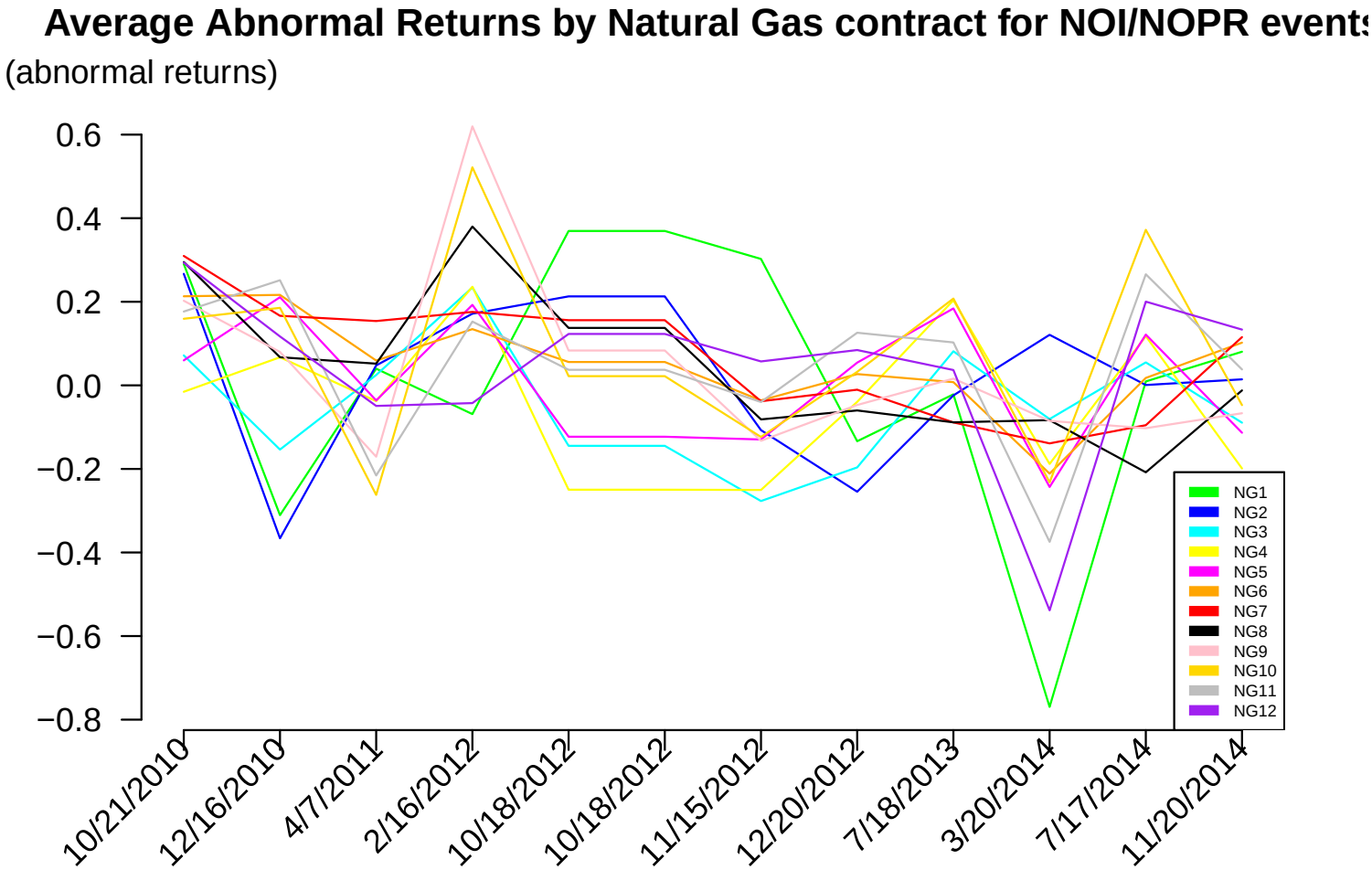
(abnormal returns)



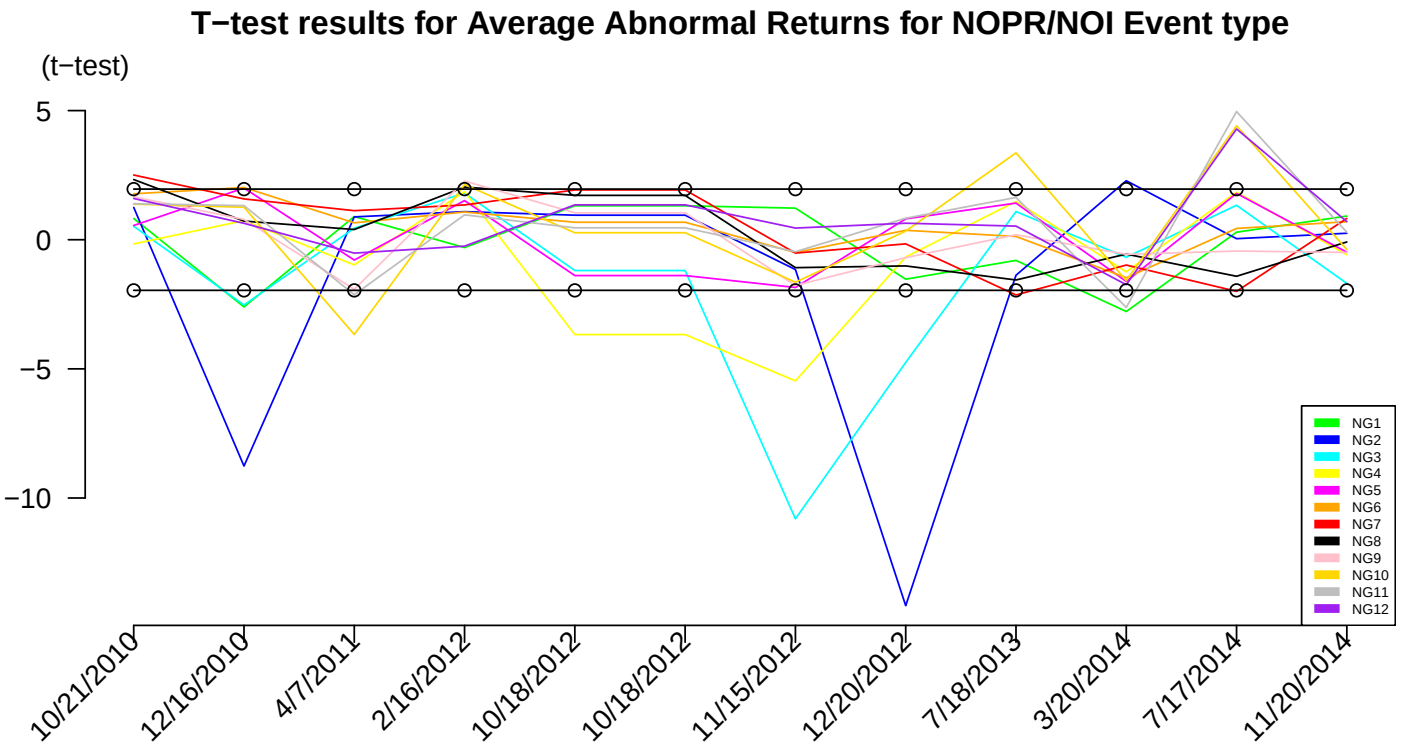
Average Abnormal Returns t-test results - Effective



Average Abnormal Returns results-NOI/NOPR



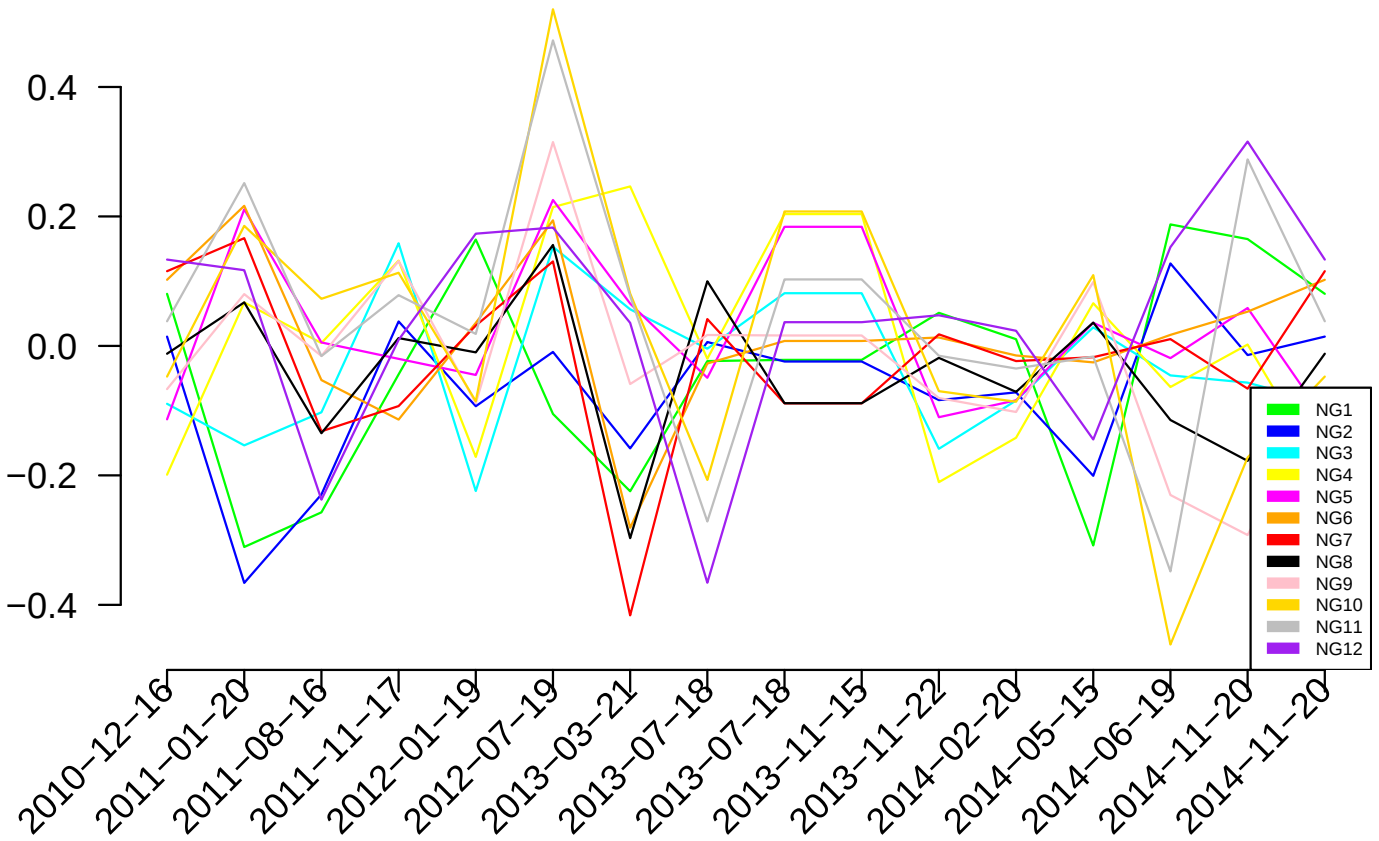
Average Abnormal Returns t-test results - NOI/NOPR



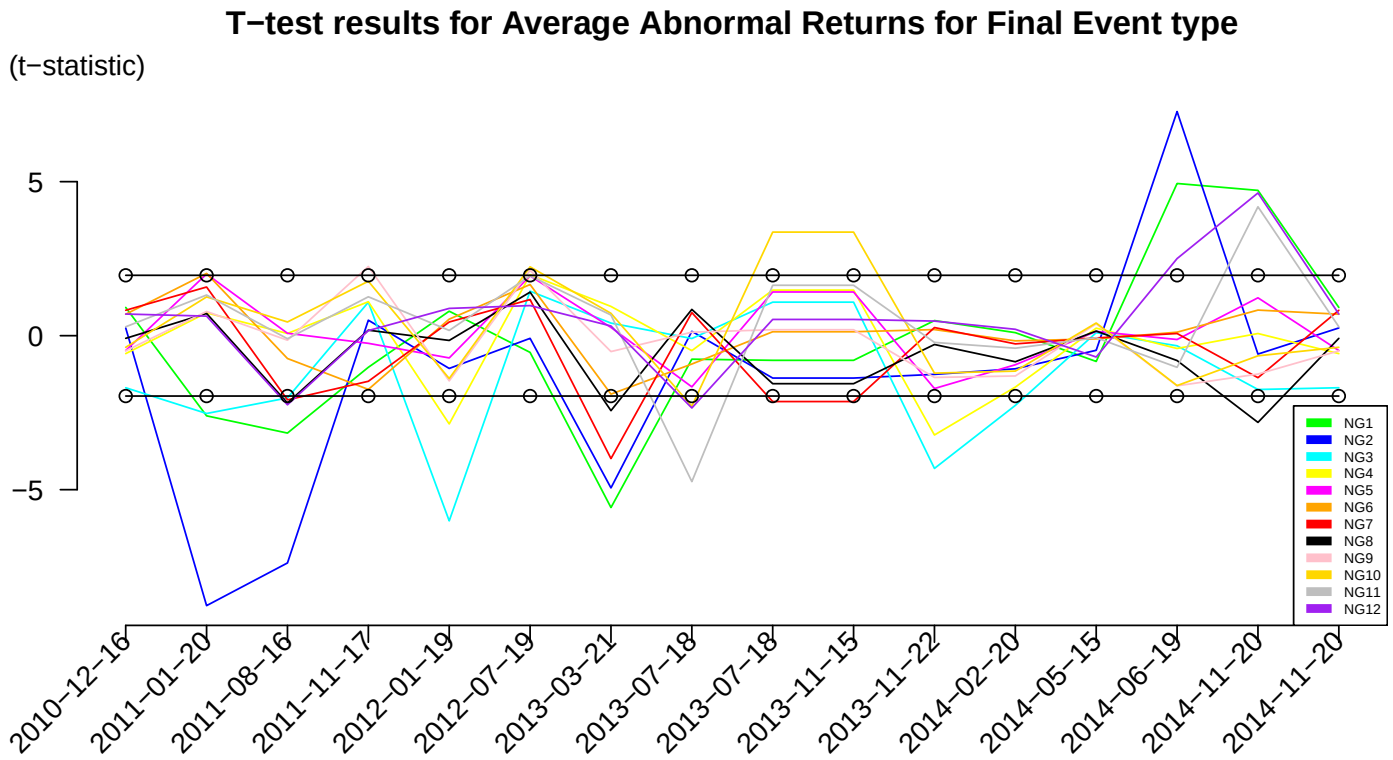
Average Abnormal Returns results-Final

Average Abnormal Returns by Natural Gas contract for Final events

(abnormal returns)



Average Abnormal Returns ttest results-Final



Significant Policy Events

Effective:
(-) 5/31/13: Revisions to Procedural Regulations Governing Transportation by Intrastate Pipeline. –> Increased costs in short term for bureaucracy.
NOI/NOPR:
(-) 12/20/12: Revisions to the Auxiliary Installations, Replacement Facilities, and Siting and Maintenance Regulations. –> Increased costs in short term for bureaucracy.
Final:
(-) 1/20/11: NatGas companies should disclose amount of fuel waived, discounted or reduced as part of a negotiated rate agreement. –> Increased costs in short term for bureaucracy.

- Regulatory events that increase bureaucratic burden on natural gas companies cause diminuished returns in short term future contracts.

Further Analysis

- Regulatory events are characterized by several attributes. Further analysis on such attributes is required to better understand size and direction abnormal returns.
- Consider significant state regulation and compare it with the federal one to determine which has the most impact.
- We would posit that the event window could be broken down into an event time frame for + or - 10 days with post event window at +10 to +30 days.
- Clustering of abnormal returns.

References

- Brown and Warner (1980, 1985): Short-term performance studies
- Loughran and Ritter (1995): Long-term performance study.
- Barber and Lyon (1997) and Lyon, Barber and Tsai (1999): Long-term performance studies.
- Eckbo, Masulis and Norli (2000) and Mitchell and Stafford (2000): Potential problems with the existing long-term performance studies.
- Ahern (2008), WP: Sample selection and event study estimation.

That’s it folks!

Thank you for having us! We hope you enjoyed our presentation and please feel free to reach out to us with any questions!