



Volatility & Difference-in-Differences Analyses



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Outline of Presentation

- Purpose and overview of analysis
- Overview of Volatility and Results
- Overview of Difference-in-Differences and Results
- Q/A

Volatility Analysis

- **Purpose:** Evaluate the frequency and volatility of gas price increases and quantify the level of the financial risk the customer face due to gas price volatility.
- **Method:**
 - Quantify the frequency and magnitude of increases in natural gas prices.
 - Historical simulation to calculate the Value at Risk and the Conditional Value at Risk from upward movement in natural gas price. In this approach, the VaR is directly calculated from past returns.

Difference-in-Differences

- **Purpose:** Estimate the economic impact of Aliso Canyon limitations on core customers.
- **Method:** Compare changes in the gas commodity procurement amount in customer bills (customer bills include commodity and transportation costs) over time in 26 zip codes areas where the SoCal Gas and PG&E service areas overlap.
- Treatment group: SoCal Gas customers.
- Control group: PG&E customers.

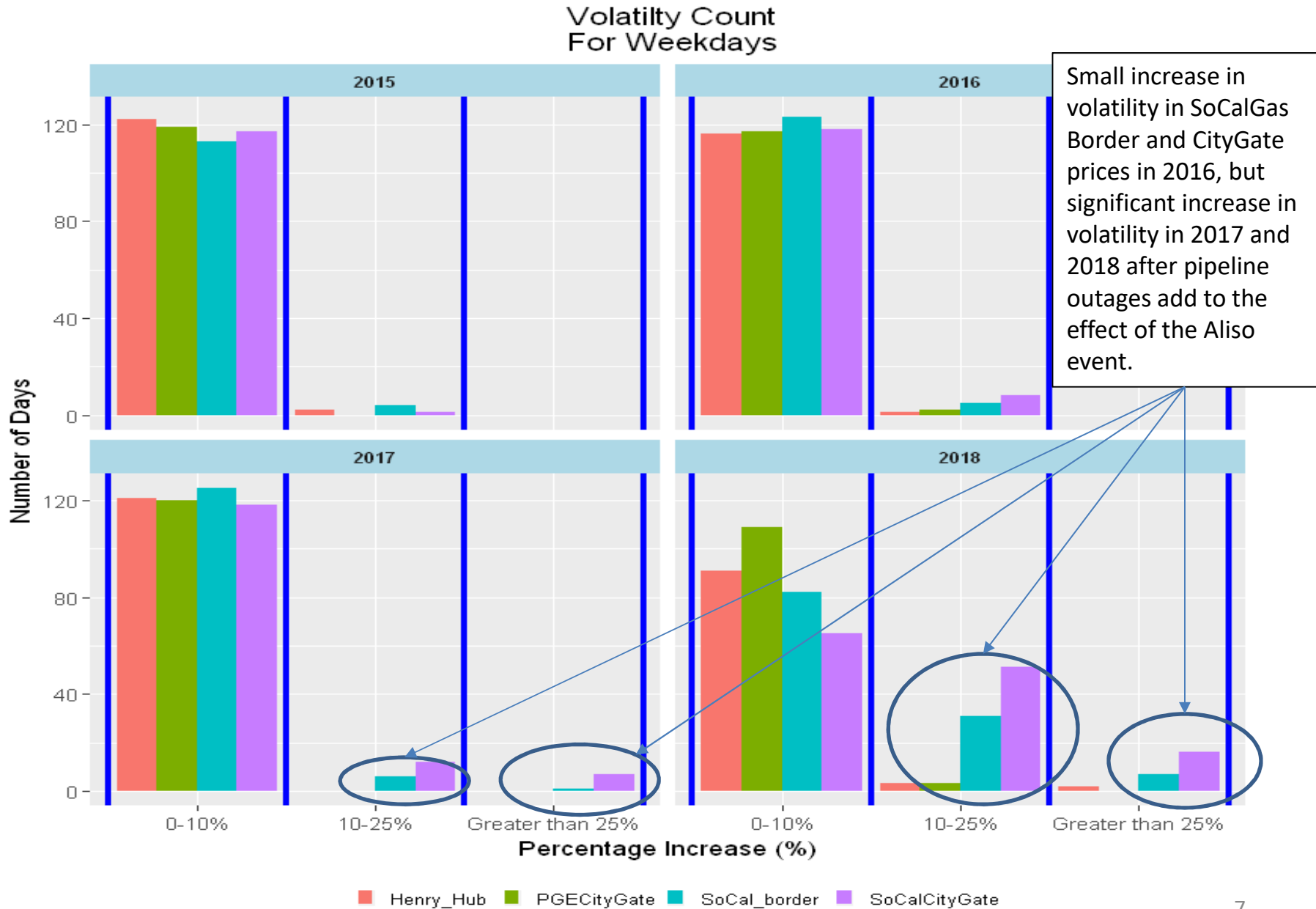


ANALYSIS 1: VOLATILITY ANALYSIS

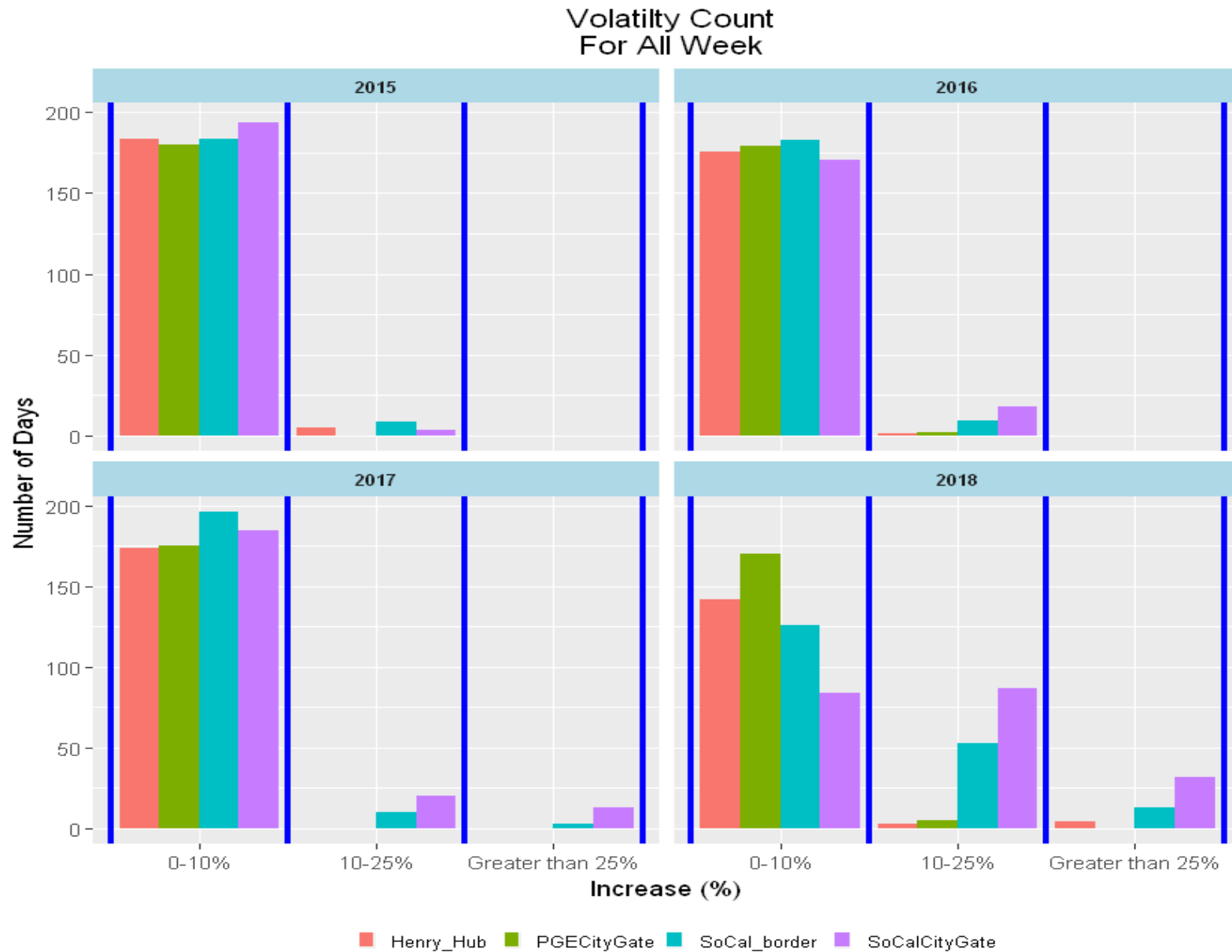
Volatility Analysis

- Since the Aliso event, natural gas prices have been more volatile.
- Staff evaluated the frequency and magnitude of increases in natural gas prices:
 - Staff calculated the frequency that the **next day** index price increased by 10 percent or more.
 - Staff calculated the frequency that the **same day** index price increased by 10 percent or more.
- Staff used a historical simulation approach to calculate the Value at Risk (**VaR**) and the Conditional Value at Risk (**CVaR**).
- **VaR** is a measure of the risk of losing money on investments. It estimates how much an investment might lose with a given probability in a time period such as a day, month or year.
- **CVaR** is equal to the average of all expected losses that are greater or equal than **VaR**.
- The gas price data are from **Natural Gas Intelligence (NGI)**.

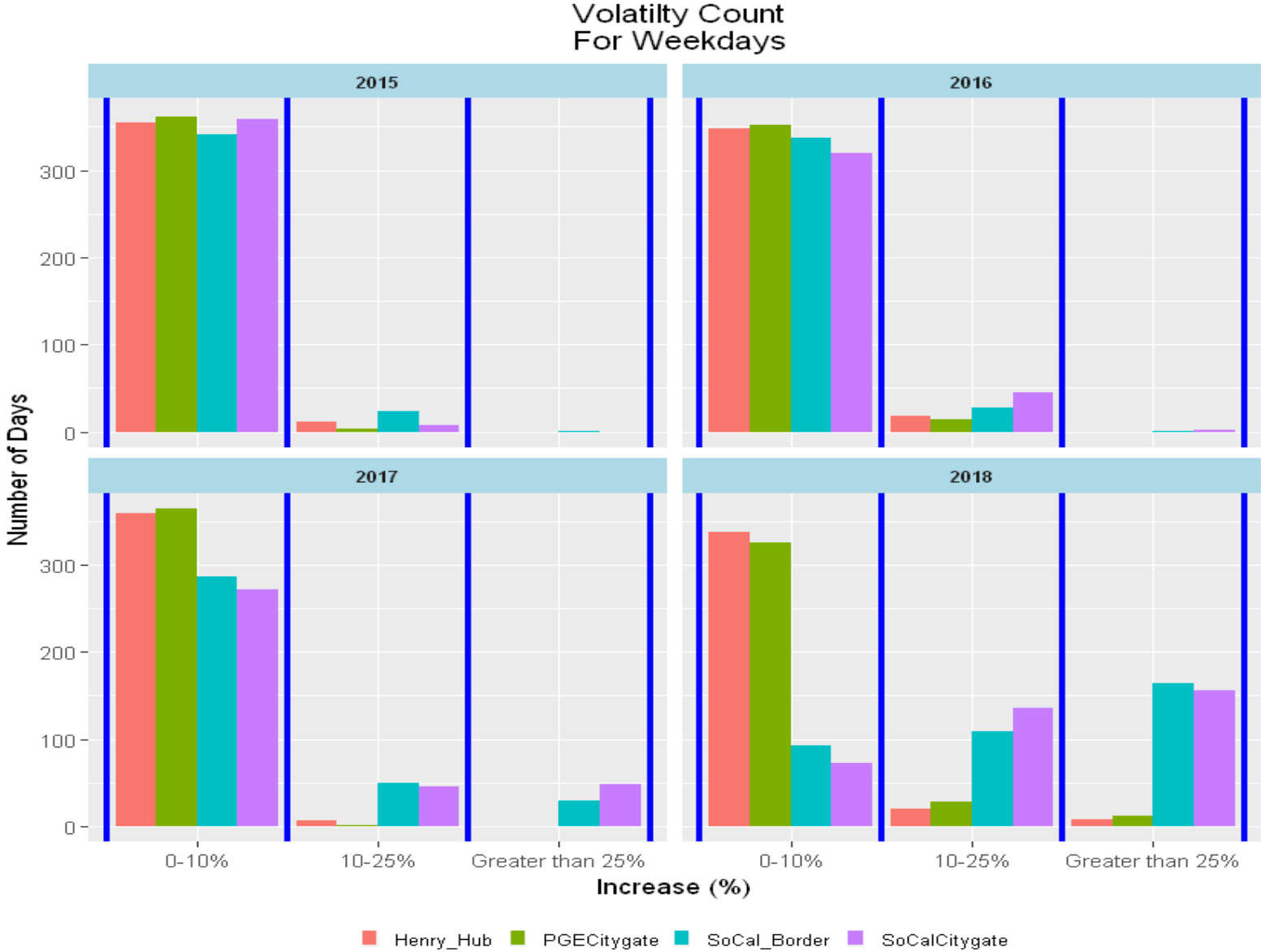
Frequency of Next Day Index Price Increases - Weekdays



Frequency of Next Day Index Price Increases – Whole Week

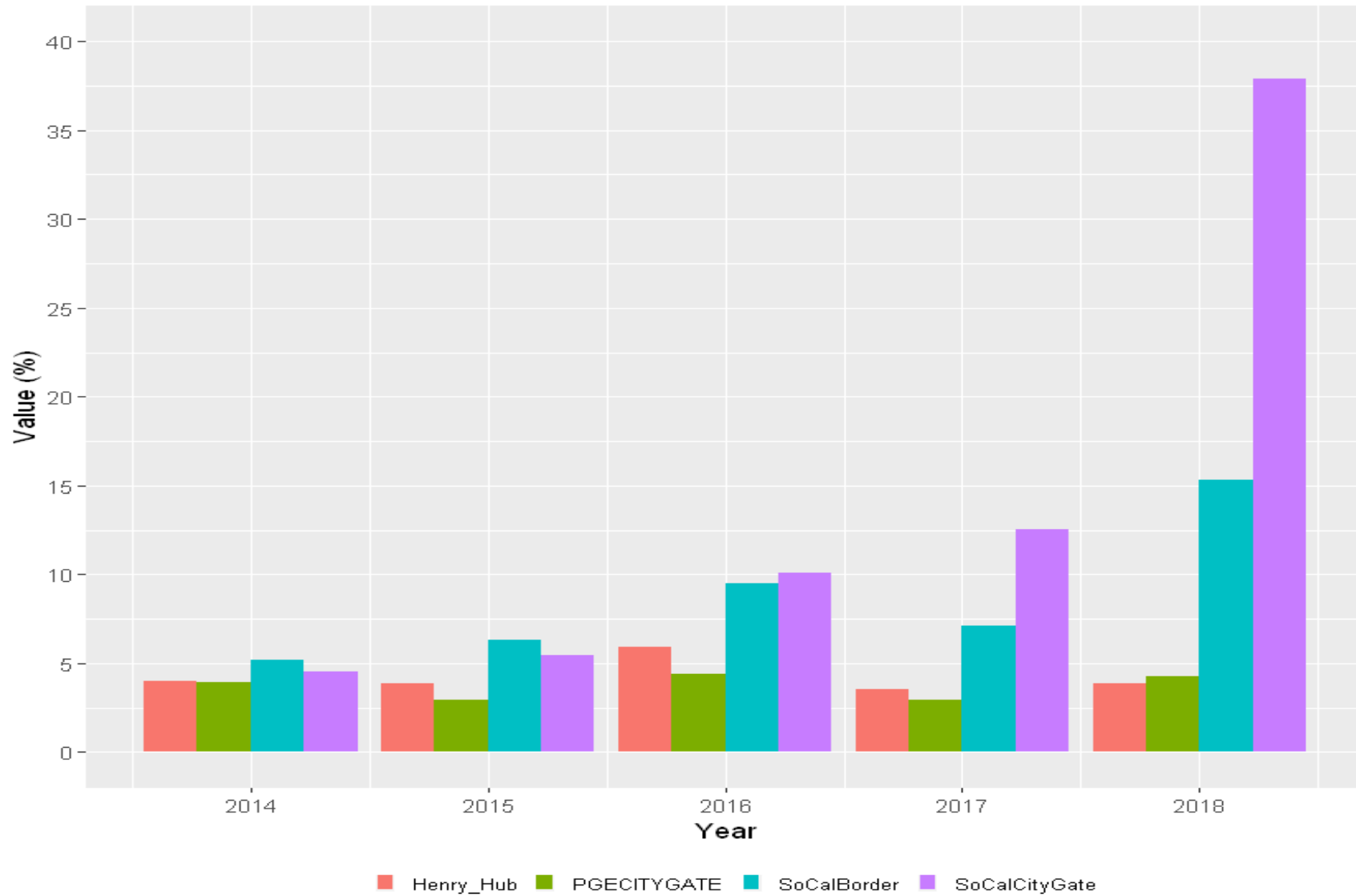


Frequency of Same Day Index Price Increases

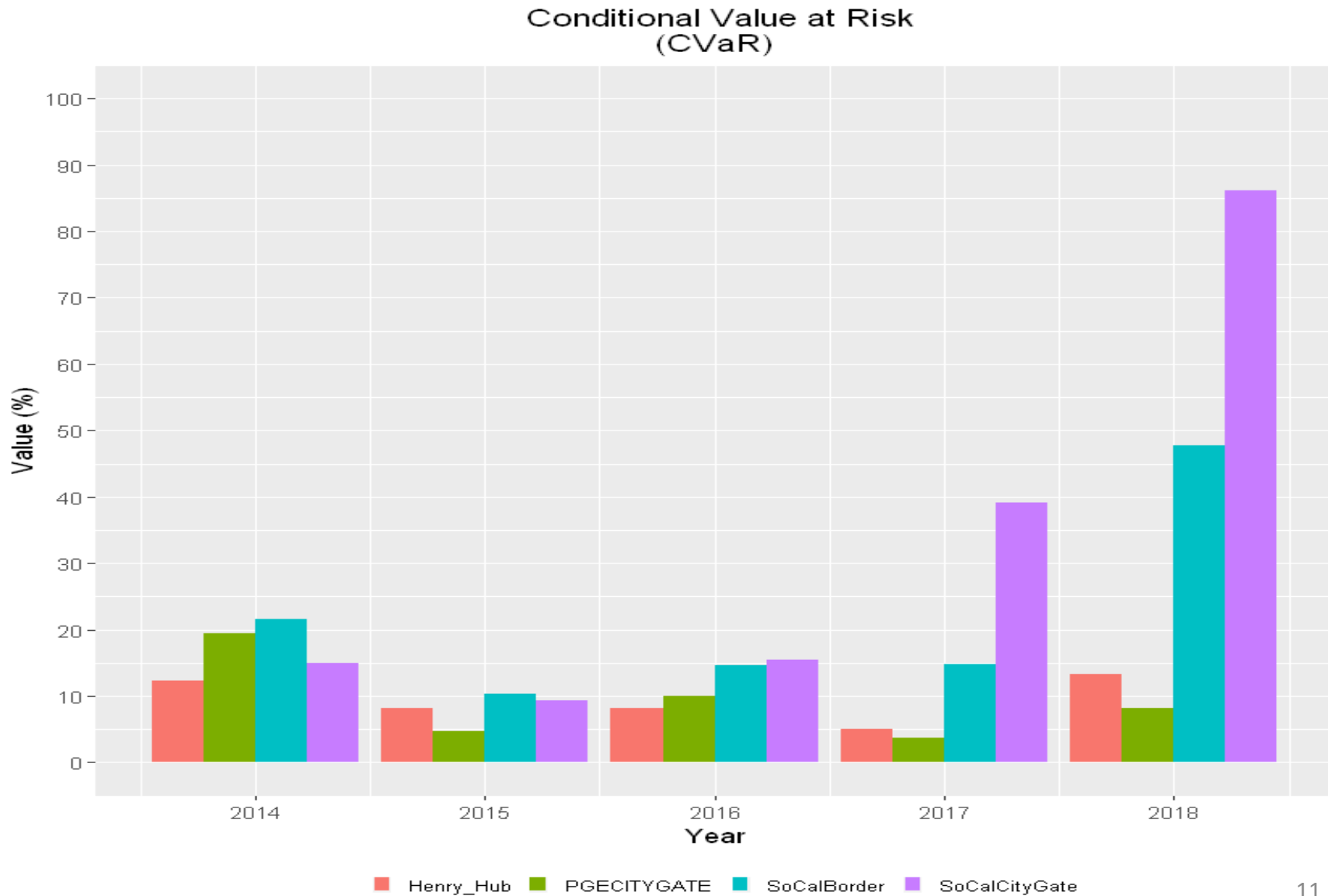


Value at Risk – 95% probability

Value at Risk
(VaR)



Increasing Conditional Value at Risk



Summary of Findings: Volatility

- SoCal City Gate and SoCal border prices became more volatile in 2017 and even more so in 2018.
 - In 2017, same day gas price increases of 25% became common.
 - In 2018, increases even greater than 25% became common.
- The risk and potential loss for natural gas buyers from SoCalCity Gate and SoCal border hubs increased in 2017 and more so in 2018.
- In 2018 the VaR is over **35%** meaning that there is a 0.05 probability, the customers expect a daily loss of 35% or more.
- CVaR is over **85%** meaning that the customers expected daily loss that occur beyond the VaR breakpoint (in this case is 95 percentile) is 85%.

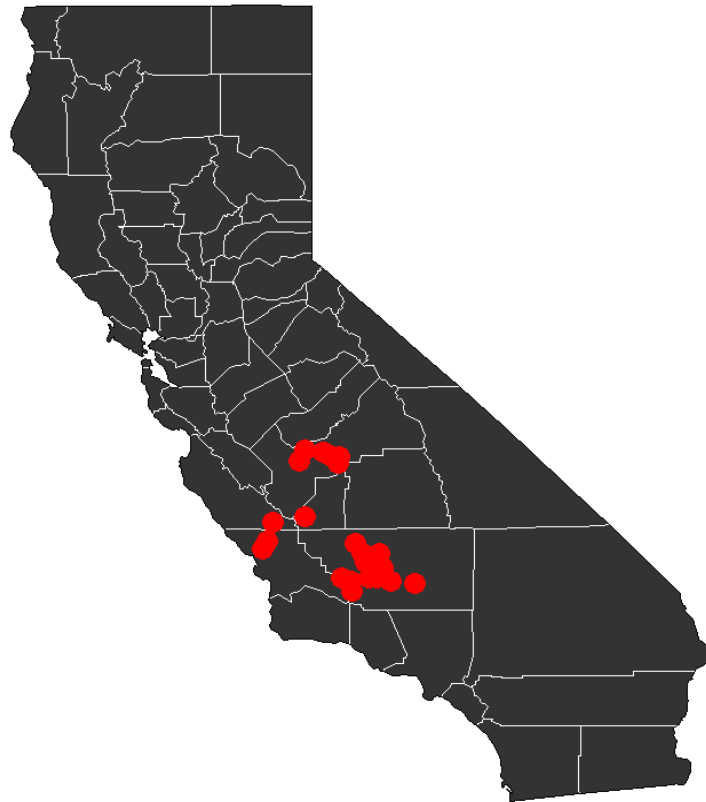


ANALYSIS 2: DIFFERENCE IN DIFFERENCES ANALYSIS AND RESULTS

Difference-in-Differences (DID)

- The purpose of the analysis is to estimate the effect of the Aliso event by comparing the changes in commodity procurement cost over time between a treatment group and a control group in zip codes where the two service areas overlap.
- A Randomized Control Trial (RCT) is the gold standard when attempting to statistically determine causation. Unfortunately, we can't always randomize.
- Difference-in-differences is an alternative when randomization is not possible.
- SoCalGas customers are affected by the event change (treatment group), and PG&E customers are not affected (control group).
- The Aliso event provides a natural experiment that allows us to identify the impact of an event.
- The important assumption for DID is that **Treatment** and **Control** groups have **Parallel Trends** in outcome before the event.

Map of PG&E and SoCalGas Overlap Service Territory (26 Overlapping Zip Codes)



DID Regression Analysis

$$Y_{it} = \beta_0 + \beta_1 * \text{treated}_i + \beta_2 * \text{after}_t + \beta_3 * (\text{treated}_i * \text{after}_t) + \varepsilon_{it}$$

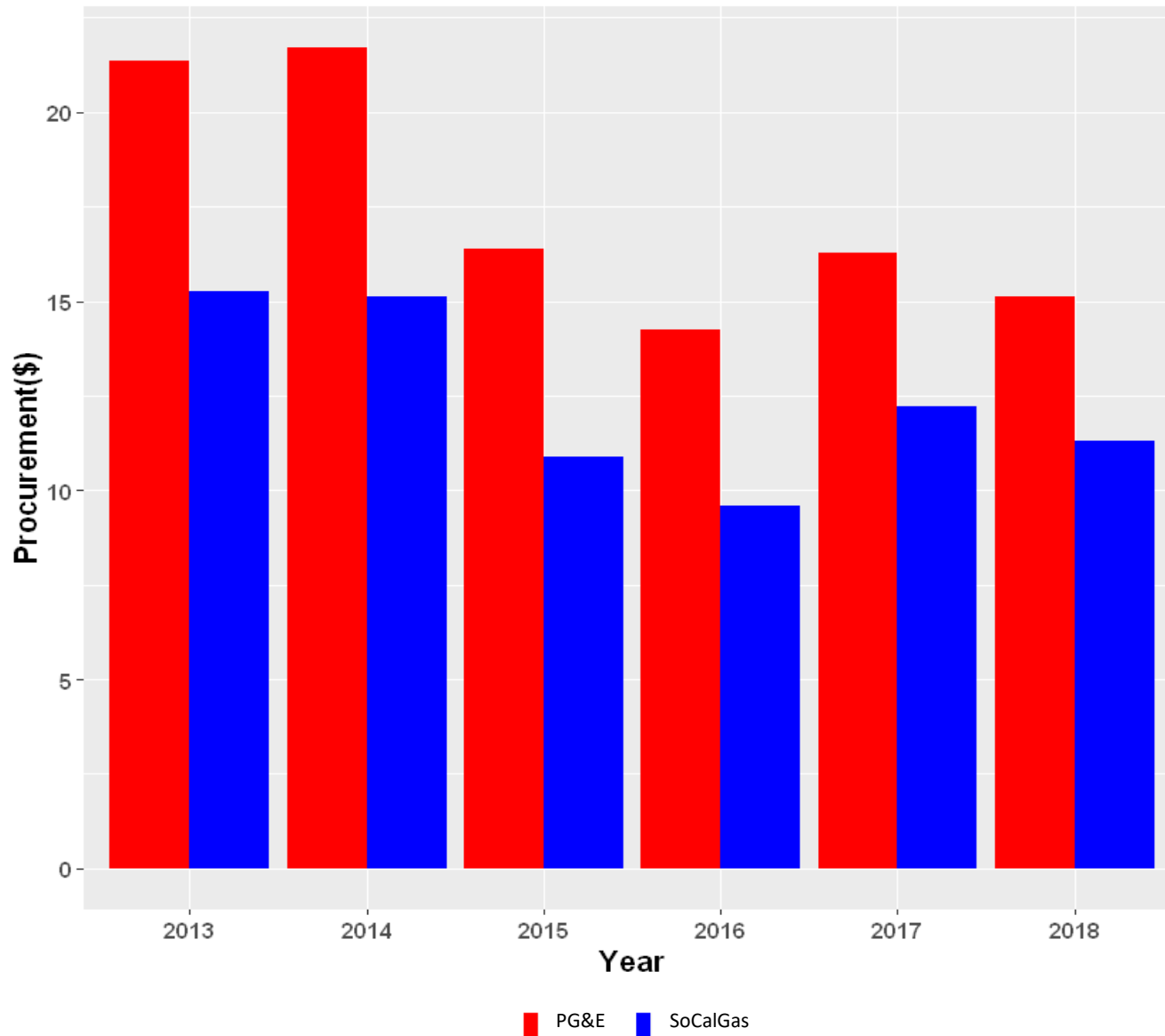
	SoCal (treatment)	PG&E (control)
Before the Aliso Incident	$\beta_0 + \beta_1$	β_0
After the Aliso Incident	$\beta_0 + \beta_1 + \beta_2 + \beta_3$	$\beta_0 + \beta_2$
Difference	$\beta_2 + \beta_3$	β_2

$$\text{DiD} = \beta_2 + \beta_3 - \beta_2 = \beta_3$$

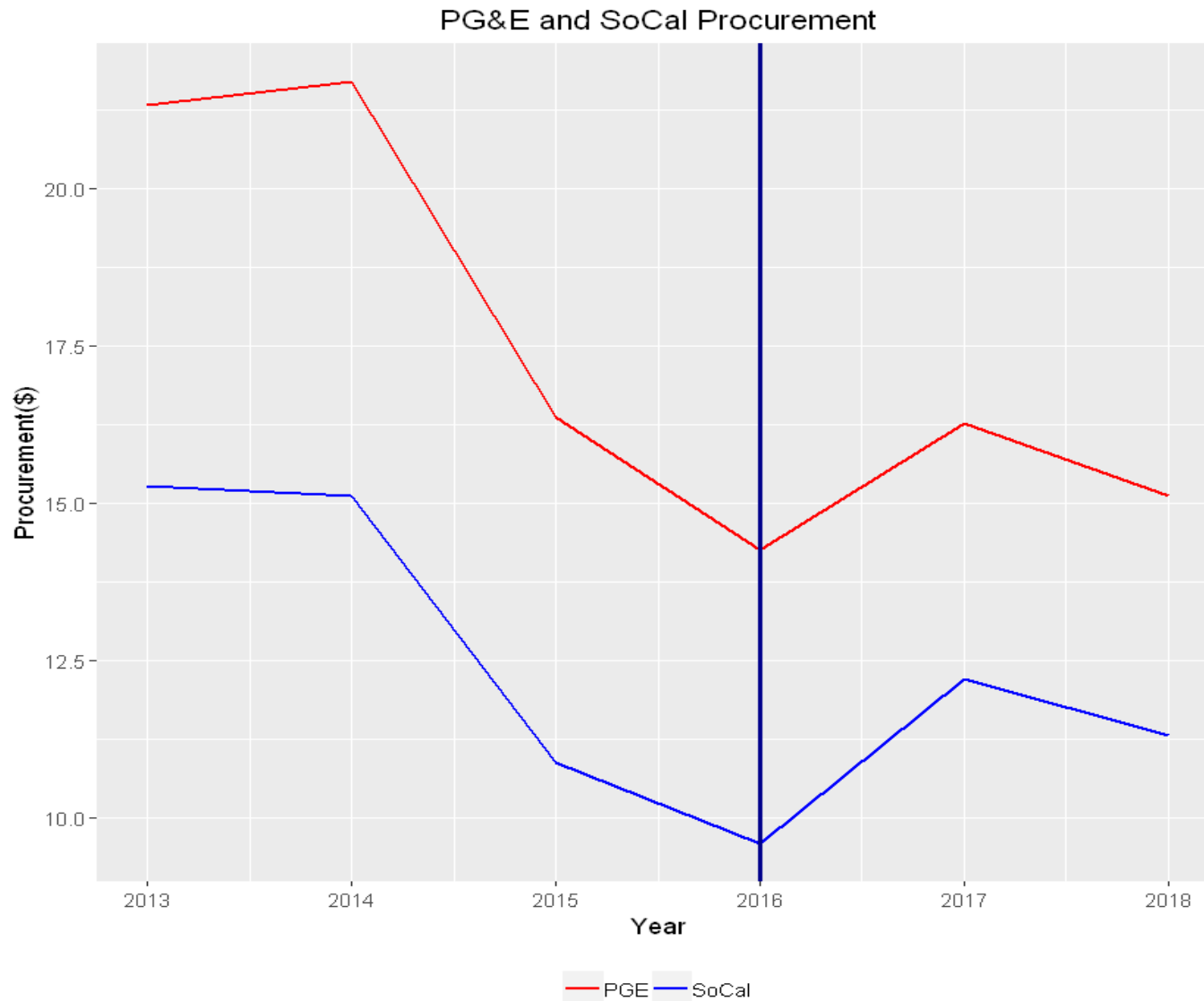
The treatment effect to be estimated from the regression equation

Procurement Cost-Overlapping Zip Codes

PG&E and SoCal Procurement

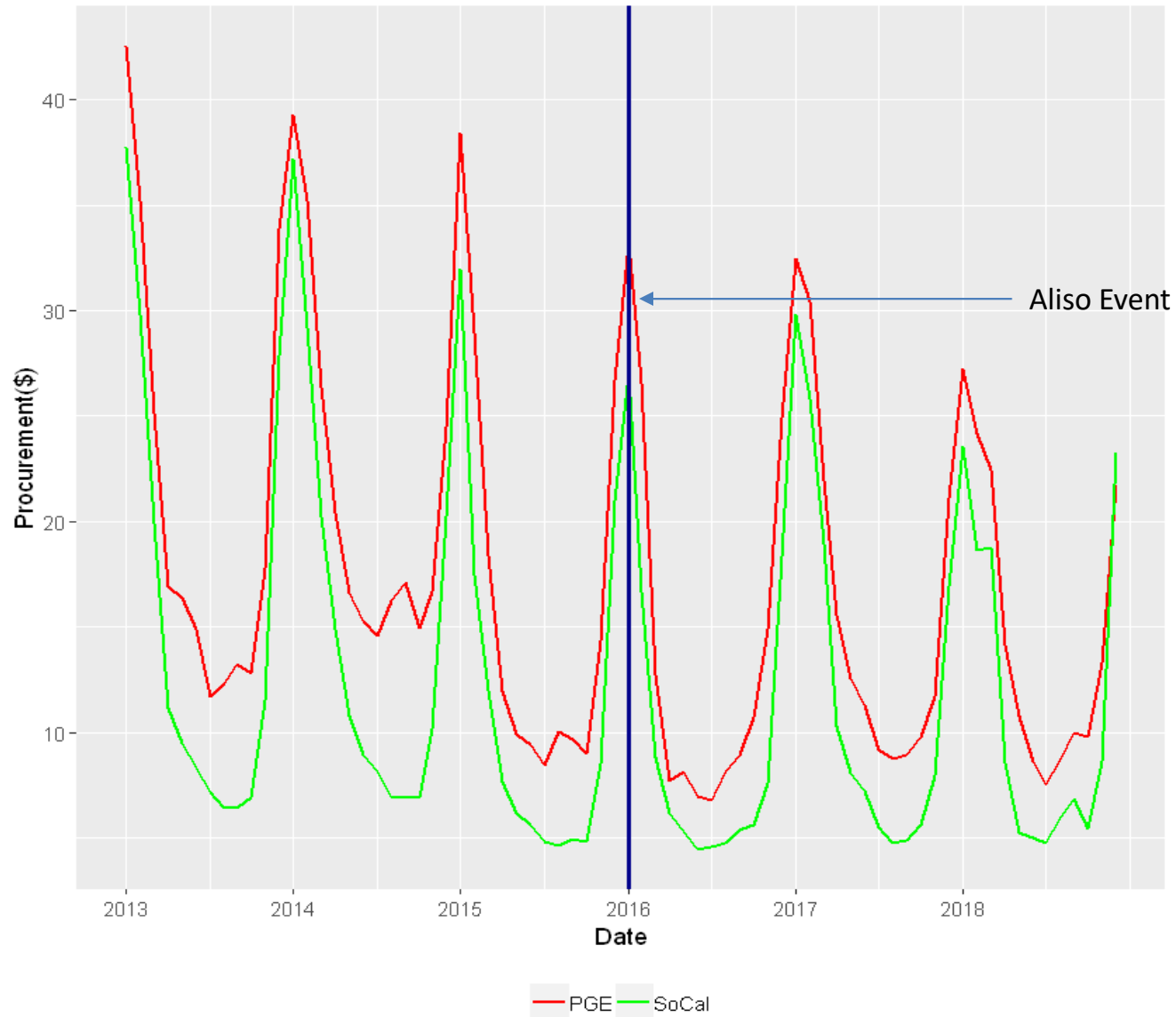


Parallel Trend Assumption Validation on Yearly Basis



Parallel Trend – Monthly Data

PG&E and SoCalGas Procurement Trend



DID Results with Robust Standard Errors : Years 2013-2018

t test of coefficients:

	Estimate	Std. Error	t value	Pr(> t)	
(Intercept)	19.53878	0.22372	87.3366	< 0.00000000000000022	***
treated	-5.84993	0.22420	-26.0923	< 0.00000000000000022	***
time	-4.51913	0.26714	-16.9170	< 0.00000000000000022	***
did	1.81794	0.26779	6.7887	0.00000000001131	***

Gas procurement cost trended downward over time.

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Even though average gas commodity costs should have fallen by \$4.52 per month due to decrease in gas prices over time, they instead fell by only \$2.70. The average procurement cost from 2016 to 2018 was **\$1.82/ Bill higher than it would have been without Aliso event and pipeline outages**

2016, 2017, 2018 average bill impacts

Year	Outage	Bill Impact
2016	Aliso Canyon	\$1.32/ Bill
2017	Aliso Canyon and Lines 235 and 4000 (Starting October 1,2017)	\$1.89/ Bill
2018	Aliso Canyon and Lines 235 and 4000 (All year)	\$2.25/ Bill

These values correspond to individual years 2016-2018 and represent the results of regression with robust standard errors.

Summary of Findings: Difference-in-Difference

- The average gas procurement cost from 2016 through 2018 after the Aliso incident increased by **\$1.82/ Bill**.
- 2016: The average gas procurement cost compared to before the Aliso incident increased by **\$1.32/ Bill**.
- 2017: The average procurement cost compared to before the Aliso incident increased by **\$1.89/ Bill**. This likely includes the **partial** effect of pipeline outages, which began October 1.
- 2018: The average procurement cost compared to before Aliso incident increased by **\$2.25/ Bill**. This likely induces the **full** effect of pipeline outages.

Appendix

Full regression results – 2016-2018 with robust standard errors

2016

t test of coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	19.53878	0.22372	87.3366	< 0.000000000000000022 ***
treated	-5.84993	0.22420	-26.0923	< 0.000000000000000022 ***
time	-5.45081	0.33611	-16.2174	< 0.000000000000000022 ***
did	1.31566	0.33699	3.9042	0.00009454 ***

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2017

t test of coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	19.53878	0.22372	87.3366	< 0.000000000000000022 ***
treated	-5.84993	0.22420	-26.0923	< 0.000000000000000022 ***
time	-3.41609	0.35705	-9.5675	< 0.000000000000000022 ***
did	1.88322	0.35800	5.2603	0.0000001438 ***

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2018

t test of coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	19.53878	0.22372	87.3366	< 0.000000000000000022 ***
treated	-5.84993	0.22420	-26.0923	< 0.000000000000000022 ***
time	-4.70552	0.31940	-14.7321	< 0.000000000000000022 ***
did	2.24517	0.32028	7.0099	0.0000000000002385 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1



Questions?

THANK YOU