



Impacts of Strategic Petroleum Reserve Release in the United States

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Abstract

In my research, I estimate the impact of strategic petroleum reserve (SPR) release in the United States during release periods from 2000 to 2022, and the effect on oil markets. To predict the announcement effect associated with SPR activity, I utilize US Energy Information Administration NYMEX Futures Prices to indicate if oil markets anticipated the announcement by US President Joe Biden to release fifty-million barrels of oil. I create a multivariate regression to calculate weekly change of futures price starting a month before and after announcement. To measure the effectiveness of the SPR, a vector autoregression model is created to estimate crude oil price change relative to periodic release from the SPR, while controlling for U.S oil production, import volume, and price lags. Expected findings based on previous research suggests the extent of SPR effectiveness is dependent on the magnitude of the oil shock.

Figure 1



Importance

- The price of oil has inflated to an abnormally high price, affecting global markets.
- The release of oil from the SPR in the past has proven to provide insignificant relief to high oil prices
- Minimal research on the announcement effect and SPR activity

Crude Oil Determinants

Factors influencing crude oil prices Include:

- **Supply** - United States, OPEC, Russia, Canada, China
- **Demand** - During Covid, price was low because of decreased demand; as demand increases, prices increase.
- **News** - Russia invading Ukraine increased the volatility of oil.
- **Policy** - NATO countries prohibiting importation of Russian oil.
- **Financial Markets** - Trading oil futures

*SPR activity is omitted since the variable is binary.

Data

Monthly data since January 2000 to December of 2021 is utilized for each variable. **West Texas Intermediate** (WTI) is a particular grade of crude oil drilled in the United States, and the predominant price measure in the U.S. Brent Prices are the predominant European price measure parallel to WTI, however omitted from the study. **Import of Crude Oil** encompasses the amount of crude oil imported measured in thousands of barrels per day. **Production of Oil** parallels imports in measurements, however, only considers U.S. production of oil. **SPR Activity**, denoted as binary variables, measures the impact of release periods starting in 2005 with the Hurricane Katrina sale, followed by 2011 IEA Coordinated Release, and the 2021 release by President Joe Biden. The most recent release in March of 2022 is expected to remain omitted from the study due to the lack of available data. **Oil contract 1** represents the calendar month following the trade date, while **Oil Contracts 2 through 4** depict the sequential delivery months after contract 1.

Methods

A vector error correlation (VEC) model is utilized in the study to examine the time series data and account for non-stationary cointegrated variables. A VEC without natural logs of each variables was regressed, however is not utilized in the model until more research is conducted. A natural log of each variable excluding SPR Activity, utilizes a vector error correction with optimal lags of five and four cointegration parameters examined. Current analysis focuses exclusively on SPR release impact, modeled as followed:

$$\Delta Y_{t-1} = \beta_0 + \beta_1 X_{t-1} + \Delta \beta_2 X_{t-1} + \Delta \beta_3 X_{t-1} + \beta_4 X_{t-1} + \Delta \beta_5 X_{t-1} + \Delta \beta_6 X_{t-1} + \Delta \beta_6 X_{t-1}$$

Where:

- ΔY_{t-1} = WTI Price measured in monthly price
- $\Delta \beta_1 X_{t-1}$ = SPR Release represented by binary variables of release periods
- $\beta_2 X_{t-1}$ = U. S. Importation of crude oil in monthly interval
- $\beta_3 X_{t-1}$ = U. S. Production of crude oil in monthly interval
- $\beta_4 X_{t-1}$ = Oil Contact 1 representing oil futures with an expiration date of **one** month
- $\beta_5 X_{t-1}$ = Oil Contract 2 representing oil futures with an expiration date **two** months after contact 1
- $\beta_6 X_{t-1}$ = Oil Contract 3 representing oil futures with an expiration date **three** months after contact 1

Preliminary Results

Statistical significance at the 99 percent confidence level is examined three difference lags in SPR activity and at the 95 percent confidence level of four lagged difference levels of SPR Activity. Other regressions excluding natural log of each variable concluded significant evidence to support the H_0 that; SPR release has an impact on crude oil prices across various fields and levels, however, is inconsistent with previous literature. Cointegration in the model is found across varying levels, most prevalent at a rank of four. Statistical significance at each variable besides production is portrayed at L._ce4.

Future Work

Improvement of current data to ensure statistical properties of previous studies and econometric analysis will continue throughout the semester. The announcement effect on SPR release in relation to daily or weekly future prices and market anticipation is expected to be conducted in a new model in coming weeks. SPR activity and the impact of release in the model is a base measurement required to examine an announcement effect, and if the announcement impact is more significant than release of crude oil from the Strategic Petroleum Reserve.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VAR.	WTI	SPR Activity	US Import	Prod.	Oil 1	Oil 2	Oil 3	Oil 4
L_ce1	1.199 (3.898)	-8.569 (5.983)	-1.066 (1.985)	1.428 (1.392)	1.912 (3.840)	-1.549 (3.536)	-2.769 (3.362)	-3.131 (3.230)
L_ce2	-0.00528 (0.0127)	-.0445** (0.0195)	0.00520 (0.0064)	0.0111** (0.0045)	-0.00314 (0.0125)	-0.0102 (0.0115)	-0.0111 (0.0109)	-0.0110 (0.0105)
L_ce3	-0.0936* (0.0509)	0.109 (0.0782)	-.0573** (0.0259)	-0.00300 (0.0182)	-0.101** (0.0502)	-0.100** (0.0462)	-.0957** (0.0439)	-0.0883** (0.0422)
L_ce4	.0679*** (0.0260)	0.0658* (0.0399)	-0.0248* (0.0132)	0.00381 (0.0092)	-.0703*** (0.0256)	-.0642*** (0.0236)	-.0606*** (0.0224)	-.0564*** (0.0215)
LD WTI	2.761 (3.656)	8.263 (5.612)	1.157 (1.862)	-1.013 (1.306)	2.936 (3.602)	3.068 (3.317)	3.203 (3.153)	3.215 (3.030)
L 2D WTI	3.199 (3.152)	7.137 (4.838)	1.980 (1.605)	-0.780 (1.126)	3.343 (3.105)	3.403 (2.860)	3.507 (2.719)	3.556 (2.612)
L 3D WTI	2.154 (2.573)	4.734 (3.949)	0.716 (1.310)	-0.294 (0.919)	2.300 (2.535)	2.368 (2.334)	2.478 (2.219)	2.543 (2.132)
L 4D WTI	2.452 (1.819)	4.382 (2.793)	0.0438 (0.927)	-0.488 (0.650)	2.505 (1.793)	2.394 (1.651)	2.350 (1.569)	2.329 (1.508)
LD SPR Activity	-0.0378 (0.0446)	-0.0158 (0.0685)	-0.0151 (0.0227)	-0.00537 (0.0159)	-0.0404 (0.0440)	-0.0348 (0.0405)	-0.0334 (0.0385)	-0.0332 (0.0370)
L2D SPR Activity	0.0243 (0.0477)	-0.0146 (0.0732)	0.0124 (0.0243)	-0.00228 (0.0170)	0.0229 (0.0470)	0.0277 (0.0433)	0.0282 (0.0411)	0.0274 (0.0395)
L3D SPR Activity	0.0149 (0.0472)	-0.262*** (0.0724)	0.0185 (0.0240)	0.00286 (0.0169)	0.00886 (0.0465)	0.00587 (0.0428)	0.00285 (0.0407)	0.000660 (0.0391)
L4D SPR Activity	0.0206 (0.0472)	-0.174** (0.0724)	-0.0237 (0.0240)	-0.00680 (0.0169)	0.0196 (0.0465)	0.0301 (0.0428)	0.0319 (0.0407)	0.0315 (0.0391)

*ce1-4 represents cointegration, four ranks were found from the VEC regression.