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Testing substitution between private and public storage in the U.S. oil market: A study on the U.S. Strategic Petroleum Reserve

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ABSTRACT

The U.S. Strategic Petroleum Reserve (SPR) was established in 1975 to mitigate major oil supply disruptions and to deter the use of energy as a geopolitical "weapon." However, policies towards the utilization of strategic oil stocks have varied under different presidencies and the SPR has often not been used in sufficient quantity or soon enough to avoid the negative economic consequences that can follow oil supply outages. Economic theory suggests that the existence of public stockpiles of commodities will alter inventory management practices of private market participants. This paper models private crude oil storage in the United States and estimates the private storage response to presidential announcements regarding the SPR. We investigate the incidence of different kinds of announcement events including releases and test sales from the SPR, announced changes in fill rates, and changes of presidency and how these events impact private land-based storage in the United States by region (PADD) as well floating storage. We find significant substitution between private and public stocks for crude oil and find that announcement events are associated with observable changes in private inventory levels, with implications for public policy choices and geopolitical strategies.

1. Introduction

Inventories play a crucial role in commodity markets, affecting spot and forward prices (Williams and Wright, 2005). At the same time, inventory levels are endogenous with inter-temporal prices. In many commodity markets, inventories are mostly held by the private sector for both speculative and "working stock" reasons (Carter and Revoredo-Giha, 2009). But governments also play an intervening role in some commodities. In the grain markets, for example, key major economies such as the United States and the European Union discontinued grain stockholding in the 1980s whereas in some emerging economies, such as China and India, fears of famine remain and governments hold relatively large stocks. By contrast, in the crude oil market, a large number of governments hold stocks for emergencies and strategic economic and political reasons (Wright and Williams, 1982). The U.S. government has such a program, the Strategic Petroleum Reserve (SPR), managed by the Department of Energy and thought to be the largest emergency supply of oil in the world.

Debate has ebbed and flowed about the effectiveness of the SPR, but recent economic literature on the topic is sparse. One way to consider the evolving role of U.S. government oil stocks is to examine the substitution between public and private storage for crude oil in the U.S. The topic is particularly timely for a number of reasons.

Firstly, the rapid rise in U.S. oil production from unconventional oil reservoirs is altering the calculus about strategic oil stockpiles in the face of declining U.S. oil import levels. The U.S. Energy Information Administration (EIA) recently projected that U.S. net energy imports might be eliminated in the 2020–30 time frame, and import levels have already declined from 60% of total U.S. oil use in 2005, to 45% currently. The changing import outlook has renewed discussion about U.S. strategic stock policy (Clayton, 2012). Secondly, falling imports and rising domestic production have brought about significant changes in pipeline flows in the U.S. crude oil delivery system, creating bottlenecks now blocking the shipment of SPR crude to some key refining centers. Policy makers are being called upon to determine whether these logistical issues are material to U.S. national security, and if so, whether they are surmountable. Finally, earlier this year the United States saw the largest buildup in U.S. inventories in 80 years. In the case of private storage, levels of crude oil storage in Cushing, Oklahoma (OK) reached peak highs. On April 17th, 2015, privately held crude oil storage in Cushing reached 62.2 million barrels, the highest level ever recorded,

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and exceeded three-fourths of working storage capacity.[1] The growing importance of storage has prompted the creation of the first ever crude oil storage futures contract on the Chicago Mercantile Exchange (CME).[2]

In this paper, we investigate the linkage between government and private inventories in the U.S. oil market. We measure the trade-off between private and SPR inventories and determine how private stockholding has responded to elections and release policies of new Presidents. We theorize that how different Presidents interpret the release conditions will change the likelihood that a release action will take place and thereby will alter the market's expectations of SPR actions. We measure how private storage has responded to different presidencies and to each of the last four emergency SPR release actions. We consider both how private storage has responded to each of the last four emergency SPR release actions as well as the interplay with private storage during the period when President George W. Bush issued orders to raise the overall fill target level for the reserve.

A priori, we expect the inter-temporal price spread (difference between distant futures prices and nearby futures prices), production, and imports to have a positive impact on quantity stored. A positive response in private storage to increases in domestic production or imports is consistent with the results found by Kilian and Murphy (2014) regarding inventory responses to supply disruptions. A positive response in private storage to increases in the price spread would also be consistent with their result on inventories response to speculative demand shocks. Our findings supplement this work by adding the SPR's role in such processes. We find that SPR policy indeed influences private storage behavior. In theory, a higher level of public stocks can substitute for private holdings, whereas pipeline bottlenecks that prevent access to a public stock release would, at least in theory, stimulate higher private holdings for refiners with less access to SPR releases. This link is important moving forward on questions about the future of the SPR in light of declining oil import levels and new pipeline transmission bottlenecks.

The SPR has come under scrutiny recently in an article by Difiglio (2014). Difiglio questions the legitimacy of owning and operating the "largest emergency reserve, despite declining reliance on oil imports." He also argues that the SPR emergency releases are poorly timed and, in the case of the Hurricane Katrina and Rita releases, ineffective in relieving disruptions in refinery capacity. Difiglio concludes that a reevaluation of the operation of the reserve is timely, given recent poor experiences with stock releases and changes in the composition of oil demand and level of oil intensity in the U.S. economy. Patron and Goldwyn (2013) also identify the timing of releases as being a problem and note, "when deploying the reserve, a large swift response is often most effective." Interestingly, substantial changes in Gulf Coast crude oil delivery infrastructure has prompted the SPR to conduct a test sale to "evaluate the SPR's ability to sell, drawdown, and distribute crude oil" in light of recent changes in pipeline and delivery infrastructure.[3] The Government Accountability Office (GAO) has also released a report questioning the appropriate size and current role of the SPR in light of recent changes to the crude oil market in the United States (GAO, 2014). The GAO recommends an official reexamination of the size of the SPR in order to evaluate whether the "SPR is sized appropriately" or if it is "holding excess crude that could be sold to fund other national priorities" (GAO, 2014). We conclude that there is statistically significant evidence justifying such calls for a policy review of the triggers for the use of the SPR.

2. History of the U.S. Strategic Petroleum Reserve: motivation and use

The SPR is a government owned network of crude oil facilities that is currently authorized to stockpile "up to 1 billion barrels of petroleum products" in order to "diminish the vulnerability of the United States to the effects of a severe energy supply interruption, and provide limited protection from the short-term consequences of interruptions in supplies of petroleum products."[4] Physical storage capacity of the SPR is currently 727 million barrels.[5] The stated mission of the Office of Fossil Energy Petroleum Reserves is twofold: to "protect the United States from severe petroleum supply interruptions through the acquisition, storage, distribution and management of emergency petroleum stocks and to carry out U.S. obligations under the International Energy Program."[6] Specifically, the SPR was created in response to the 1973–1974 Arab oil embargo.[7] The SPR's goals are to acquire and stockpile a vast amount of oil and release it for sale during times of severe supply interruptions. The SPR does not seek to enrich the federal government by profitably timing crude oil purchases and sales, nor does it seek to ensure that refineries and pipelines are operating at maximum efficiency. Rather, the SPR aims to ameliorate a "severe energy supply disruption" which is defined as (1) a severe increase in product prices which is (2) likely to cause a major adverse impact on the national economy.[8,9] Crude oil has few substitutes and the refined oil products derived from crude oil are an input in the production of many goods and services. The consequences of a shortage negatively affecting the economy are so severe that public stockholding was justified when the SPR was created (Jaffe and Soligo, 2002).

Another reason that Congress authorized the creation of the SPR was to discourage future export embargoes against the United States (Andrews and Pirog, 2012). In his memoir, *Years of Renewal*, Kissinger (2012) explains that the SPR was created specifically to be a tool to redress the bargaining imbalance in the global energy market. The SPR was designed to give the United States greater room for maneuvering in foreign policy negotiations despite the fact that the U.S. is a major importer of oil. In addition, one goal of the SPR was to prevent global economic damage from undue manipulation of oil markets. The existence of the SPR has meant that any country or group of countries considering imposing an oil embargo on the United States must account for the United States' strategic oil reserves. The possibility of a U.S. SPR release increases the cost and disrupts the timing of any embargo. Whether the SPR has prevented oil embargoes cannot be tested. Much like the success of the Patriot Act or the Transportation Security Administration cannot be proven by the absence of terrorist attacks, the success of the SPR cannot be judged by the absence of oil embargoes. An embargo event could disprove the efficacy of the SPR, but the absence of an embargo is simply the absence of evidence.

[1] Weekly Petroleum Status Report, *U.S. Energy Information Administration*, April 22, 2015. http://www.eia.gov/petroleum/supply/weekly/archive/2015/2015_04_22/pdf/wpsrall.pdf. Breul, H., Comstock, O. "Crude oil storage at Cushing, but not storage capacity utilization rate, at record level." *U.S. Energy Information Administration*, March 23, 2015. http://www.eia.gov/todayinenergy/detail.cfm?id=20472.

[2] "First-ever physically delivered crude oil storage futures contract announced." *Commodities Now*, March 4, 2015. http://www.commodities-now.com/news/power-and-energy/18397-first-ever-physically-delivered-crude-oil-storage-futures-contract-announced.html.

[3] "Strategic Petroleum Reserve Test Sale 2014" *Department of Energy*, Report to Congress, November 2014.

[4] Congress, U. S. "Energy Policy and Conservation Act." Public Law 94.163 as amended through Public Law 113.67 (2013).

[5] "History of SPR Releases." *Department of Energy*, 2015. http://energy.gov/fe/services/petroleum-reserves/strategic-petroleum-reserve/releasing-oil-spr.

[6] "Petroleum Reserves Vision, Mission and Goals" *Department of Energy*, 2014.

[7] "Petroleum Reserves" *Department of Energy*, 2015. http://energy.gov/fe/services/petroleum-reserves.

[8] Congress, U. S. "Energy Policy and Conservation Act." Public Law 94.163 as amended through Public Law 113.67 (2013).

[9] On July 19, 2000, in response to questioning about the 2000 Heating Oil Exchange SPR release by President Clinton, Energy Secretary Bill Richardson stated, "The government does not want to be in the heating oil business, but we must be ready to respond to a shortage or severe price spike." Gorlick, Adam. "Clinton Makes Oil Reserve Pledge." ap.org. Associated Press, 19 Jul. 2000. http:// http://www.apnewsarchive.com/2000/Clinton-Makes-Oil-Reserve-Pledge/id-a95cc1a015bc3a499743f554b3762596.

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