The Strategic Determinants of Oil Stockpiling Behavior

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Dedication

To my wife

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Abstract of Dissertation

The Strategic Determinants of Oil Stockpiling Behavior

Oil is a vital input to industrialized economies. Despite efforts to moderate their fuel consumption, oil-importing nations remain vulnerable to the adverse consequences of oil supply disruptions. This dissertation examines an understudied area of energy security policy that constitutes a concrete response to oil supply insecurity: strategic oil stockpiling. The International Energy Agency (IEA) requires member countries to maintain oil stockpiles equivalent to 90 days' worth of imports. Nations meet this obligation in different ways. Some governments hold public stocks, which are costly but represent a robust policy instrument. Other governments take a comparatively weaker approach, by mandating that private companies hold extra inventory. Industry mandates minimize costs, but they do little to improve energy security. This dissertation explains what determines nations' approaches to oil stockpiling based on their threats and capabilities.

This project distinguishes between economic vulnerability to oil price shocks in the global market and national security vulnerability stemming from the threat of a physical supply cutoff. Oil stocks address the former through collective IEA releases and the latter through replacing lost imports. Market power impacts oil stockpiling strategy in countries facing primarily economic vulnerability. Large states, which can decisively impact the success or failure of a collective IEA release, invest in robust strategic stockpiling programs which moderate the economic threats by ensuring the IEA's

collective capability. In contrast, small, economically vulnerable IEA members minimize costs, because the efficacy of their programs does not impact market stabilization outcomes. Small IEA members facing national security threats stemming from the potential of oil coercion pursue robust government-owned oil stockpiles despite their inability to influence the market, because they treat energy security as a matter of national sovereignty.

This dissertation evaluates this theory of oil stockpiling behavior using a multi-methodological empirical strategy designed to capture both broad trends across the IEA as well as the nuances of energy security decision making in individual countries. The project first tests multiple hypotheses derived from this explanatory model with a statistical analysis of government oil stockpile levels in IEA countries from 1984-2012. This analysis points to the importance of state-level factors such as dependence on hostile supply sources and market power. Case studies of oil stockpiling in the United States, Sweden, and the Czech Republic buttress the quantitative results. The discourses on energy security in each of these countries further highlights the role of threats and capabilities in explaining differences in oil stockpiling policy. The project concludes with a discussion of contributions and policy implications and an application of the project's logical model to strategic oil storage in China.

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"Given America's present situation, it may be wise to do the following: take steps to conserve energy; concentrate on research about, rather than on development of, our own energy sources; and build a petroleum stockpile sufficient for riding through, say, a six-month embargo. A six month stockpile would provide a comfortable margin of safety."

- Kenneth Waltz, *Theory of International Politics*

Chapter 1: Introduction

By any standard, oil is the most important commodity in the world. Oil defines the fortunes of producer nations and animates the energy security discourse of importer nations. In terms of scale, trade in petroleum represents about five percent of global GDP.[1] Despite promising alternative mobility technologies, transportation-sector petroleum consumption is a defining attribute of modern society that will persist for the foreseeable future. Stable oil supplies therefore represent a key economic input for all nations. Shocks to the oil price can significantly impact global output. Further, oil is a critical component of mechanized warfighting. Military requirements, and the fact that vulnerable oil supplies can leave importing nations open to coercion, make stable oil supplies a critical issue for many countries. For producer countries, oil can represent a source of strength that fundamentally impacts the way that they approach foreign affairs. It follows that energy security objectives play a role in the foreign policy decisions of importing and exporting nations alike. In short, oil plays a significant role in international politics.

Academic treatments of oil's role in international politics might be described as uneven. In the wake of the Arab oil embargo in the 1970's, oil market issues featured prominently in major international relations debates.[2] However, as oil prices decreased in

[1] Hughes, 2014 presents a good discussion of the significance of oil to the international economy.
[2] For example, The Organization of Petroleum Exporting Countries (OPEC)'s role international politics featured prominently in the development of Keohane and Nye's theory of complex interdependence in 1977. Waltz also deals with oil dependence in *Theory of International Politics* (1979). The early history of the International Energy Agency, discussed in detail below, is an anchor case for Keohane's *After Hegemony* (1984). These are some of the most widely cited works in the field. Hughes and Lipscy (2013) provide an excellent summary of this early work.

the 1980's and energy security became a back-burner policy issue, academic interest in the role of petroleum in international politics waned. In the 2000's, oil prices rebounded and energy security returned as a major policy topic. Since then, international relations scholars have written about the role that oil plays in conflict, how states have reacted to the globalization of the oil market, the reaction of industrialized nations to energy vulnerability, the role of oil supply concerns in U.S. grand strategy, and numerous other topics.[3] These recent contributions enrich the understanding of oil's role in international politics, but the literature is far from saturated. Compared to the discipline of economics, in which numerous journals and professional organizations are dedicated exclusively to energy analysis, political scientists have only scratched the surface. It follows that numerous energy-related topics of theoretical and empirical interest remain understudied in the political science space.

This dissertation focuses on a major policy response undertaken by oil importers to address energy security threats: oil stockpiling. To date, no study exists which employs a political science framework to comprehensively evaluate this topic. Since World War II, oil-importing nations have developed petroleum stockpiles to guard against potential supply losses. Oil stockpiling requirements represent a core component of membership in the International Energy Agency (IEA), a supply security organization founded by oil consumers in response to the 1973 Arab Oil Embargo. Over time, nations have taken approaches to building strategic oil stocks. Some have poured considerable resources into government-held reserves, while others have minimized costs by placing the burden of oil stockpiling on industry. The level of government involvement in oil

[3]Notable examples include Glaser, 2013; Klare 2001 and 2004; Hughes, 2014: Duffield, 2008 and 2014; Gholz and Press, 2010.

stockpiling directly impacts the efficacy of strategic reserves and constitutes a clear measure of nations' commitment to energy security. This project conceptualizes oil stockpiling as a form of state behavior and argues that differences in the level of government involvement in oil stockpiling can be explained by the nature of energy vulnerability that nations face and by the market power that their oil stockpiles confer.

Background: Oil Matters

To provide context for a dissertation focused on differences between states' approaches to energy security policy, it is important to briefly explain the characteristics of oil that render it a pivotal component of world affairs. Oil plays a transformative role in most petroleum-exporting countries. The supply and demand patterns for petroleum render it susceptible to dramatic price fluctuations that harm the economies of importing countries. It also fuels modern warfare and can play a major role in military outcomes and strategic decision making. These unique attributes of petroleum drive energy policy choices in consumer states and impact the contours of international energy governance.

For oil-abundant countries, hydrocarbon wealth fundamentally shapes every attribute of state behavior. Political scientists' treatment of oil-rich countries is relatively advanced. Much has been written about the impact of oil on domestic governance in exporting countries.[4] To summarize: countries which are heavily dependent on oil rents are not usually well-run. More recently, scholars have shown that under some circumstances oil can lead to aggressive foreign policies in producer nations and impact the alliance strategies that they pursue.[5] A deep-dive into the mechanisms outlined in these literatures is beyond the scope of this project. However, the significance of oil for

[4] For example see Karl, 1997 or Ross, 2012.
[5] Colgan 2010 and 2013; Kim, 2016.

exporting countries is notable here insofar as it illustrates that petroleum can fundamentally drive international political outcomes. Further, it highlights that suppliers cannot necessarily be expected to be accommodating partners for the oil importers which are the focus of this study.

Oil's unique market characteristics cause its price to fluctuate more drastically than a normal commodity. Demand for oil is extremely inelastic in the short run, meaning that consumption patterns do not change much in the face of substantial price changes. This is attributable to the inflexible demand structure for oil, especially in the transportation sector. While importing nations have been successful at diversifying their power sectors away from liquids, petroleum products remain the only viable fuel for enabling mass population mobility. Long-term demand abatement strategies can work, but they are extremely costly and challenging. When oil supply is compromised, the only thing that consumers can practically do in the short run is pay more. In developed countries, economic stagnation and increased energy efficiency have moderated oil demand growth, but this consumption is not expected to *contract* in the coming years.[6] In fast-growing developing economies the demand for oil continues to expand.

The supply side of the oil market further complicates the picture. In the short run, oil supply is also inelastic, which also contributes to oil price volatility. Projects that add new supply to the global market can take many years to develop, making the supply of oil relatively fixed in the short term. This means that when oil is taken off of the market, consumers (who cannot quickly adjust their consumption patterns) are forced to bid up the price of the remaining barrels. These price spikes can be severe in the event of a

[6] EIA, 2016b.

major supply disruption. Tight oil production in the United States, which can respond relatively quickly to price signals, is changing this somewhat. Shale producers can ramp up output much faster than their conventional counterparts.[7] Notwithstanding this positive trend, *severe* curtailments in the global supply of oil will still result in price spikes.

Outside of the emergency stocks discussed in this dissertation, the only other release valve for the global market is spare production capacity. Control of this resource lies in the hands of a few of producer governments. In the 1960's and 1970's the governments of producer countries increased their involvement in petroleum output through nationalizations and through the establishment of state oil companies. During the same period, the Organization of Petroleum Exporting Countries (OPEC) was founded and began to play a major role in global oil supply.[8] These developments greatly increased the market power of producer governments and their leverage over importers. Even as the development of the "spot" market for oil has reduced the direct role played by exporters and the number of producing countries has grown, market power in petroleum production has remained largely outside of the hands of importer governments. Spare capacity still represents a major source of leverage for producers, most notably Saudi Arabia.[9] When this power disparity is combined with the susceptibility of oil output to disruptions stemming from other risks such as natural disasters,

[7] The "surgability" of tight oil production in the United States is the subject of considerable debate. Under the market circumstances at the time of writing, a surfeit of drilled, but uncompleted wells mean that tight oil production could increase rapidly. However, because of the steep decline rates in tight oil plays, it is not clear that this will be a durable long-term attribute of the market.
[8] Hughes, 2014.
[9] Estimates of OPEC spare capacity vary. A reliable source for these estimates is the U.S. Energy Information Administration (www.eia.gov). Some scholars contend that OPEC is no longer an effective manager of the oil market (see Colgan, 2014).

mechanical/infrastructure failures, and above-ground conflict, it quickly becomes evident why security of the supply of oil is a major concern for governments.

Price spikes caused by acute oil production shortages can severely harm the economies of importing nations. For firms, expensive oil increases input costs, which leads to reduced output. Costly oil also takes away disposable income from consumers, which limits their ability to purchase other goods. The uncertainty generated by an unstable oil market also curtails investment as well as purchases of oil-intensive consumer durable goods, such as automobiles. Further, as dearer petroleum drives economic actors from more- to less-energy-intensive activities, frictions associated with these shifts known adjustment costs further impede growth. All of these factors come together to slow economic output. In addition reduced growth, high oil prices contribute to inflation. The empirical record bears out the significance of the relationship between oil supply shocks and economic stagnation. 11 out of 12 post-World-War-II recessions have been preceded by shocks to the world oil price.[10]

In addition to supporting the prosperity of the industrialized world, oil also constitutes a major input to modern warfare. Tanks, aircraft, most naval vessels, field generators, and other military equipment require petroleum to operate. A supply cutoff could cripple a modern military. The threat of oil coercion and strategies to mitigate it played a large role in driving great power grand strategy in the run up to World War II.[11] The globalization of the oil market and the development of military fuel stockpiles have reduced the importance of operational energy considerations in the development of

[10] The classic study on this issue is Hamilton, 1983. For reviews of this literature see Jones, Leiby, and Paik, 2004 and Vincent, 2016.
[11] Kelanic, 2012; Kelanic, 2016.

energy security policy.[12] This said, the United States remains committed to sustaining a functional world oil market. Since the Carter Administration, the maintenance of stable oil supplies from the Persian Gulf has been an explicit goal of U.S. foreign policy.[13] For smaller oil importing nations whose imports can be restricted by an adversary, a curtailment of the flow of petroleum can constitute a first-order existential threat. When shifts in the behavior of exporters is viewed in concert with these importer responses to vulnerability, it becomes clear that oil drives foreign policy outcomes to an extent that fundamentally influences the nature of international politics.

Oil Stockpiling as State Behavior

A key contribution of this dissertation is that it treats oil stockpiling as state behavior. Most academic analysis of strategic oil stocks is rooted in the economics discipline. A quantitative literature exists that addresses policy questions such as how large oil stockpiles should be and how they should be used.[14] This project goes a step further, by considering both the economic threats and the non-economic threats that oil stockpiles defend against. This project rigorously unpacks why some nations made the choice to pour resources into oil stockpiles while others did not. In some cases economic analysis played a major role, but in other cases security factors drove policy. To best understand the constellation of approaches to oil stockpiling across the IEA, the most productive approach is to conceptualize oil stockpiling as a state response to vulnerability.

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[12] This project tables the issue of military petroleum stockpiles. The exact volumes, locations, and characteristics of these stores are not publicly available. The coercion mechanism outlined here would still hold, because a supply cutoff could leave a coercible, even if its military had enough fuel to operate.
[13] This issue is carefully evaluated in Glaser and Kelanic, 2016.
[14] Notable examples include Teisberg, 1981; Hogan, 1983; Murphy, Toman, and Weiss, 1987; and Leiby and Bowman, 2000. The role of economic reasoning in the development of the U.S. Strategic Petroleum Reserve is discussed in chapter four.

The extent of oil-importing nations' peacetime vulnerability to supply cutoffs became acutely apparent during the 1973 Arab oil embargo. Industrialized oil-importing countries scrambled to mollify Arab oil producers in response to the cutoff and came together in 1974 formed the International Energy Agency (IEA) to facilitate oil supply security. The International Energy Program (IEP) agreement laid out the organization's collective energy security functions, which included demand restraint measures, oil stockpiling requirements, and the Emergency Sharing System (ESS), wherein countries would share oil stocks among members in the event of a supply emergency. Founding members of the IEA sought to share information, coordinate policy, and establish a counterweight to OPEC. For these countries, the most significant policy requirement associated with IEA membership was the requirement to hold oil stocks equivalent to 60 days' worth of imports, a requirement that would later be expanded to 90 days.[15]

Petroleum stockpiles can address both the national security threat of supply cutoffs and the economic threat of a roiled global market. For an importing nation, a strategic reserve of petroleum provides a first line of defense against a physical curtailment of oil supplies. If a pipeline or waterborne imports are compromised, a domestic oil stockpile can be drawn down to cover the lost supplies while the supply issue is resolved. Collectively, a release of IEA oil stocks can stabilize the global oil market in the event of an acute oil supply crisis by making up for lost petroleum flows. The security benefits of a strategic reserve accrue exclusively to the stockpiling nation in question; the economic benefits provided by the totality of IEA stocks accrue to all oil-importing nations, whether or not they hold an effective oil stockpile. Considerable

[15] Colgan, Keohane, and Van de Graf, 2011; Van de Graf and Lesage, 2009.

heterogeneity exists among IEA members in terms of which of these threats predominate in stockpiling decisions.

Building a strategic oil reserve is a costly decision for states. Developing an oil stockpile entails purchasing barrels on the open market and developing storage facilities above and beyond what industry requires to function.[16] In the negotiations that led to the IEA's founding, the requirement to hold an oil stockpile represented the most costly component of membership. The organization therefore granted members flexibility in terms of how they could meet this requirement. While members were encouraged to build publicly held stockpiles fully segregated from (but connected to) the commercial oil system, they were permitted to "count" industry reserves towards their stockpiling requirement, provided that they could demonstrate the legal authority to release these stocks in a crisis. Providing this low-cost option facilitated the initial agreement to found the IEA, but it presented many questions about the true utility of industry stock is a crisis.[17] This option also allowed for a considerable variety of approaches to meeting the organization's stockpiling requirement.

The distinction between the public and the private approaches to oil stockpiling anchors this dissertation. Expending resources on an oil stockpile constitutes a robust commitment to energy security. Public oil stocks are a far more effective energy security asset than rules mandating that industry hold extra reserves. A public stockpile, controlled by the government, can be put in use when an oil release serves the nation's

[16] All countries with a petroleum system require a certain volume of crude oil to keep the system "wet". This includes sufficient inventories to keep refineries running and "line pack" volumes to keep oil in pipelines moving. These volumes, which are difficult to estimate, cannot be used in an emergency to replace lost supplies.
[17] Krapels, 1980.

interest. This places a formidable weapon in the hands of importer governments. Government-owned stocks also demonstrate a meaningful resource commitment to addressing energy security threats. Industry mandates, on the other hand, are a far less effective tool. In many cases it is not clear whether companies are actually holding adequate stocks to address supply crises. More importantly, governments have far less control over the use of industry stocks in a crisis, which makes them a moderately effective energy security tool at best. This strategy allows IEA members to check the 90-day box, but it betrays a desire to minimize costs rather than maximize efficacy.

This dissertation contends that the choice between building a government-owned oil stockpile, mandating that industry holds oil stocks, or pursuing some combination of the two constitutes a form of state behavior, akin to the development of a weapons system. Oil stockpiling strategies are a response to nations' threat environment which can be best explained by assessing the capabilities that they confer and the global hazards that they address. This state-level conceptualization of oil stockpiling allows for a cogent assessment of energy security policy across IEA members of varying attributes. It provides a far more compelling explanation of oil stockpiling outcomes compared to explanations rooted in domestic politics.

Introducing the Theory

The model developed in this dissertation offers a clear explanation for oil stockpiling in IEA countries, as well as an outlook for potential oil stockpiling strategies that non-IEA countries might be expected to pursue. It bases its explanation of oil stockpiling behavior on the type of threat that oil stockpiles primarily address and the market power that oil stockpiles confer. Nations consider the nature of their primary

energy security threats and what their strategic reserves can accomplish in choosing an approach to oil stockpiling. Fundamental characteristics, such as the size of national economies and geography underlie these drivers.

The most important theoretical distinction that this project makes is the delineation between economic vulnerability and security vulnerability. For a majority of countries, energy security represents a prosperity issue. Because the oil market is globalized, most countries do not worry about who they purchase their barrels from. Exporters are no longer practically able to embargo an individual nation with access to waterborne crude. If petroleum shipments from a given exporter are withheld from a particular customer, other supplies can easily take their place. Shortages in the world market are digested through the price mechanism. Spikes in the world market cause all importers to suffer economically, regardless of their suppliers. The extent of this economic vulnerability varies based on a host of factors associated with energy consumption patterns and the structure of national economies. In importing countries where oil stockpiles primarily address economic vulnerability, the primary benefits from strategic oil stocks come from the ability of the IEA as a whole to address a shock to the global market.

For importers whose supplies are vulnerable to physical cutoff, access to oil represents a national security issue. Given that the security of maritime oil shipments is guaranteed by the U.S. Navy, a physical cutoff is a remote possibility for most IEA nations – all of whom are American allies. However, for landlocked states which depend on a single country for most of their supplies, or for countries that could conceivably be the target of an American naval blockade, the vulnerability of physical shipments of

petroleum persists. Because a true supply cutoff would devastate an industrialized nation, these countries are open to coercion. For captive importers, oil stockpiles not only address the prosperity threats from disruptions in the global market, but they also address the national security vulnerability associated with access cutoffs.

Nations' market power varies as much as the type of threat that they face. This dissertation defines the market power of an oil stockpile in terms of its ability to materially influence the world oil balance. The IEA's 90-day requirements means that large importers will necessarily hold large stockpiles. The largest members, such as Japan and the United States, hold oil stockpiles large enough to unilaterally address many supply crises. More importantly, the ability of the IEA as a whole to address supply shocks hinges on the successful participation of these major members. For small oil importers, 90 days' worth of petroleum supply does not amount to much relative to the 93-million-barrel-a-day global market. In the event of a large supply outage, these small nations depend on the efficacy of the IEA, which is underpinned by the contributions of larger members. This fundamental difference in capabilities impacts the cost-benefit ratio of various oil stockpiling strategies. The decision to maximize the effectiveness of strategic reserves is far different for nations that can materially impact the success or failure of an IEA release.

This dissertation presents a theory that explains how these factors together shape IEA members' oil stockpiling strategies. Nations with large market power that face primarily economic energy security threats, can be expected to pursue a robust oil stockpiling strategy if their economic vulnerability is pronounced. The key logic here is that the efficacy of their strategic reserve directly impacts the economic benefits that they

receive in the event of a release. If this economic vulnerability obsolesces, nations can be expected to reduce the costs of their programs. Smaller oil-importing nations facing primarily economic vulnerability whose oil stockpiles do not confer significant market power, can be expected minimize oil stockpiling costs. Whether or not these countries effectively contribute to an IEA collective action they will enjoy the benefits of market stabilization, so they have no incentive to pursue a robust stockpiling program.

The calculus differs for countries where a potential cutoff of energy supplies represents a national security threat. This is the case where physical shipments of oil can potentially be cut off, leaving states open to coercion. Even if the scale of a stockpile is minimal in a nation facing a supply security threat, governments can be expected to pursue a resource-intensive oil stockpiling strategy as a matter of national defense. For countries in this category, the approach to oil stockpiling goes beyond economic calculus that weighs potential prosperity loss against program costs. These nations treat oil access as a matter of national sovereignty. Nations with large market power that also face physical security threats can be expected to pursue the most intensive approach to oil stockpiling, pursuing both government-held reserves and compelling industry to hold extra inventory. No nations in the IEA currently occupy this category, but this likely represents an apt characterization of China's stockpiling program.

Dissertation Plan

This dissertation proceeds as follows. Chapter two details the project's theory. The discussion begins with a conceptualization of energy security and the two types of vulnerability developed here. It then unpacks the IEA's role in global oil stockpiling in the context of theories of international organizations. The chapter then fully

characterizes the dependent variable and independent variables and explicates the dissertation's explanatory model in detail. Chapter three reports the findings of the project's quantitative analysis. Hypotheses derived from the theory presented in chapter two are tested using a time-series cross sectional regression analysis of public oil stocks. The results support the dissertation's assertions, but a robust explanation required fleshing out the mechanisms that led to different oil stockpiling choices.

The next three chapters present cases analyses of oil stockpiling policy in IEA countries. Chapter four discussed the development of the U.S. Strategic Petroleum Reserve (SPR). This assessment highlights the importance of economic vulnerability for the U.S. and illustrates how the substantial market power of the United States fundamentally shaped the country's approach to energy security. Chapter five evaluates oil stockpiling in Sweden, which represents a clear case of cost-minimization in a small IEA member. In chapter six, the extent to which security considerations and potential coercion influences oil stockpiling is presented in a case study of the Czech Republic. As is the case with many Eastern European countries that depend on Russia for hydrocarbons, the country has poured considerable resources into energy security notwithstanding the fact that they cannot influence the world market.

The conclusion summarizes the project and discusses its theoretical and policy implications. The primary academic contribution of this dissertation is empirical insofar as it represents the first assessment of oil stockpiling that employs the tools of international relations. Beyond that, the model here illuminates what considerations lie behind the oil stockpiling choices that non-IEA countries will make in the future. The future of global energy security will likely hinge on the approach that China and other

emerging importers make in this area. Using the same approach as the other three cases, the chapter concludes with an assessment of oil stockpiling in China.

Chapter 2: A Theory of International Oil Stockpiling Behavior

Member countries of the International Energy Agency (IEA) are required to hold oil stockpiles equivalent to 90 days' worth of net petroleum imports. Some governments meet this requirement by owning their oil stocks outright while others mandate that industry hold more stocks, which constitutes a far less effective strategy. This dissertation addresses why stockpiling policy outcomes differ in IEA countries and in doing so illuminates how states approach energy security policy. This project will contribute to the literature on energy security and add depth to contemporary policy discussions related to oil security.

The theory proposed here argues that the nature of a nation's energy vulnerability is a key driver of oil stockpiling outcomes. Over the years, the concept of energy security has evolved. In the oil space, concerns about physical access to oil imports have largely been replaced by concerns about the stability of the world oil market. This project will explore these two types of vulnerability in depth; both of which persist today. It argues that countries whose physical supply security remains vulnerable treat energy supply as a national security issue and will pursue government-intensive oil stockpiling strategies. For IEA members whose main vulnerability is economic, the degree of government involvement in their program will be driven by the market power that oil stocks confer. Countries whose import levels necessitate large oil stockpiles play a major role in protecting the global economy from oil shocks. Countries with smaller stockpile requirements can reap the collective energy security benefits of the IEA no matter what. Larger IEA members are therefore more likely to expend more resources on oil

stockpiling because the efficacy of their stockpile is critical collective energy security goals.

The theory advanced here adds to the literature on energy and security. Principally, it will constitute the first in-depth analysis of what drives oil stockpiling behavior. In doing so, the project adds to the literature on how oil-importing states react to the vulnerability caused by petroleum dependence. The project also illustrates how states approach national contributions to the provision of a global collective good. Lastly, this dissertation it provides an empirical examination of the relative importance of economic and security drivers of state behavior, which has been extensively studied in political science. The project also addresses many contemporary energy security policy issues such as how states respond to Russian attempts at energy coercion, the direction of energy security policy in the United States, and the future of oil stockpiling in China.

This chapter first conceptualizes energy security, delineating between different types of energy vulnerability and highlighting how the concept has evolved over the years. It then discusses why oil stockpiling is the clearest example of energy security policy. After an overview of the IEA's role in global energy security, an exploration of the dependent variable, government ownership of oil stocks, follows. This section explains why the distinction between government-owned oil stocks and stockpiling requirements for industry is so important and characterizes the variation of oil stockpiling strategy in IEA member countries. The chapter subsequently outlines the two explanatory factors that determine oil stockpiling outcomes: market power and the nature of a country's energy vulnerability profile. It ties all of these factors together in a model

of oil stockpiling behavior and concludes with a summary of the argument and a brief treatment of this dissertation's empirical strategy.

Conceptualizing Energy Security

The central concept in this dissertation is energy security, which a widely cited Council on Foreign Relations study defines as "the reliable and affordable supply of energy".[18] This definition has been expanded by scholars and practitioners to encompass other factors such as climate and environmental issues and the impact of energy relationships on the likelihood of war. Although these topics are important, this project focuses on the more narrow definition. A stable supply of affordable energy continues to be a critical requirement for the functioning of industrialized societies. Further, the policy measures that states undertake to maintain secure supplies of energy have far-reaching implications. Responses to energy insecurity such as support for clean energy research, shifts in economic planning, and the cultivation of friendly relationships with energy exporters fundamentally impact the trajectory of oil-importing nations. Specifically, this project focuses on the insecurity of oil supplies to oil-importing nations and the use of strategic oil stocks to address this vulnerability. Oil imports can represent a critical area of energy insecurity for importing nations, and national strategies to address this problem vary widely.

Two Types of Vulnerability

Two broad types of oil supply vulnerability have received attention in the study of energy security: vulnerability of access to oil and economic vulnerability to oil shocks. These concepts are often conflated and errantly addressed as if they were the same thing,

[18] Deutsch, Schlesinger, and Victor, 2006.

so it is worthwhile to explicitly delineate between them here. Vulnerability of access to oil refers to the potential loss of imported oil due to supply interruption, compromised delivery infrastructure, or deliberate embargo. Given the centrality of petroleum to modern warfare, this type of vulnerability has a clear linkage to traditional conceptualizations of national security. Access to a reliable supply of oil is critical for mechanized war fighting and surviving a blockade of oil imports is a very real concern for some importer governments.[19] Further, under certain circumstances vulnerability of a nation's physical access to oil can leave it open to coercion.[20] The imperative to maintain access to oil imports can fundamentally impact an oil-importing nation's national security and its national security decision making.[21] This dissertation treats vulnerability of access to oil as a national security issue as opposed to a prosperity issue.

For many countries, vulnerability of access to oil matters less than it did when the IEA was founded. Oil markets are globalized and, for the most part, supply disruptions are digested through the price mechanism.[22] In the U.S. context, some commentators assert that a globalized oil market can address almost any supply problem that might arise and that concerns over supply security are overblown.[23] These arguments notwithstanding, the security of access to oil remains relevant to the study of energy security policy. Access concerns vary significantly among oil-importing countries. For example, the United States produces a considerable amount of oil indigenously, imports oil from a diverse array of producers, and has the military power to protect the imported

[19] Kelanic, 2012.
[20] Hughes and Long 2014/2015.
[21] Glaser, 2013.
[22] For a good review of the economics of oil markets see Adelman, 1993.
[23] Gholz & Press, 2010.

barrels that could conceivably be threatened. Other importers face considerably greater threats to their ability to access physical petroleum supplies. Many IEA countries, notably those in Eastern Europe, rely on potentially hostile trading partners for their oil and have little ability to diversify their petroleum supply chain due to the dictates of geography and infrastructure.

The second type of vulnerability relevant to the study of energy security is the economic vulnerability of oil-importers to supply shocks. This concept is less straightforward than physical supply vulnerability, but no less important. When an oil supply shock befalls the global market, prices increase. Sudden increases in the price of oil slow the rate of economic growth in oil-importing countries, sometimes severely. The severity of a country's economic vulnerability to oil supply disruptions is determined by numerous factors, including the structure of the economy, the oil-intensity of economic output, and the level of oil consumption. Even if an oil-importing nation maintains access to an adequate amount of crude oil to sustain military activities, dramatically increased prices still have an impact on the country's prosperity.[24] Compared to the vulnerability of oil access, which has a direct linkage to warfighting capability, economic vulnerability is less clearly a national security issue. Glaser argues that threats to prosperity stemming from oil supply disruptions impact national security when they are severe enough to warrant military action.[25] Whether or not these nations' economic vulnerability to oil supply disruptions threatens national security, it certainly qualifies as an energy security issue.

[24] Hamilton 1983, Hamilton 2009, Vincent 2016.
[25] Glaser, 2013.

States can be expected to react differently to these two types of vulnerability. The vulnerability of physical oil supply access, depending on the specific circumstance of an importing country, can constitute a critical national security concern. Historically, major powers have gone to great lengths to preserve their access to oil.[26] In the era of mechanized war fighting, losing access to oil means losing the ability to fight. Further, industrialized societies need oil for transit systems and industry to function. The threat of a cutoff of physical oil supplies leaves importing nations more vulnerable to coercion. Where compromised access to energy is a real threat, energy security is a matter of state survival. Given the primacy of national security in the hierarchy of state goals, it follows that energy security is a critical issue in states with access concerns.[27] These states can be expected to be more willing to expend resources to "internally balance" against the threat of a supply cut off.

Where physical petroleum supplies are relatively secure, energy security is more of a prosperity issue. For countries where access concerns are moderate, instability in the world oil market harms them primarily through the price mechanism. While the potential economic harm caused by an outage in the global oil market could constitute a vital national interest for these consuming nations, most threats to oil supply security are not existential threats to their security and functioning. It follows that energy security concerns in these states are somewhat lower on the ladder of policy priorities. Where energy security is a prosperity issue, states can be expected to frame energy security investments in terms of costs and benefits. In cases where the benefits of energy security investments are limited, states can be expected to pursue a strategy of cost minimization.

[26] Kelanic, 2016.
[27] Waltz, 1979; Mearsheimer; 2001; Glaser, 2010.

This dissertation argues that the distinction between these two types of vulnerability and how states respond to them drive of energy security policy.

Energy Security Policy: Strategic Oil Stockpiling

A relevant question to ask is: what constitutes energy security policy? A simple answer is anything that enhances the reliability and affordability of energy supplies or reduces a state's vulnerability to supply and price shocks. In the oil security space, energy security policy might be thought of as anything that reduces states' vulnerability to an oil supply cutoff and/or economic vulnerability to a price shock. Governments have implemented a host of programs that enhance their energy security. Demand mitigation measures, domestic oil production inducements, subsidies for renewable and efficiency technologies, support for national oil companies, and military measures to secure access to oil all fit this description. However, most of these policies serve multiple goals. Do countries create national oil companies to facilitate supply security or to collect economic rents? Do governments push renewables to reduce oil imports or to limit carbon emissions? The answer to these questions and others like them is "yes," which makes it difficult to discern the relative importance of energy security in driving most energy policy decisions. This makes the systematic assessment of how states react to energy insecurity challenging

Oil stockpiling is more clearly an *energy security* policy than any other step governments take to respond to these vulnerabilities. Strategic oil stocks address both of the types of oil supply vulnerability outlined above. First, they can be used in the event of a physical oil supply disruption in which a country's access to oil is compromised. Second, they can be used as part of an IEA collective action that addresses a supply

outage in the global oil market. This collective function defends the national economies of oil importers from the price impact of international supply disruptions. It is notable that oil stocks can be used to address both national security concerns that are specific to one country and global oil supply threats that are relevant to all oil-importing nations collectively.

Academic investigations of nations' responses to energy vulnerability have come in two primary forms. First, extensive research has been conducted on the impact that vulnerable energy supplies have had on domestic economic policy making in oil-dependent countries.[28] Second, the impact that securing energy supplies has on states' foreign policy, with particular emphasis on the impact of oil dependency on the likelihood of war.[29] Energy security policy, has received considerably less attention. With a few notable exceptions, measures taken by the IEA and its members to directly address energy supply vulnerability have not been the subject of academic analysis.[30] Moreover, most research on this topic has focused more on the evolution of the IEA as an institution as opposed to state responses to energy insecurity and how the IEA fits into those strategies.[31] This project will make an empirical contribution to the literature on energy security and international relations by filling this gap.

The Role of the IEA

The central goal of this dissertation is to conceptualize and explain oil stockpiling as a form of state behavior. The project is not primarily focused on the IEA and the light

[28] For a comprehensive review see Hughes and Lipscy, 2014. Notable examples include Ikenberry 1986, Duffield 2012 and 2015, and Hughes 2014.
[29] Klare, 2001.
[30] Cheon and Uprelainen, 2015.
[31] Keohane 1984; Van de Graf and Lesage 2009; Colgan 2009; Kohl 2010; Colgan, Keohane, and Van de Graf 2011; Van de Graf 2012; Colgan and Van de Graf 2015; Wilson 2015.

that its trajectory can shed on the literature on international organizations. However, the vast majority of oil-importing countries that maintain petroleum stockpiles do so under that auspices of the International Energy Program (IEP). Compliance with the IEA's stockholding requirement partially motivates oil storage in IEA countries. This project argues that the approach that nations take to complying with this requirement is a useful measure of the strength of energy security policy. However, the fact that states choose to adhere to the dictates of an international body cannot be taken for granted, given that many IEA members neither face severe access concerns nor have the ability to materially influence the efficacy of IEA stockpile release. Therefore a brief discussion of the role IEA is in order here. This section will give an overview of the IEA's history in the context of the international organizations literature, arguing that it was designed to be a fundamentally strong organization; that its approach to global energy security has successfully evolved with the oil market; and that maintaining its strength is in the interest of all members.

In the wake of the first Arab oil embargo, sixteen oil-importing nations signed the 1974 International Energy Program Treaty establishing the IEA. Membership was limited to members of the Organization for Economic Cooperation and Development (OECD). The legally binding treaty placed three key requirements on members: that they hold oil stockpiles equivalent to 90 days' worth of net imports; that they establish a domestic program for emergency demand restraint during sever supply interruptions; and that they participate in an Emergency Sharing System (ESS) in severe supply emergencies. The treaty stipulates that if oil imports into a member state or the membership as a whole were curtailed by seven percent, demand restraint measures

would be triggered and oil would be shared among members as directed by the IEA secretariat. Failure to comply with these requirements could result in a reduced oil allocation in a crisis.[32] As originally designed, the treaty constituted, "a remarkable delegation of authority to an international organization."[33]

Within a decade, the shortcomings of the IEA in the context of an evolving world oil market were made clear. The IEA failed to adequately address the oil supply crisis caused by the Iranian revolution in 1979. Demand restraint did not materialize and the ESS was not triggered, though Sweden unsuccessfully requested assistance. The price of oil skyrocketed before the organization could muster a response. Faced with this challenge, the organization adopted the Coordinated Emergency Response Mechanism (CERM) in 1984. Under the CERM, an oil stock release to balance the market and stabilize prices became the IEA preferred response to an oil supply disruption.[34] In a crisis, oil stocks are put on the market as opposed to allocated to specific buyer countries and release decisions are made based on a consultative process. This framework gave the IEA has considerably more flexibility to address crises before they reach catastrophic proportions. The CERM effectively codified the shift in the IEA's focus to the global oil market. It also increased the importance of strategic oil stocks.

Perhaps the most notable attribute of the IEA is that it was designed to be extraordinarily strong. The IEP treaty initially granted the organization supranational authority over member countries. Further, the requirements to maintain oil stocks and implement painful demand restraint measure in a supply crisis were respectively

[32] Scott, 1994.
[33] Keohane, 1984, p. 225.
[34] Toner, 1987; Emerson, 2006.

resource-intensive and onerous. The most pivotal actor in the original design of the IEA was U.S. Secretary of State Henry Kissinger, who wanted to develop a strong consumer-country counterweight to Organization of Petroleum Exporting Countries (OPEC).[35] Around the same time the U.S. passed the Energy Policy and Conservation Act (EPCA), which authorized the creation of a Strategic Petroleum Reserve (SPR) of up to 1 billion barrels, clearly demonstrating American commitment to addressing the collective vulnerability problem presented by the oil embargo. While the U.S. anchored the OECD's institutional response to the 1973 oil supply crisis, it did not want to share this burden alone, so it sought participation from other developed oil importers.[36] The founding of the IEA accords with the expectations of hegemonic stability theory, which suggests that a central hegemonic power will provide international public goods, but that these actors will seek to coerce smaller states into assisting with the provision of the collective good.[37] The preponderant U.S. role in the IEA's founding is a critical part of the story, but it does not fully explain why the founding members of the IEA chose to cede so much sovereignty to an international organization.

A more complete picture of the IEA's design must account for the nature of the issue area that the organization was founded to address. Oil supply outages harm economies, frighten importers, and represent a major challenge to address because of the uncertainty that these events present. This was especially true at the time of the IEA's founding, when the world oil market was not yet fully globalized and market information did not instantaneously impact prices everywhere. Further, energy security policies to

[35] Colgan, 2009.
[36] Kissinger, 1982.
[37] Gilpin, 1982; Snidal 1985.

withstand oil shocks, namely demand restraint and the use of oil stocks, would not efficiently address supply crises if they were not coordinated across importing countries. Faced with an issue that entailed uncertainty about the state of the world, uncertainty about others' actions, and enforcement challenges; the IEA's founding members established an organization with restrictive membership and a high degree of centralization and control. This comports with conjectures about how rational states approach the design of international institutions.[38] The IEA was designed to be a strong institution because a strong institution was needed to defend global energy security.

Once formally established, institutions are difficult to change. In the case of the IEA, reforming the requirements for members or opening the membership up to non-OECD countries would require a formal revision to the IEP treaty. To some extent, the founders of the IEA circumscribed the future evolution of the organization. This fits the theory of path dependence, which has been used to explain various social phenomena, including the role of international organizations.[39] Rather than undertake the behemoth task of re-designing the IEP treaty, IEA member states have established informal approaches to addressing global energy issues to maintain the organization's relevance. These changes have come in the form of developing the CERM to address oil supply disruptions as well as expanding the range of issues that the IEA addresses in its day-to-day activities.[40] The CERM reduces the possibility of forced demand restraint and oil sharing by favoring the release of oil stocks in a crisis. This maintains the IEA's ability to address oil supply shocks, but in a manner that reduces the likelihood that the

[38] Koremenos, Lipson, and Snidal 2001.
[39] Pierson, 2000; Duffield, 2003.
[40] Van de Graaf and Lesage, 2009; Colgan, Keohane, and Van de Graaf, 2011; Colgan and Van de Graaf 2015.

organization will dictate policy individual member states. The IEA continues to be a bulwark against turmoil in the world oil market, even with a more flexible mechanism for addressing supply outages. Members are able to enjoy the many of the benefits of a "hard law" organization while limiting the associated sovereignty costs.[41] The key cost that members must pay to maintain the IEA as a strong institution, is holding an oil stockpile equivalent to 90 days of imports.

The IEA provides a clear collective benefit for its members in the form of collective energy security and a relatively more stable world market. This does not fully explain why member states are willing to pay the cost of IEA compliance. For any individual state, breaking off from the IEA and free-riding on the organization's distributed benefits could represent a rational decision. Why has no country ever left the IEA? Three reasons stand out. First, the basic benefits that international institutions are thought to provide to states are very real in the case of the IEA. Keohane (1984) argues that international regimes act to reduce uncertainty and transaction costs of international policy coordination and discusses the IEA as an example of this. Member states cannot take perfect information about oil markets and the response to oil supply crises for granted. The information that they glean from participating in the IEA's collective monitoring of oil markets and continued emergency preparedness activities is real. Second, Most IEA members are also members of the European Union (EU) which also mandates that members hold oil stocks equivalent to at least 90 days of net imports or 61 days of consumption, whichever is higher.[42] For this subset of IEA members, the costs of non-compliance are heightened because abandoning their stockpiling commitment would

[41] Abbott and Snidal, 2000.
[42] Tosun, 2011.

also cause them to incur EU penalties. In this case, issue overlap strengthens the case for adherence to both organizations' requirements.

Most importantly, IEA members' commitment to the organization impacts its strength in a tangible way. The market stabilizing role that the IEA plays is rooted in the psychology of market actors. The influence that the IEA is able to have in quelling market volatility and ameliorating price shocks is rooted in the organization's credibility in the eyes of actors who buy and sell oil.[43] When a disruption appears imminent, this risk influences the global oil market. However, prices increase less than they would otherwise based partially on the qualitative knowledge that OECD nations would present a united response to a major outage in the form of IEA action. This likely limits volatility in the world market. If a member, no matter how small, were to leave the organization in a public way the IEA's perceived capabilities would be damaged. The impact of a small member the IEA would damage the organization's influence on the market in a way that goes beyond capabilities. This partially explains the organization's appetite for trying to accommodate Australia, its one free-riding member. While small members' contribution to an IEA collective action is not consequential (this idea is fully fleshed out below), their exit from the organization could be. Taken together, these factors present a reasonable case for why the IEA is an important organization and why member countries expend resources to meet their IEA commitments. How they meet this commitment is the topic of this project.

[43] Clayton, 2012; McNally, 2012.

Dependent Variable

The dependent variable of this dissertation is the extent of government involvement in oil stockpiling in IEA countries. Member countries can comply with their 90-day IEA requirement either by holding publicly-owned oil stocks, by mandating that commercial entities hold certain levels of oil stocks, or through some combination of both public and private stocks. The IEA originally allowed private stocks to count towards compliance requirements to reduce the costs of joining the organization and facilitate broader adoption of the IEP treaty. This dissertation treats oil stockpiling as a form of state behavior and focuses on what drives the governments of IEA members to invest in publicly held oil stocks as opposed to pursuing lower-cost, less effective options.

Government-owned oil stocks are a more effective energy security policy tool than industry-mandated stocks. This difference stems from the mechanism through which they are used. Although both types of stocks can theoretically offset supply shortages, publicly held stocks provide a far more powerful tool to governments. In the event of a supply disruption, governments place their publicly held stocks onto the market to offset physical supply shortages (and the accompanying price spikes). This gives governments the ability tailor the release to meet the specific requirements of a given crisis. IEA countries have comparatively less control over industry stocks. "Releasing" mandated industry stocks involves lifting the stockholding requirement on private enterprises, which does not guarantee that companies will put the oil onto the market to assuage a disruption.[44] In some cases, commercial actors could hold onto their oil stockpiles during a crisis based on the expectations that prices would continue to

[44] IEA, 2014.

escalate. Short of the unpalatable and in some cases infeasible measure of requiring private actors to put their stocks on the market, governments cannot ensure that commercial entities would address a crisis.

The importance of this delineation cannot be overstated. Publicly held oil stocks provide governments with a formidable defensive weapon that can address threats to energy security, because they have full control over how the stockpile is used. Industry mandates provide virtually no guarantee that a supply disruption will be addressed in a manner consistent with an IEA member's energy security goals. This disparity in effectiveness became clear in the IEA collective action to address outages caused by Libya's civil war. The organization committed to releasing 60 million barrels of oil to address the situation. Member countries participated in the collective action through selling government-owned stocks, lifting industry mandates, or pursuing a combination strategy. The only successful component of the action proved to be the public stockpile sale, because private entities whose stockpile mandates were lifted did not sell the oil.[45] When stockholding mandates on European refiners were lifted, the decision about whether to sell the volumes was based on short-term refining margins and the incentives for individual firms as opposed to the stability of the global market.[46] This example highlights the relative strength of publicly held stocks.

In addition to being more effective than industry mandates, government-owned oil stocks are far more costly. Along with the steep acquisition cost of oil, constructing and/or leasing facilities to hold oil represents a significant monetary commitment. Industry mandates cost governments relatively little. In paying the substantial costs of

[45] Patron and Goldwyn 2013.
[46] Clayton, 2014.

developing an oil stockpiles, governments are demonstrating commitment to addressing energy insecurity. When these costs and the relative strength of public stocks as a policy instrument are taken into consideration, the significance of governments choosing to build oil stocks becomes clear. States that develop public oil stockpiles are expending substantial resources to better defend their society and economy against various types of oil supply shocks. This dissertation treats the level of government involvement in oil stockpiling in a country as a measure of the strength of a nation's energy security policy.

The ownership structure of public oil stocks varies. In some countries, such as the United States, the stockpile is owned by a government department. The operations and oil acquisition are directly funded through tax dollars. In other countries, public stocks are managed by an "agency", which is an independent body that exists to maintain the oil stockpile. Agencies take on various corporate forms – some are public corporations directly tied to governments, while other are completely private corporations or industry associations. The agency model, which is common in Europe, entails a relatively smaller financial commitment from governments. Many agencies raise the money to acquire their stocks through issuing bonds and continuously rolling over the debt. Often, these entities lease commercial oil space to store oil rather than constructing their own facilities. With few exceptions[47], these reserves are still classified as public stocks because they still possess the critical attributes of all government-held oil: namely that the can be released at a government's discretion and that the costs of oil stockpiling are borne by the government rather than industry.

[47] In Austria and Switzerland, Agencies manage the stockholding obligation, but the barrels are owned by oil companies, so stocks in these countries are not classified as public.

In some European nations, governments maintain part of their oil stockpile in foreign countries. This practice can make sense where the logistical systems of two countries are interconnected (e.g. if crude oil imports arrive in country A through country B's port) and often requires a bilateral agreement. Governments can also hold stocks across national borders by purchasing "tickets" from private companies. Tickets give a country the option to take delivery of a specified volume of petroleum in the event of a crisis. Tickets and foreign storage allow IEA members whose logistical systems preclude oil storage on a large scale to meet their obligation. The measure of publicly held oil stocks used in this dissertation only counts physical volumes held within a country's borders. This definition of public stocks helps test the relative importance of difference types of vulnerability, as only physical volumes held in-country can address *both* threats to physical oil supplies and contribute to the stability of the global market. While barrels stored anywhere can help balance the global market, only stockpiled oil stored within a country's borders can completely defend a country against an access cutoff. In many cases, denial of oil access between European allies seems implausible, but this dissertation assumes that fundamental uncertainty about the intentions of other states factors into state behavior, including the oil stockpiling decisions that IEA members make.

Considerable heterogeneity exists in the level of government involvement in oil stockpiling, which this dissertation will seek to explain. Table 2.1 separates IEA member countries into categories based on the level of public stocks in each country:

Table 2.1: Government Involvement in Oil Stockpiling	
Primarily Public	Germany, Japan, South Korea, United States, Czech Republic, Slovakia, Hungary, Estonia, Finland
Partial Public	France, Ireland, Spain, Poland, Netherlands, Portugal, Belgium, Italy
Industry Obligation or Tickets	Sweden, New Zealand, Greece, Luxembourg, Turkey, Switzerland, Austria, UK, Australia (planned)

The countries in the "primarily public" category meet the entirety of the IEA stockholding obligation with public stocks held within their borders. These countries expend considerable resources on their stockpiling programs. For example, over time the United States has spent more than $27 billion on developing the SPR. Nations in this category mostly purchased their oil through appropriated (as opposed to borrowed) funds and most of them have built and currently maintain extremely expensive government-owned oil storage facilities. In the cases of Japan, South Korea, the United States, and the Czech Republic, oil stocks are completely owned by government entities. These countries have the most robust government involvement in oil stockpiling, demonstrating a pronounced commitment to energy security.

Oil stockpiling policy in countries in the category "partial public" exists on a continuum. Some countries in this category, such as France and Ireland, meet most but not all of their IEA stockholding obligation through public stocks. Other countries in this category, such as Belgium and the Netherlands, hold minimal amounts of publicly-owned oil in country. With the exception of Poland, public stocks in all of these countries are held by agencies. Nations in this category typically finance their oil stockholdings

through issuing debt and often meet a large portion of their IEA obligation through stocks held abroad. Stockholding policy in these countries is heavily focused on compliance with IEA (and European Union) requirements. These countries represent a middle ground between IEA members with a resource-intensive public approach and IEA members who rely completely on industry mandates.

Countries which meet their IEA obligations solely through industry obligations have the least robust approach to oil stockpiling. Government involvement in meeting IEA commitments is relatively minimal. Austria and Switzerland have agencies to manage the enforcement of the oil stockpiling obligation and New Zealand's Ministry of Energy manages their ticket purchases, but no countries in this category own any oil. These nations have far less control over the use of oil stocks within their borders. The efficacy of tickets in a real crisis remains untested. Nations in this grouping cannot guarantee when and how oil stocks would be released under emergency circumstances and they are only able to contribute to IEA collective actions at the margin. They have also made a much smaller resource commitment to energy security. While these countries are in good standing with their IEA obligations, they do not significantly contribute to global energy security.

Australia is coded in this category based on recent policy developments. For years, Australia's net imports were small enough that they could meet their IEA obligation with industry working stock. Increases in net imports in the 2010's pushed them out of compliance. To date the country has neither expended the resources to establish a stockpile nor has it placed any type of stockholding obligation on industry. However, in 2017 the government issue a plan to return to IEA compliance by 2026

through the acquisition of tickets.[48] Australia will not be able to protect itself from threats to the physical flow of oil (to the extent that these exist). However, based on the current proposal, the country will cease brazenly free-riding on the collective protection against oil price shocks provided by other IEA members.

Over time, IEA countries have increased the volume of government stocks, both in terms of days of import cover and as a share of the total volume of oil stocks. Government stocks represented less than 30 percent of total IEA stocks in 1984; they accounted for more than 45 percent in 2012.[49] The portion of oil stocks that are publicly held across the IEA has increased as Eastern European members, many of which meet a large share of their obligation through public stocks, have joined over time. Some nations deviate from this trend. Sweden, New Zealand, and Greece, which now meet all of their obligation with industry mandates, held government stocks at the beginning of the period and unwound their stockpiles when the option to meet the IEA obligation with industry mandates became available. The Netherlands has shifted a portion of their government-owned storage abroad, decreasing the days of cover that they meet with domestically held government stocks.

The differences between IEA countries have remained relatively stable since the CERM was adopted in 1984. For the most part, countries have remained in the categories outlined in table 2.1. The countries noted above abandoned government oil stockpiling at the beginning of the period, some of the "partial public" countries did not begin to acquire petroleum until later in the period, and in some cases countries have opted to increase government involvement in their programs over time. The explanatory

[48] Government of Australia, 2017.
[49] IEA, 2014.

factors discussed below explain many of these movements. That said, dramatic policy departures on energy security appear to be rare in IEA countries. This makes sense, given the fact that many of the attributes that determine a country's energy security position, such as geography or economic structure, are relatively slow to change. Path dependency also likely plays some role in this intra-country stability over time. Once the relevant institutions are put in place and an approach to IEA compliance becomes established, shifts in nations' approach to stockpiling policy become less likely. This is especially true in the context of developing programs that can require substantial up-front capital expenditures.

Explanatory Factors

This dissertation argues that two major factors drive the differences in governments' oil stockpiling strategy: the market power conferred by a nation's stockpile and the nature of the primary energy security threat that a nation faces. This section outlines the basic logic that underpins each of these variables and lays the groundwork for the explanatory model developed in the following sections.

Oil Stockpiles' Market Power: Size Matters

The IEA measures size of national oil stockpiles in days of net oil imports and requires that countries hold 90 days' worth of stocks. This approach syncs countries commitments with the size of their energy sector and allows for normalized intra-country comparisons. For instance, in 2012 the U.S. SPR held an inventory of around 695 million barrels compared to the Czech Republic's 15 million barrels, but in terms of days of cover the comparison is 94 to 90. The days-of-coverage measure allows for the assessment stockpiling policy in a way that accounts for national circumstances.

However, the absolute size of a country's stockpile has fundamental implications for what it can accomplish.

IEA countries are heterogeneous in terms of the size of their energy requirements and the amount of oil that they import. In 2013 the United States consumed more than 18 million barrels per day while Luxembourg consumed less than 60 thousand barrels per day. Further, while most IEA countries import a majority of the oil that they consume, some countries have significant domestic oil production.[50] This diversity of energy circumstances means that the amount of oil IEA members need to store to meet their 90-day commitment varies substantially. Many countries only need to hold a few million barrels to remain in good standing, while other need massive reserves to comply. Table 2.2 lists the ten largest 90-day stockpiling requirements based on the measure of net imports used in this dissertation:

Table 2.2: Ten Largest IEA 90-day Requirements in 2012 (Million Barrels)

United States	665
Japan	417
South Korea	200
Germany	194
France	147
Spain	105
Italy	104
Netherlands	85
Turkey	59
Belgium	52

[50] Norway, Denmark, and Canada are IEA members, but they do not have a stockholding commitment because they are net exporters. This dissertation focuses on IEA members that are net importers.

The American and Japanese requirements dwarf those of other IEA countries. Only a few large importers must hold more than 100 million barrels. The members not listed here can meet their IEA obligation with less than 50 million barrels. These size differences have major implications for what nations can do with their oil stocks.

The IEA's approach to addressing international supply crises is the collective release of oil stocks. The shares that IEA member countries must contribute to a collective action are based on their share of total IEA oil consumption.[51] In the event of a crisis, members will collectively determine whether and how many barrels should be release and share the responsibility of putting oil on the market. All of the members will benefit from the collective good of a stabilized market, but the contributions that they make towards achieving this end will vary based on how much oil members consume.

In this context, both the size of a nation's stockpile and the extent of their responsibility in a collective action matter. For large IEA members, particularly the United States and Japan who together account for close to half of IEA stocks, participation in a collective action is critical. Without the participation of large members an IEA release would not add adequate barrels to the global market to balance supply and demand and the resulting price escalation would still be damaging. For example, if exports from southern Iraq were lost (around two million barrels per day) and the IEA decided to address the problem, failure of the U.S. to effectively participate would leave the world market close to 1 million barrels per day short.[52] This would likely fail to

[51] Ibid.
[52] The U.S. obligation in a collective release is currently 43.5%. The actual amount released in a crisis varies with a nation's current required and the specific circumstances of the crisis. The U.S. released 50% of the volume in the 2011 Libya collective action (Clayton, 2014).

stabilize prices and all IEA economies would still suffer considerable economic consequences from the supply shock.

Conversely, effective participation of small members matters far less. In the same Iraq scenario, any one small IEA member country could fail to participate in the collective action (or, more likely, lift industry obligations to no effect) and the majority of the lost barrels would still be replaced. The price impact would be mostly the same with or without their contribution. Thus, smaller IEA members can enjoy the collective economic benefits of a stock release whether or not their participation is effective.

The importance of stockpile size in the context of a globalized market extends beyond participation in an IEA collective action. In some circumstances, a large IEA member might release stocks to address a global supply crisis outside of an IEA collective action. Although this is unlikely, discussion around the 2011 Libya collective action suggests that disagreement among members about a release is far from an impossibility.[53] In the event of a go-it-alone release, only nations with a large stockpile could hope to effectively stabilize the global market. The U.S. strategic petroleum reserve can be drawn down at a rate of more than four million barrels per day.[54] This rate, which is larger than the oil output of all but five of the world's oil producing countries, can be sustained for up to 90 days, and at a reduced (but considerable) rate after that. This means that the U.S. has the ability to address a large supply crisis for a brief period or a smaller supply crisis for a sustained period. The same is true for Japan. Only a few IEA members enjoy the market power to individually stabilize the global market, but this capability can be expected to play a role in how they view oil stockpiling.

[53] Difiglio 2014.
[54] DOE, 2017.

National Vulnerability and Stockpiling Strategy

IEA members face various types of energy security threats. While the IEA's broad mission has shifted to a focus on the security of the world oil market against supply shocks, differences in individual members' threat profiles still influence how they approach oil stockpiling. For some nations, the economic vulnerability to oil supply shocks is the primary driver of energy security policy. Elsewhere, access to physical barrels of oil arguably matters as much as it did when the IEA was founded. For some countries, both types of threat are relevant. This dissertation will illustrate how each of these distinct types of vulnerability combine with market power to drive oil stockpiling outcomes.

For most countries, physical access to oil matters less than it did when the IEA was founded. Oil is traded in a liquid, global market. Most IEA countries can access crude oil through waterborne imports or through a friendly transshipment state. Outages in individual producer states are transmitted through the price mechanism. The IEA's shift to the CERM emphasizes balancing the world oil market as opposed to addressing physical shortages in individual nations. However, the obsolescence of physical access concerns is based on a set of factors that not all importing countries can take for granted. Nations must have access to petroleum from countries who are willing to sell to them. The variety of sources of crude that have distributed the market power in the global trade of oil are only available to countries that can safely import barrels. Western European IEA members have extensive marine import infrastructure and a well-developed pipeline network that links landlocked Western European countries to their allies with ports. Asian and Pacific IEA members receive all of their oil imports via marine shipments, so

they can access oil from anywhere in the world. For all of these countries, the security of marine imports is guaranteed by the U.S. Navy. Barring a generational change in the movement of hydrocarbons in Europe or the world's naval balance of power, access to oil is unlikely to be a concern for Western European or Asian and Pacific IEA members for the foreseeable future.

The same cannot be said for Eastern European IEA members. These nations rely heavily on Russia for their crude oil imports. Further, most of them receive their imports via pipeline, which decreases the flexibility that they have to diversify imports in the event of a deliberate curtailment of crude supplies. Table 2.3 illustrates the extent of their dependence on Russia:

Table 2.3: Five Largest Crude Oil Import Shares from Russia (2013)	
Slovakia	100%
Poland	95%
Hungary	94%
Finland	87%
Czech Republic	64%

Based on the modality of transit (except in the case of Finland) and import share, these countries are clearly vulnerable to a supply cutoff from Russia. Further, Russia's willingness to use energy as a coercive weapon with its near neighbors has been repeatedly demonstrated.[55] While the globalized energy market of the 21st century has changed the nature of energy security for most IEA members, traditional fuel access threats are very real for these countries.

[55] This topic is addressed extensively in Chapter 6.

The nature of the threat that IEA members face relates directly to how they approach oil stockpiling policy. Disruptions in the global market are dealt with collectively by the IEA. For targeted supply cutoffs, however, an IEA collective release might not be called for and barrels from other countries might not be able to reach the state in question. In the case of a deliberate crude embargo, Eastern European IEA members would need the strongest measures possible to insure the continuity of fuel supplies. It follows that these countries would be more likely to make substantial investments in energy security, because energy security concerns are more intertwined with their broader national security. Not surprisingly, oil stocks are much more likely to be owned by the government in these countries that rely on Russia for a predominant share of their oil imports. This causal logic is not unique to Eastern Europe. While these states are the clearest examples of captive markets vulnerable to cutoffs from a potentially hostile exporter, any nation whose physical access to petroleum could be compromised can be expected to take relatively more rigorous energy security measures. For example, the same mechanism could be expected to hold for countries that import barrels by water, but do not have good relations with the United States. While this is not the case for any IEA members, at some point it could be the case for China.

Countries' economic vulnerability to oil supply outages is comparatively less straightforward. The relationship between oil price shocks and economic output is the focus of an expansive literature in the energy economics field.[56] While the exact nature of this linkage is constantly changing, the consensus among most energy security policy makers in IEA countries is that oil importers are economically hurt by price shocks. This

[56] Reviewed in Vincent, 2016.

line of thinking is the contemporary raison d'être for the IEA's current oil security regime. The extent to which an individual nation's economy would be hurt by an oil price shock varies with their level and flexibility of consumption, the structure and energy intensity of their economy, and numerous other factors. Evaluating and measuring individual IEA countries' economic vulnerability to oil price shocks is beyond the scope of this project – such an investigation would be the purview of an energy economics dissertation.

This dissertation assumes that if countries' physical access to oil could not reasonably be assumed to be threatened, they participate in the IEA stockholding regime for collective protection against shocks to the global market. For this majority of IEA countries, energy security is primarily a prosperity issue. This delineation between physical supply security concerns and market-based prosperity concerns is useful here, because states can be expected to have fundamentally different responses to threats to their prosperity and threats to their survival. Where energy security concerns are not a matter of survival, governments must consider the costs and benefits of more and less robust stockpiling options and the relative importance of energy security to other prosperity-based goals.

This motivation to build oil stockpiles also has different implications for state behavior because the prosperity benefits of strategic stocks, which are transmitted to nations through the global oil market, are non-excludable. All countries accrue the economic benefits of an effective IEA release. In smaller nations, no matter how vulnerable a national economy is to a price shock, the benefits that they accrue from an IEA collective action will be determined by how effective the IEA as a whole is at

addressing a given supply outage. The importance of a given nation's *impact* on how effective an IEA release at stabilizing the oil market in a crisis is driven by their market power. This ties back to the capability factor discussed above. If a nation can expect to benefit from the prosperity preservation benefits from an IEA collective release no matter how big their contribution, then cost minimization can be expected to drive stockpiling outcomes. If the economic benefits of an IEA release depend on a given member's participation, then they can be expected to pursue a stockpiling strategy that maximizes the ability of the IEA to stabilize global oil prices. This relationship between the type of vulnerability that nations face and the capabilities that their stockpiles confer represents the core of this dissertation's explanatory model.

The Model

As discussed above, the approach that IEA members choose has fundamental implications for the utility of their barrels in an oil supply crisis and illustrates their level of commitment to energy security. This dissertation argues that a combination of the type of threat that a country faces and the market power that their stockpile confers drives national strategies for meeting the IEA's 90-day requirement. Table 2.4 outlines the basic model of this project:

Table 2.4: The Drivers of National Oil Stockpiling Strategies

		Primary Threat Addressed by Oil Stocks	
		Economic Vulnerability	**Security Vulnerability**
Market Power Conferred by Oil Stocks	**Large**	*High Economic Vulnerability:* Significant Government Involvement	Significant Government Involvement and Industry Mandates
		Low Economic Vulnerability: Limited Government Involvement/Cost Minimization	
	Small	Limited Government Involvement/Cost Minimization	Significant Government Involvement

The primary threat that nations face is divided into security vulnerability and economic vulnerability. Economic vulnerability to a global oil shock is still an issue for countries whose primary concern is oil access. However, in countries for which access concerns are real, these security concerns are a more critical driver of energy security policy. This is the case because compromised access to oil is more likely to open a state up to coercion because fuel access is a matter of state survival. In the event that oil imports into a country are compromised and the world market is not roiled, economic dislocation

in that country would still be severe. Access concerns should be thought of as an additional threat faced by these nations.

The market power conferred by oil stocks is split into "small" and "large" in this model. In reality, the market power conferred by an oil stockpile exists on a continuum, just as the level of government involvement does. However, there is a threshold above which the market power of an oil stockpile shifts the fundamental energy security capabilities of a state. For a few IEA members, such as the U.S. and Japan, their oil stockpiles are large enough to address a large-scale global oil supply disruption on their own and an IEA collective action would be ineffective without their participation. These nations' market power is classified as "large" and the market power of all other IEA members is classifies as small. The conceptualization of this factor is intended to capture what nations can do with their oil stockpiles and how these capabilities drive their approach to energy security policy.

Countries which have large market power and primarily face economic vulnerability occupy the first category. These countries can be expected to pursue a robust government oil stockpiling strategy and expend considerable resources on energy security, provided that their economic vulnerability to an oil price shock is high. The United States and Japan definitively belong in this category. Both of these countries can currently count on the American Navy to guarantee the security of their access to maritime imports. Further, the U.S. is a major oil producer along with being a major oil importer, which further decreases access concerns. Even though the threat of a physical supply cutoff is not a currently a threat for these countries, they still maintain significant stockpiling programs.

This dissertation argues that these nations expend the resources to hold oil stocks themselves because the market power conferred by the size of their required stockpiles makes them uniquely important participants in the IEA's collective energy security system and gives them the ability to address a global oil shock on their own. Nations can be expected to shoulder an outsized share of the cost of providing a collective good if they expect to enjoy a large portion of the benefits of that collective good and those benefits outweigh the costs.[57] Because the nations in this category can materially impact the efficacy of an IEA oil stocks release, they expend considerable government resources on their oil stockpiling programs, which serve to defend both the global economy and their national economies. The category is subdivided in to low- and high-economic vulnerability. If the economic vulnerability country whose oil stockpile conferred substantial market power were to decrease substantially, it would shift to a cost-minimization strategy notwithstanding its ability to influence global supply stability.

The next quadrant contains countries whose primary vulnerability is economic, but that do not have the market power to address an oil supply disruption on their own. An IEA collective action could likely be successful if any one member in this category did not effectively participate. Government oil stockpiling in these countries is limited, but on a continuum. The benefits of remaining the IEA are similar across these countries – the collective strength of the organization depends on their continued membership in good standing, but their individual contributions to the IEA's market-stabilizing capability are limited. These members pay the compliance costs so that the IEA can maintain its institutional integrity. The approach to oil stockpiling in these countries is

[57] Olson, 1971.

driven by cost minimization. The subcategories of stockpiling approaches are detailed in table 2.5:

Table 2.5: Cost Minimization in States with Limited Government Involvement		
Strategy	**Benefit to Cost Ratio of Strategic Oil Stocks**	**Example:**
Partial Public	Medium	Ireland
Industry Obligation or Tickets	Low	Sweden
Free Riding	Extremely low	Australia (pre 2017)

The drivers identified in the model also speak to variation along this partial spectrum, albeit slightly less clearly. Countries whose programs are categorized as "partial public" have the most robust approach to energy security in this category. Some of these countries have market power that comes close to the larger countries (France) and others face access concerns similar to the countries in the next quadrant (Poland). Countries whose stockpiling obligations are met exclusively through industry mandates and/or tickets comply with the IEA's stockpiling requirement, but they would enjoy the collective energy security no matter how effective or ineffective their individual national contribution to a release was. This category includes relatively less prosperous IEA members that can be expected to be more attentive to costs (Greece) and IEA members with extraordinarily small market power (Luxembourg). This dissertation argues that the combination of lack of market power and distributed energy security benefits drives these countries to minimize the cost of their stockpiling programs.

As the lone pure free-rider in the IEA, Australia occupied the final sub-group of the cost minimization category until 2017. Should its compliance plan falter, the country would fall back into the free-rider category. Australia cannot impose a mandate on

industry without creating great hardship and it has refused to expend government resources to acquire oil stocks. It remains to be seen how effective the country's ticket-based approach will be. Like other IEA members whose primary concern is their economic vulnerability to oil shocks, Australia does not currently face significant threats to its maritime imports. Like the United States, it produces a large portion of its petroleum domestically. If a large oil supply shock befell the world market, Australia would be able to enjoy the benefits of an IEA collective release whether or not they contributed. This relatively benign threat profile, combined with the high start-up costs of an oil stockpiling program, has led the Australian government to do nothing. Their free-riding represents an extreme example of the behavior that the model offered in this dissertation predicts.

The next category consists of countries that do not have the market power to determine the efficacy of an IEA collective action or address a global crisis on their own, but whose access to crude oil is vulnerable to a physical cutoff. Many Eastern European IEA members fit into this category. These countries import a majority of their crude oil from Russia and most of that oil is imported by pipeline. These nations' energy lifeline comes from a country with a demonstrated willingness to use energy exports to advance geopolitical goals. The Czech Republic, Slovakia, Finland, and Hungary all fit into this category and all of them have government-owned oil stockpiles. This affords these governments control over their oil and demonstrates a commitment to energy security that goes far beyond that of their (more economically advanced) Western European peers. The dissertation argues that these governments have chosen direct ownership of their oil stockpiles because these countries treat the security of oil access as a national security

issue warranting significant resources. As shown in table 2.3, Poland has pronounced dependency on Russia, but their strategic stockpile ownership is split between industry and government. The country is currently rebuilding their government-owned reserves.

The last category is countries for which a 90-day oil stockpile is large enough to influence the global market who also face concerns about access to oil. Under these circumstances, a country could be expected to pursue a relatively intense oil stockpiling strategy in which a large government-owned stockpile was developed *and* commercial actors were required to hold substantial inventories beyond their operational needs. Currently, no IEA country fits into this category. If the maritime balance of power in the Pacific or the U.S.-Japan relationship shift dramatically, Japan could potentially fit in this category. Japan's vulnerability to oil based coercion is well-documented.[58] One could argue that this historical vulnerability partly contributes to the extent of the current stockpiling program, notwithstanding the security guarantee that the United States provides them.

The only country that could potentially fit into this category currently is China. An oil stockpile equivalent to 90 days of Chinese net petroleum imports would hold more than 500 million barrels of oil.[59] A strategic reserve this size would be large enough to stabilize the global market. A fully developed Chinese oil stockpile would also protect the country's oil consumption from an American naval blockade for a certain period of time. The model proposed in this dissertation would predict that, given these imperatives China would pursue an intensive oil stockpiling strategy. This is in fact what is currently occurring. China is both building up a massive government-owned oil stockpile *and*

[58] Kelanic, 2012.
[59] Author's calculation based on EIA data.

developing substantial commercial oil reserves through its national oil companies. For its part, the IEA has reached out to China and other non-OECD partners to cooperate on energy security issues, which benefits both parties in the pursuit of collective energy security.[60]

Conclusion and Research Plan

The model proposed in this dissertation solves the empirical puzzle of why some nations meet their IEA oil stockpiling commitment through government-owned oil stocks while others choose to rely on less-costly, less-effective industry obligations. It argues that countries with acute physical access vulnerabilities will build government oil stockpiles because they approach stable oil supplies as a matter of national security. For countries whose primary vulnerability is economic, the level of state involvement in oil stockpiling is driven by the market power conferred by a 90-day stockpile and the extent to which oil price shocks impact their economies. Countries whose stockpiles would necessarily be small based on the size of their economy can be expected to pursue less costly and less effective stockpiling strategies or free ride. The intersection of vulnerabilities and capabilities yields a cogent explanation for oil stockpiling behavior in IEA member states.

Some might argue that domestic factors could provide a more compelling explanation of stockpiling outcomes. The open economy politics (OEP) literature in international political economy focuses how the economically derived preferences of domestic interest groups are aggregated through domestic institutions and translated into

[60] Kohl, 2010; Wilson, 2015.

international outcomes.[61] This approach to international relations provides a useful tool for explaining many areas of energy policy, which can be conceptualized a "joint goods" that yield both private and public benefits.[62] These explanations warrant consideration, given that energy security policy is not made in a vacuum. Nations' broad approach to energy issues, the status of the domestic oil and gas industry, and the relative strength of domestic energy interest groups likely influence oil stockpiling outcomes in IEA countries to some extent. Broader factors outside of the energy sector, such as the state of business-government relations in a country or the level of economic development might also play a role.

However, domestic factors cannot provide a complete explanation of the oil stockpiling strategies pursued in IEA countries. The state-level attributes identified in this project fundamentally shape the space in which domestic actors operate. Governments of economically vulnerable countries considering the costs and benefits of a government strategic oil reserve face categorically different tradeoffs depending on the market power conferred by their stockpiles. This market power is a factor of the size and resource endowment of a country. The national security vulnerability of captive importers represents a higher order concern for governments than the economic interests of any single group. This circumstance is an inescapable factor of geography. As the following empirics will show, these national characteristics of IEA members provide a more comprehensive explanation of how they approach strategic oil storage.

[61] The seminal work in this area is Moravcsik, 1997. Lake (2009) reviews strengths and weaknesses of open economy politics as a sub-field.
[62] Hughes and Lipscy, 2013.

Further, some of the fundamental assumptions of OEP analysis do not hold for oil stockpiling policy. OEP research typically ascribes preferences to actors based on what microeconomic theory suggests is in their interest. In some cases the policy preference of a given actor can be clearly assessed based on their production profile and assumed to be strong. This assumption is less tenable in this policy area. While no companies want to hold uneconomic inventory, the costs of strategic oil storage in countries that employ industry mandates does not drastically compromise their profitability. Often these costs are passed directly to consumers. Because being compelled to shoulder the burden of stockpiling is a secondary issue for the oil industry, their efforts to impact energy security policy are comparatively less vigorous than in other areas. This renders the link between domestic actors' economic interests and policy outcomes less robust. Without an ironclad expectation that a given economic interest group would present a united policy front, domestic factors represent a secondary driver of policy outcomes.

Finally, OEP explanations of international relations are typically employed to explain international economic outcomes. The theory and evidence presented here suggest that energy security and policies to enhance energy security can extend beyond the economic realm into the security realm. Given this, an analytical approach is necessary that can explain both the behavior of nations facing security vulnerability and nations facing economic vulnerability. This dissertation's focus on state-level attributes accomplishes this. The project's empirical strategy will address these domestic issues in the empirical chapters and in doing so provide a comprehensive explanation for why IEA members pursue the oil stockpiling strategies that they do.

To test the validity of the theory proposed here, this dissertation will employ a two-part empirical strategy designed to both evaluate broad trends across IEA countries and to trace the process of energy security decision making. First, a time-series, cross-section statistical model will be run to evaluate the impact of variables on the level of government oil stocks in all IEA stockpiling countries from 1984-2012. Second, case analysis evaluates oil stockpiling policy in three different IEA archetypes. It begins with an in-depth study of SPR policy in the United States. It then evaluates cost minimization approach followed by Sweden. The third case focuses on the Czech Republic, highlighting the importance of access concerns in stockpiling policy in a country dependent on Russia. These countries represent the full variation of IEA countries in terms of stockpiling strategies and will allow for an examination of both the significance of market power and physical supply access. This approach will provide a comprehensive empirical validation to the theory advanced here and speak to multiple contemporary policy issues.

Chapter 3: A Quantitative Analysis of Oil Stockpiling Behavior

The theoretical model developed in the previous chapter yields four archetypes of oil stockpiling countries: (1.) large-market-power countries focused on economic vulnerability (which is split into low and high), (2.) small-market-power countries focused on economic vulnerability, (3.) small-market-power countries focused on physical access to oil, and (4.) large-market-power countries focused on physical access to oil. The first category is populated by the United States and Japan. A detailed analysis of the history of U.S. SPR follows, which highlights the importance of market power in the history of the development of SPR policy over time. The fourth category could only plausibly be occupied by China, which will is discussed in the conclusion. The remaining 25 IEA countries under consideration fall into categories two and three. Category two includes countries ranging from major oil-importing economies (France, Germany) to importers whose footprint on the oil market is negligible (Luxembourg). Countries in category three are also diverse in terms of their energy position and level of economic development (Slovakia vs. Finland). Given the diversity of countries that participate in the International Energy Program, it makes sense to investigate whether the factors identified in this dissertation impact oil stockpiling policy across countries. A statistical analysis can yield insights in this area.

Quantitative analysis can also illuminate whether the drivers of energy security policy identified in this dissertation have impacted the evolution government involvement in oil stockpiling over time. This is particularly critical, given the dramatic changes that have occurred in the oil market since the IEA was founded. Since the founding of the

IEA in 1973, oil markets have become vastly more integrated and liquid. The sample period in this chapter (1984-2012) has seen extraordinary fluctuations in the oil price, which reflect the evolution of the global market.[63] The changes have often driven the extent to which energy security has constituted a critical issue for oil importing countries. Further, many of the factors that could potentially influence energy security policy in IEA countries, such as patterns of energy use and the prevalence of potentially hostile suppliers in nations' import portfolio, have shifted considerably since the organization's founding. Quantitative analysis of time-series cross-sectional data of the entire population of oil-importing IEA countries can illuminate the drivers of oil stockpiling over time.

The model described in this chapter assesses what has driven energy security policy in IEA countries since the IEA's establishment of the Coordinated Emergency Response Mechanism (CERM). Because governments delineate between private and public oil stocks in their official reporting, the level of government involvement in oil stockpiling can be directly evaluated. Multiple variables are used to evaluate the importance of physical access to oil supplies. Most of the measures used in the analysis represent fundamental characteristics of nations' energy sectors that characterize how much oil countries produce and consume, the sources of oil imports, and the role that energy plays in national economies. These metrics provide a broad view of the energy characteristics of IEA countries and highlight how these attributes have changed over time. The analysis here offers a view of the drivers of oil stockpiling policy from 30,000 feet.

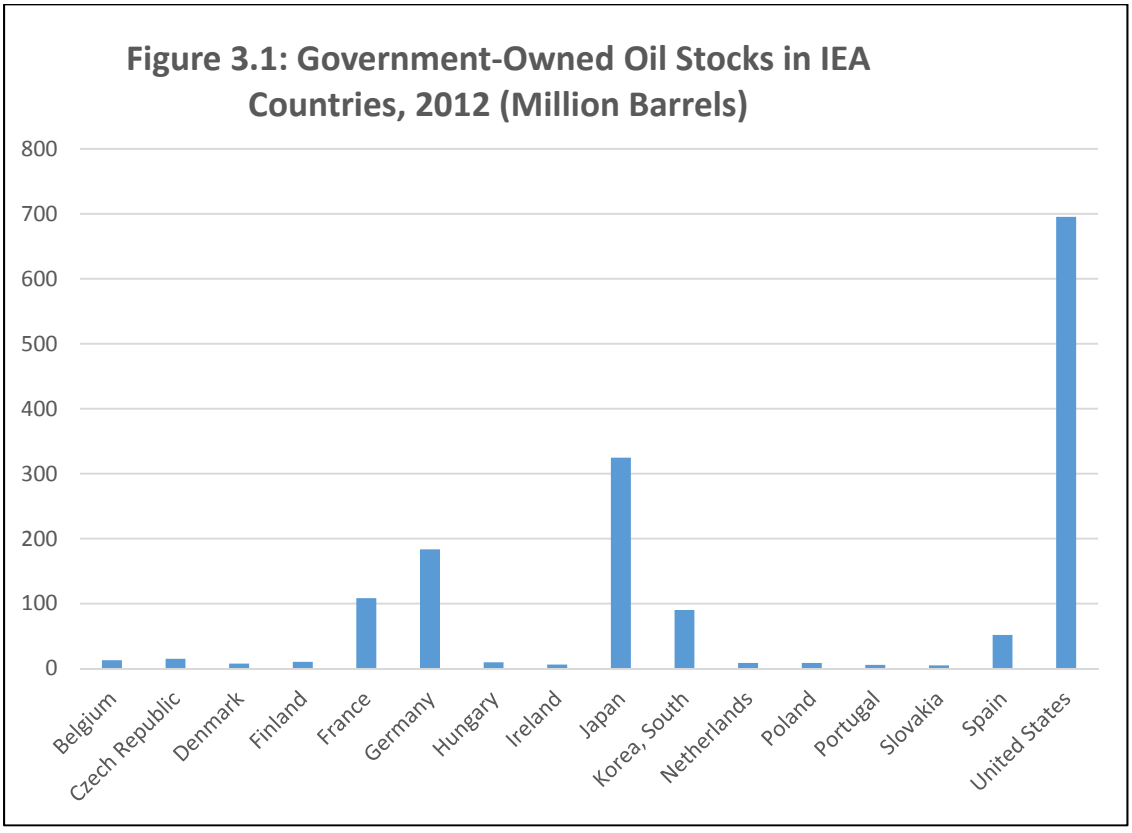
[63] The initial year of the sample period is based on data availability. Prior the establishment of the CERM in 1984, countries did not report data on their oil stockpile levels in a systematic manner.

The model in this chapter tests for both the influence of physical oil access concerns and economic vulnerability concerns in determining oil stockpiling policy. The results presented here constitute a meaningful component of empirically validating the explanation of energy security policy advanced here, but it is just a start. It remains critical to trace how the concepts addressed in this quantitative analysis translated into policy outcomes. Elucidating the role that these concepts play in determining nations' oil stockpiling strategies is especially important because, relative to many policy areas, energy security is an issue that is not universally well-understood by the public and decision makers. The quantitative measures of energy vulnerability discussed in this chapter vary in terms of how easy they are for non-technical observers to understand. To truly understand how the types of vulnerability translated into policy outcomes, qualitative analysis is required. The model discussed here is a valuable first step.

This dissertation argues that oil stockpiling policy is driven by the degree of market power conferred by nations' oil stockpile and by the nature of energy vulnerability that they face. Testable hypotheses follow from this theory that can be evaluated using quantitative analysis of government stockpiling in IEA countries. This chapter discusses this analysis, which partially supports the project's broader argument. It begins with a discussion of the dependent variable in this analysis, government oil stockpiling measured in days import cover. A conceptual discussion of the independent variables and their hypothesized impact on energy security policy follows. The results of the statistical analysis are then presented and unpacked. The chapter concludes with a summary of key takeaways and insights that can inform the case analysis.

Dependent Variable

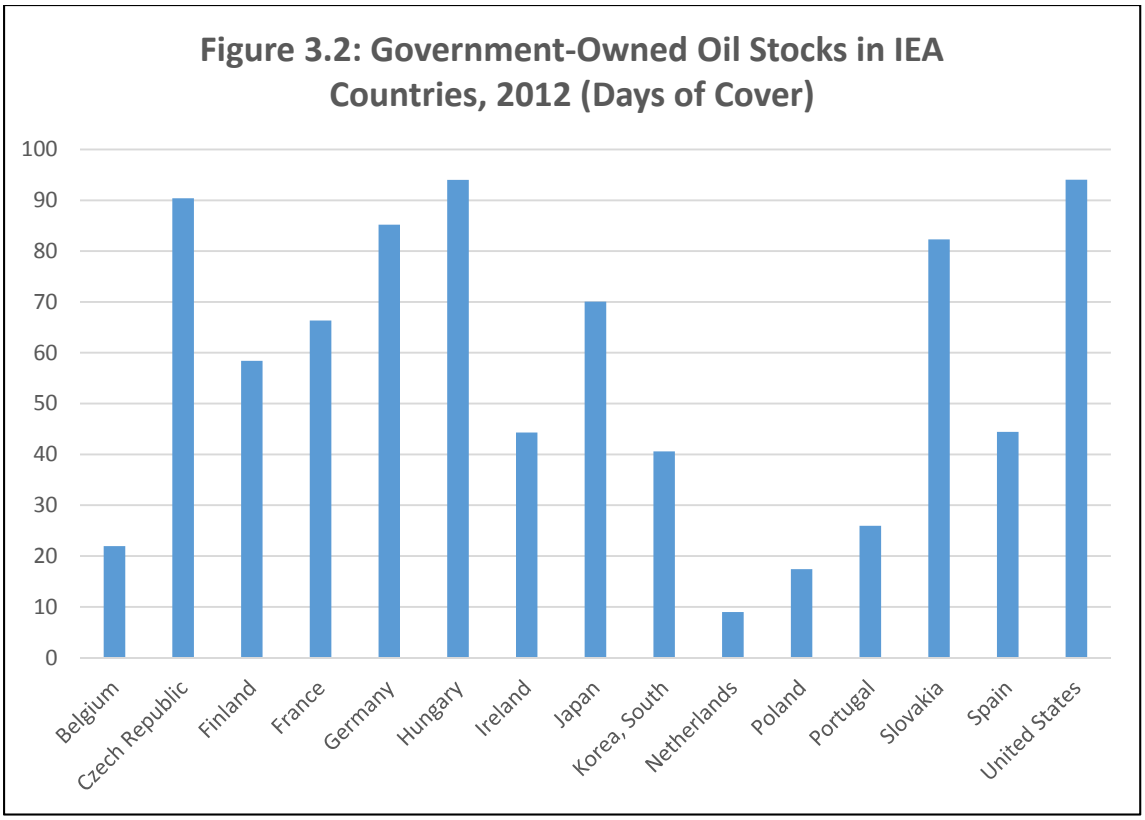
The dependent variable under consideration in this dissertation is the level of government involvement in oil stockpiling. Quantifying this concept is relatively straightforward – governments publish data on the size of their oil inventories, both public and private. The level of public stocks directly measures the level of government involvement in oil stockpiling. The U.S. Energy Information Administration (EIA) makes data on the level of government oil stocks available for IEA countries that goes back to 1984.[64] Total levels of publicly held oil stocks for the countries that took this approach to meeting their IEA obligation are displayed in Figure 3.1:



[64] Unless otherwise specified, all energy data in this project come from EIA.

Twelve IEA countries held no government-owned oil stocks in 2012. Austria, Greece, Italy, Luxembourg, New Zealand, Sweden, Switzerland, Turkey, and the United Kingdom met their IEA obligation with industry stocks or tickets; Canada and Norway have no requirement to hold oil stocks because they are net exporters; and Australia held no public stocks and did not meet their IEA obligation. Figure 3.1 clearly shows that there is a wide variance in the absolute size of national oil stockpiles in countries that have some level of government stocks.

To assess drivers of strategic oil stockpiling behavior, it is necessary to transform the dependent variable. The absolute size of a nation's oil stockpile is primarily a function of the size of a nation's economy and oil import levels. This dissertation seeks to address the level of government involvement in meeting the IEA's 90-day stockholding obligation, which is primarily a function of policy choices. Therefore, the analysis presented here will quantify government-held oil stocks in terms of days of import cover that they provide. This measure is calculated by dividing a country's level of oil stocks in a given year by its level of net petroleum imports (total imports –total exports) in that year. Use of this approach is codified in the IEP, which stipulates member stockpile requirements in terms of days of imports rather than absolute levels. Levels of publicly held oil stocks measured in days of cover are shown in Figure 3.2:



This transformation normalizes the scale of the dependent variable based on the size of the economy in question. This is especially important, because the government involvement in oil stockpiling is intended to capture the extent of a given country's resource commitment to energy security. In this context, it is appropriate to factor in the size of an economy. For example, U.S. SPR held 696 million barrels of oil in 2012, compared to Slovakia's five million barrels. However, in terms of days of import cover, the two countries were very close (94 days vs. 82 days). This is also a better conceptual measure of government oil stockpiling. The absolute size of a nation's oil stockpile is a function of both policy choices and the size. This transformation isolates the policy component of government involvement in oil stockpiling, while controlling for the size. This better illustrates the relative importance of energy security across countries.

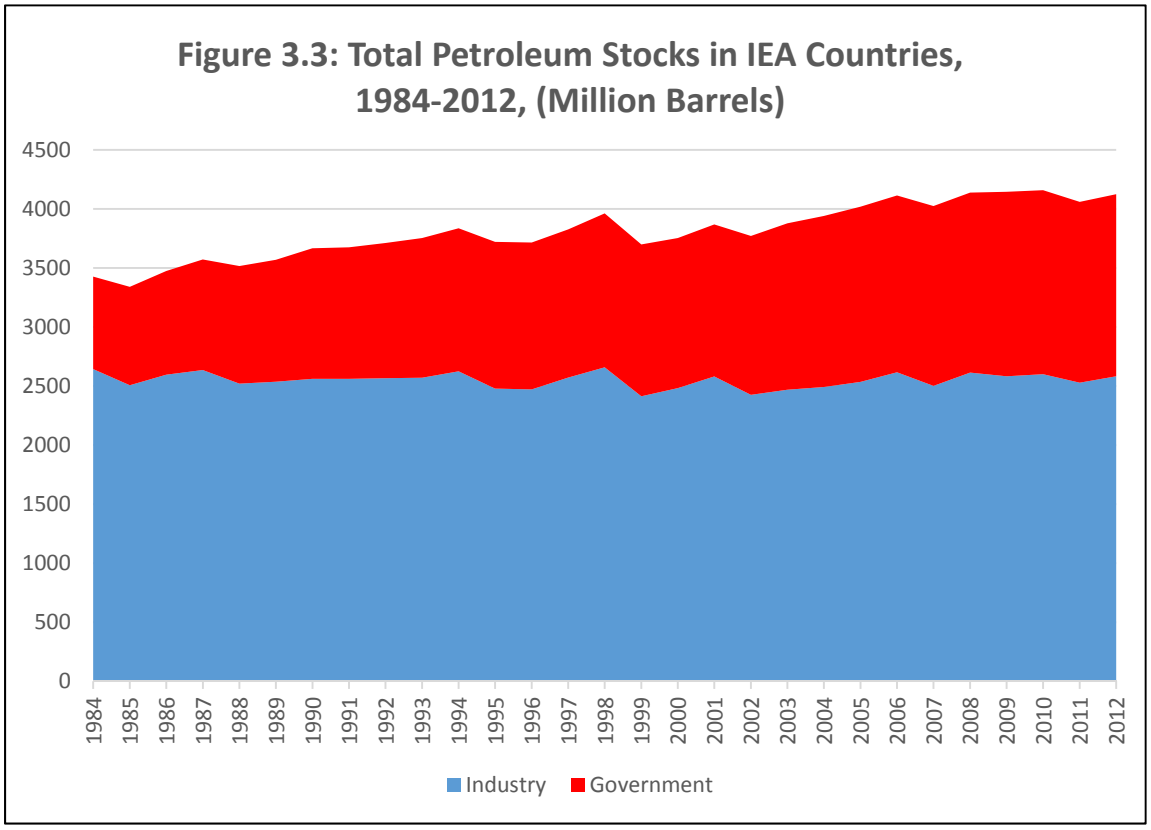
The use of days of import cover does necessitate dropping five of the 28 IEA countries from the dataset.[65] Australia, Canada, Denmark, Norway, and the U.K. are removed from the panel because they were net exporters for all or part of the sample period. While the fact that countries which have no import vulnerabilities still choose to hold government oil stocks is interesting, it would not make sense to assign these countries negative or zero values when they were exporting petroleum – their status as net exporters did not mean that their stocks make them more vulnerable. Given the intractable variance in absolute levels of strategic stocks and the importance of measuring the functional importance of government-held reserves, the benefits of this transformation outweigh the drawbacks.

Another potential transformation would involve taking the portion of total oil stocks represented by government stocks. The problem with this approach is that the level of commercial oil stocks in a given country is not solely a policy outcome. EIA provides data on the level of commercial oil stocks in IEA countries. However, it does not delineate between stocks which are held because of policy mandates and stocks which are held because of business requirements. Specifics of mandatary stockholding levels are not publicly available across countries over this time period, which makes it impossible to isolate the portion of industry stocks that represent the portion of stocks held above normal operating requirements. Further, depending on the configuration of a country's petroleum supply system, a significant portion of commercial stocks might be required to keep the logistical system working (e.g. tank bottoms, pipeline fill) which makes it difficult to determine what portion of commercial oil stocks could be considered

[65] The IEA now has 29 members. Estonia joined the IEA in 2014.

available for use in an emergency response. Industry stock levels are included as a control variable.

Over time, the total volume of publicly held IEA petroleum stocks has increased substantially. This results from both increases stemming from growing import levels (countries maintaining the same approach to 90-day compliance, and purchasing more oil as the compliance level increased) and from countries deliberately shifting to a more government-intensive approach. Both phenomena demonstrate a resource commitment to energy security. The trajectory of the total volume of IEA petroleum stocks over time can be observed in Figure 3.3:



The total volume of government-held stocks has increased from just short of 800 million barrels in 1984 to more than 1.5 billion barrels in 2012. This increase occurred while the volume of industry stocks remained virtually the same. Growth in government-owned oil

stocks was not just a function growing volumes of oil being traded. Public stocks across the IEA accounted for 45 days of import cover in 1984 and 65 days of import cover in 2012.

The rate at which stock levels changed from 1984 to 2012 varies across countries. Some national stockpiles grew steadily over the period, while others saw rapid expansions over short periods. In a few cases, nations held government oil stockpiles and divested of them. Greece, Italy, and New Zealand jettisoned small stockpiles in the early 1980's and shifted to industry mandates. In-country, government-held volumes have slowly decreased over time in the Netherlands, which now holds a large portion of its government stockpile abroad (likely because they are a major trading hub and have minimal access concerns). The move away from government-held stocks was most stark in Sweden, which moved from a full 90-day stockpile to no government stocks in a five year period. The various differences between countries' stockpiling trajectories over time illustrate the puzzle that this dissertation sets out to solve: what drives national choices in oil stockpiling behavior? To begin answering this question, many of the concepts presented in the theory chapter are quantitatively operationalized. A discussion of these independent variables follows.

Independent Variables and Hypotheses

At the core of this dissertation's explanatory model is the distinction between security vulnerability and economic vulnerability. The model proposed here argues that in countries with physical supply security concerns the government will play a greater role in oil stockpiling. Where the primary vulnerability is economic, the severity of economic concerns and the degree of market power conferred by oil stocks drive the

extent of government involvement in oil stockpiling. The independent variables here quantitatively operationalize both types of vulnerability. Based on the logic of the model, variables that represent the vulnerability of physical oil supply should exert a clear, positive influence on government involvement in oil stockpiling.

The picture is somewhat less straightforward for variables that represent economic vulnerability. While one could argue that any vulnerability should positively influence government oil stockpiling, the relationship should be less clear based on the explanation presented here. The severity of economic vulnerability is only expected to play a role in oil stockpiling when countries possess the market power to influence the world oil market with their stockpile. For small countries, even if they are severely economically vulnerable to oil price shocks the can still enjoy the benefits of IEA oil market stabilization without an effective stockpiling strategy. Per the logic of the model here, economic vulnerability to oil price shocks is a necessary, but not sufficient condition for pursuit of a government intensive oil stockpiling program. Therefore one should expect these relationships between variables that measure economic vulnerability to oil price shocks and government stockpile levels to be relatively weaker than the relationships related to physical supply security.

This analysis quantitatively operationalizes each type of vulnerability. Physical supply security concerns are represented by measures of indigenous oil production and import dependence on potentially hostile sources. The first physical vulnerability variable is the level of oil production in a country, measured in thousand barrels per day. If a country produces more oil within their borders, they can be expected to be relatively

less concerned about the physical security of imported oil supplies relative to countries with less indigenous production.

H1: As domestic oil production increases in a country, government-owned oil stockpile levels will decrease.

This metric could prove problematic – when the IEA net exporters are dropped from the dataset, most of the remaining countries have little to no oil production except for the United States. This issue is specifically addressed in the analysis. The importance of domestic oil output in energy security decision-making must viewed through the lens of policymakers perceptions. A nation could still be vulnerable to a physical supply cutoff even with some level of domestic oil production. However, significant or rising domestic petroleum production levels could moderate the *perceived* insecurity of physical oil supplies which could impact energy security choices.

The same phenomenon could hold for the second measure of physical supply security concerns: the share of OPEC supply in a country's total imports. To some extent, all participants in the global oil market are dependent on OPEC, because they have long been the swing producer in the global oil market and remain the world's only source of spare oil production capacity. Recently some scholars have questioned the significance of OPEC's role in the global market.[66] While it is true that some aspects of OPEC's role in the world oil market might have obsolesced, they the source of the most notable oil embargo against Western importing countries. The memory of this, and a general aversion to importing oil from hostile sources, has likely influenced IEA

[66] Hughes and Long, 2014; Colgan, 2014.

members' approach to energy security policy making over the period in question. Dependence on OPEC can be expected to increase energy security concerns.

H2: As the share of OPEC imports in a country's total oil imports increases, its level of government-owned oil stocks will increase.

This measure does not necessarily capture the importance of OPEC to a given IEA member's energy security. It does serve as a proxy for dependence on imports from hostile sources that could impact decision makers' *perception* of energy insecurity. Because decision-maker perception is a key component of how the first two variables impact oil stockpiling, the quantitative results presented here should be taken as a first approximation. The impact that domestic oil output and dependence on OPEC have on policy choices needs to be fleshed out in the case analysis.

The final variable that represents physical supply security concerns is the share of Russian imports in total petroleum imports. For countries which are substantially dependent on Russia for oil and gas, access concerns are a tangible problem. This real and perceived concern should cause states to pursue a resource-intensive energy security strategy:

H3: As the share of Russian imports in a country's total imports increases, its level of government-owned oil stocks will increase.

This is a conservative measure of energy dependence on Russia, because it does not account for natural gas imports. Strategic petroleum stocks could also help a gas-import-dependent nation with a supply cutoff to the extent that infrastructure allowed for the use of oil-based fuels in heating and power generation. The relationship can be expected to be significant and strong, given that the energy security threat that dependence on Russia

represents is widely acknowledged and animates many debates on energy security in IEA countries. The main drawback of this measure is that it does not distinguish between pipeline and waterborne imports due to data limitations. The ability of countries whose imports from Russia (or anywhere else) to withstand a supply outage from a hostile source is infinitely greater that countries who receive the bulk of their imports by pipeline. The impact of geography and infrastructure on stockpiling decisions will be fleshed out in the case studies.

The next two independent variables tested here are intended to measure the extent to which a country is economically vulnerable to oil price shocks. This dissertation argues that in countries for which this type of vulnerability drives of energy security policy, the market power conferred by oil stocks determines the extent to of government involvement in oil stockpiling. Absolute stockpile size is not tested here and cannot be included as an independent variable because it is a component of the dependent variable. In terms of quantitative analysis, the only thing that can be tested is whether measures of economic vulnerability exert an independent impact on oil stockpiling policy in IEA countries over time. If these variables are significant across a wide variety of countries *regardless of the market power conferred by national oil stockpiles*, then the mechanics of how different types of vulnerability impact energy security policy might be different than how the model here envisions. Market power might not be as an important a factor as initially thought. Conjectures associated with these variables can be thought of as alternative (though not directly contrary) hypotheses.

The first measure of a country's economic vulnerability to oil shocks is the level of oil consumption, measured in thousand barrels per day. The logic behind this variable

is straightforward – the more oil that a nation consumes, the more vulnerable its economy likely is to oil price fluctuations. The testable proposition here is whether changes in the metric over time significantly impact energy security choices in IEA countries.

HA1: As the level of oil consumption in a country increases, its level of government-owned oil stocks will increase.

The absolute level of oil consumption in a country materially impacts its economic vulnerability to oil shocks, because directly impacts the scale of wealth transfer that occurs in an oil shock. However, this measure does not capture the degree to which a country's prosperity is linked to petroleum consumption.

A better measure of economic vulnerability is oil-intensity of economic output, which is measured here as $1000 of Gross Domestic Product (GDP) produced per barrel of oil consumed in a year. The more GDP that a country can produce with a barrel of oil, the less oil-intensive its economy is. If this economic vulnerability independently drives energy security decision making, government involvement in oil stockpiling can be expected to vary inversely with the amount of GDP produced with a barrel of oil.

HA2: As the amount of GDP produced by a barrel of oil in a country decreases, its level of government-owned oil stocks will increase.

While oil-intensity of economic output is likely the best measure of the extent to which a country's prosperity is impacted by oil output, unlike the measures of physical supply vulnerability, this concept does not feature prominently in the public discourse on energy security. If either this or consumption prove significant, qualitative analysis will be required to assess the mechanism through which they influence energy security decision making.

A more straightforward alternative explanation for oil stockpiling choices is that they are the result of domestic politics. Obviously the totality of domestic energy, security, and economic issues that could influence the stockpiling choices that countries cannot be captured in a single analysis. However, one variable that speaks to both the role of the state in energy markets and the politics of energy policy is a country's level of fuel taxation. A considerable component of the public discourse on oil supply security is framed in terms of how much consumers pay for petroleum products. Not only do countries' individual fuel-pricing mechanisms vary, but they have great bearing on how oil supply shocks impact their citizens and budgets. The less a government taxes petroleum products, the bigger the domestic price impact of an oil supply shortage will be. This is the case because the share of the price of a gallon of gasoline or diesel represented by crude oil is far higher in countries with low gasoline taxes, such as the United States.[67] When oil prices escalate, the percentage change in product prices is much smaller in countries with high taxes.

Given that gasoline prices are a pocketbook issue for voters in many countries, it could be the case that oil price escalations entail greater political costs for government representatives in countries where the fuel pricing regime renders *consumers* more vulnerable to the impact of oil shocks. Governments that do not heavily tax fuel, and are therefore more vulnerable to the consumer-driven political impact of oil price shocks, could be expected to seek a more robust instrument to address oil supply crises and put more resources towards energy security.

[67] For example, if the oil content of a gallon of gasoline costs $1.00 and the taxes cost another $1.00, then a doubling of the oil price will lead to a gasoline price escalation from $2.00 to $3.00, or 50%. If the taxes cost $4.00, then a doubling of the oil price will lead to a gasoline price escalation from $5.00 to $6.00, or 20%.

HA3: As the level of fuel taxation in a country decreases, its level of government-owned oil stocks will increase.

This assertion is distinct from the arguments focused on systemic vulnerability, because the key attribute "doing the work" is the domestic micro-politics of gasoline, diesel and heating oil, rather the national-level macro-politics of crude oil. Investigation of fuel pricing mechanisms is also relevant to non-IEA countries, which often subsidize consumer petroleum products.

In addition to a lagged dependent variable to control for temporal effects, three substantive control variables are included. First, the analysis controls for country wealth, using GDP per capita. Acquiring and maintaining government oil stocks is expensive, so the countries that build stocks might simply do so because they can afford to. Second, the model controls for commercial stocks. While this dissertation argues that commercial stocks are not a robust energy security instrument, they do provide some measure of supply security. To the extent that countries choose to build strategic oil stocks even in the presence of commercial stocks, the empirical results will be proven more robust. Lastly the study includes a lagged oil price, which is the same across countries, to control for conditions in the world oil market. This variable could impact both the level of concern about oil security in IEA nations as well as the feasibility of procuring oil stocks, which varies with prices. Together, these controls should account for the major factors that could confound this study's results.

The independent variables investigated in this analysis are summarized in Table 3.1. The model proposed in this dissertation would predict that the variables associated

with physical supply security are stronger drivers of oil stockpiling policy that those related to economic vulnerability to oil price shocks or domestic politics.

Table 3.1: Independent Variables and Hypotheses		
Concept	**Operationalization**	**Expected Sign**
Vulnerability of physical oil supplies	Domestic oil output (thousand barrels per day)	Negative
	OPEC share of total oil imports (percentage)	Positive
	Russia share of total oil imports (percentage)	Positive
Economic vulnerability to oil shocks	Total Oil Consumption (thousand barrels per day)	Positive
	Oil Intensity of GDP ($1000/barrel consumed)	Negative
Domestic energy politics	Diesel fuel taxation (U.S. Dollars per liter)	Negative
Controls	Lagged dependent variable (days of net import cover)	N/A
	GDP per capita (Current U.S. dollars)	N/A
	Industry oil stocks (days of net import cover)	N/A
	Lagged Brent Crude price (U.S. Dollars per barrel)	N/A

As is the case in any quantitative investigation of a social phenomenon, the measures outlined above are abstractions of reality. Fundamental energy concepts do not necessarily translate into the discourse on energy policy. The results here, therefore, should be taken a tentative support for this dissertation's explanatory theory. If the results are completely contrary to the propositions here, the model is likely flawed. If the results accord with the model, the theorized relationships are worth investigating more rigorously in the qualitative case studies.

Regression Analysis

To test the above hypotheses, a time-series, cross-sectional regression analysis of government oil stockpiling in IEA net importing countries is performed. After removing the IEA's five countries which have been net exporters at some point, the panel includes 23 countries for the years 1988-2012. Four years of data at the beginning of the series on the independent variable must be dropped to include a lagged Brent crude oil price. This leaves a dataset of 565 country-year observations, which is an adequate size for this model specification. Table 3.2 lists the variables in the model and provides descriptive statistics:

Table 3.2: Regression Variables (1988-2012)

Variable	Unit	Source	N	Mean	Standard Deviation	Min.	Max.
Government days of import cover	Days	EIA	565	23.32	29.06	0.00	108.23
Domestic oil production	Thousand barrels per day	EIA	565	452.17	1919.82	-23.75	11118.69
OPEC share of oil imports	Percentage	IEA	565	0.41	0.31	0.00	1.00
Russian share of oil imports	Percentage	IEA	565	0.21	0.31	0.00	1.00
Oil Consumption	Thousand barrel per day	EIA	565	1709.09	3876.66	27.00	20802.16
Oil Intensity of GDP	$1000 of GDP per barrel consumed	EIA, World Bank	565	1.90	0.97	0.43	7.32
Diesel fuel taxation	U.S. Dollars per unit	IEA	539	0.56	0.32	0.04	1.93
GDP per capita	U.S. Dollars	World Bank	565	25542.84	17278.06	1693.74	112028.60
Industry days of import cover	Days	EIA	565	77.63	39.00	9.94	185.29
Lagged Brent crude price	U.S. Dollars per barrel	EIA	565	37.20	27.78	12.76	111.26

Over time and across countries, all of these measures vary significantly. The independent variable, government days of import covers, has a value of zero in 264 (roughly half) of the observations. These values are included in the models, as they represent a deliberate policy outcome that is directly relevant to the theory advanced here.

Given the relative homogeneity of IEA countries, the ranges of values for the independent variables is striking. The United States is an outlier in terms of domestic oil output – the other countries that are significant producers are net exporters and thus dropped from the dataset. This is addressed expressly below. The U.S. also has extraordinarily high oil consumption, although this variable is on more of a continuum across countries. Both the share of OPEC crude and the share of Russian crude in IEA countries' import mix ranges from zero percent to 100%. Oil intensity of economic output, fuel taxation, industry stocks, and even GDP per capita also vary widely across time and space. This highlights both the diversity of energy and economic circumstances in IEA countries (which will be addressed in the model specification discussed below) and the extent to which energy policy and energy markets have evolved in the years under consideration. The Brent crude oil price for the period is emblematic of this – oil has averaged as low as $12.76 and reached as high as $111.26 during the period.

The primary model specification in this analysis is a fixed-effects regression with a lagged dependent variable and panel-corrected standard errors. The approach allows for the assessment of longitudinal variation within countries over time, while accounting for dynamics.[68] The coefficients yielded by the model only capture within-country change over time. The extent to which this compromises the findings of the model

[68] Beck and Katz, 1995; Beck and Katz, 1996; Wilson and Butler, 2007.

depends on how much the variables change over time.[69] Here there is considerable heterogeneity. In many countries, the independent variables assessed here have changed considerably over time (e.g. per capita GDP in South Korea, oil production in the U.S.) while other have remained fairly stable (e.g. the portion of imports from OPEC in many countries). These model limitations underscore that the statistical analysis provided in this chapter constitutes a starting point for this dissertation's empirics as opposed to and end point.

The results of the analysis are presented in table 3.3. Model one, described above, provides some support the theory advanced in this dissertation. The variables representing physical supply vulnerability support the assertion that this vulnerability drives countries to build oil stockpiles, regardless of the size of their economy. Domestic oil production, which again is problematic due to the exclusion of countries that have been net exporters during the period, is slightly statistically significant, but not in the expected direction. This is addressed further below. Dependence on OPEC crude and dependence on Russian crude are both highly statistically significant and in the expected direction. Evaluation of these coefficients but be undertaken in the context of the variables' scale, which is a percentage. They mean if OPEC or Russian imports were to grow from zero to 100 percent, the level of government-owned oil stocks would increase by around six or 11 days, respectively. In the context of a responding variable whose mean value is 23, these values have a substantive impact.

The variables associated with economic vulnerability to oil price shocks or domestic fuel politics are not statistically significant in the primary model. Zero falls in

[69] Bartels, 2015.

the 95 percent confidence range for the coefficients associated with oil consumption, oil intensity of GDP, and domestic fuel taxation. These findings accord with the theory advanced in this dissertation. The impact that economic vulnerability has on oil stockpiling policy is expected to be moderated by the market power that oil stocks provide to a country. These attributes would not be expected to change the direction of stockpiling policy in a country over time *on their own.* Further, the linkage between these variables and national vulnerability might not be readily understood by the average voter and therefore might be less likely to impact the public discourse on energy security. The same can be said for domestic fuel prices – it might come as a surprise to many voters that higher gasoline taxes actually help insulate them from oil shocks. The controls are not statistically significant, other than the lagged dependent variable, which is highly significant. This makes sense – oil stocks are expensive and even the most aggressive energy policy takes time to implement. Therefore annual changes in the level of government held oil stocks can be expected to be fairly moderate, making the previous year's level relevant to the current year.

Intra-country differences are obscured in the fixed-effects specification above, as this variation is "soaked up" by the country dummy variables. While the primary approach of this dissertation will be to address intra-country differences through case analysis, a between-country effects regression could illuminate the cross-national significance of some of these variables while. To accomplish this, model two estimates a between-effects regression of the averages of the relevant variables. This amounts to a regression of 23 averages, which obscures the longitudinal effects and reduces the explanatory power of the model.

Table 3.3: Drivers of Government Oil Stockpiling, 1988-2012

Variable	*Model 1*	*Model 2*	*Model 3*	*Model 4*
Domestic oil production	0.004* (0.002)	-0.025* (0.011)	0.011 (0.019)	0.052 (0.011)
OPEC share of oil imports	6.177*** (1.792)	-58.989 (30.159)	5.970** (1.917)	-57.744 (30.159)
Russian share of oil imports	10.709*** (2.350)	-14.386 (34.271)	10.536*** (2.354)	-12.680 (34.271)
Oil Consumption	0.001 (0.001)	0.017** (0.005)	0.000 (0.001)	0.014 (0.005)
Oil Intensity of GDP	-0.036 (0.542)	3.661 (10.055)	0.085 (0.566)	3.802 (10.055)
Diesel fuel taxation	1.919 (2.288)	13.793 (26.484)	3.134 (2.340)	11.184 (26.484)
GDP per capita	0.000 (0.000)	-0.001 (0.001)	0.000 (0.000)	-0.001 (0.001)
Industry days of cover	0.006 (0.017)	0.001 (0.197)	0.002 (0.017)	-0.017 (0.197)
Lagged Brent crude price	0.026 (0.015)	-0.029 (1.342)	0.010 (0.016)	0.203 (1.342)
Lagged DV	0.833*** (0.035)		0.836*** (0.036)	
R^2	.975	.382	.972	.456
Wald X^2	600.77		309077.95	
F		3.23		2.47
Probability	.000	.028	.000	.073
N	537	539	514	512

**** p < .001, ** p <.01, * p < .05*

In the between effects specification, domestic oil production switches to the expected direction (negative) and remains statistically significant. The only other explanatory variable that is statistically significant is the level of oil consumption, which is also positive. Consumption, which is measured is absolute terms in this model, might be considered to be a proxy for the market power conferred by oil stocks in the context of a between effects regression. In a given country over time, increasing oil consumption means increasing economic vulnerability to oil shocks. While this relationship holds in comparing the relative levels of oil consumption between countries, larger consumption is also linked to a larger IEA stockpiling requirement in absolute volume terms and thus more market power. It could therefore be the case that this variable, which is framed as an alternative hypothesis in the primary model, could actually accord with the basic logic of this dissertation's theory: that size matters.

The significance associated with oil consumption in the between model could also be directly related to the United States, which consumes close to *four times* the amount of oil as the next most prolific IEA oil consumer. The impact of the United States could also be also be driving the change is sign between model one and model two. The U.S. is both a prolific oil producer and holds an enormous government oil stockpile. To address the potential impact of the outlier status of the United States, the same models were run without the United States. Model 3 re-estimates the fixed-effects model without the United States. Domestic oil production is no longer statistically significant, but both dependence on OPEC and dependence on Russia remain significant and their coefficients stay much the same.

Model 4 re-estimates the between-country effects regression without the United States. None of the variables in this specification are statistically significant. The only major change between this model and the between-effects model with the United States is that domestic oil production is no longer statistically significant. This makes sense – none of the remaining nations in the model produce meaningful quantities of petroleum. This result underscores the difficulty of interpreting the output of a between-effects model that is only comparing a handful of data points. The results of this dropping the United States suggest that the measures of physical supply vulnerability are relatively strong predictors of the extent of government involvement in oil stockpiling, but that measures of other types of vulnerability are not, on their own, major drivers of energy security policy.

Conclusion

The preceding analysis lends strong support to the idea that states whose physical access to supplies of oil can potentially be threatened are likely to have relatively more government involvement in oil stockpiling. Both dependence on OPEC and dependence on Russia lead countries to adopt stronger energy security measures. Both of these outcomes suggest that dependence on a hostile supplier of petroleum leads to a more resource-intensive approach to energy security. This result holds in multiple model specifications. Variables associated with prosperity threats perform less well. The theory advanced in this dissertation would predict this outcome: countries whose primary energy security vulnerability is economic are expected to take a more resource-intensive approach only when they enjoy large market power. The modeling approach here effectively controls for the absolute size of national stockpiles, which precludes directly

assessing market power as an independent variable. The significance of absolute consumption levels in the between-effect regression model partially speak to scale and validate the importance of market power to some extent. A measure linked to domestic energy politics also performs poorly, which lends limited support this project's conceptualization of energy security policy as a form of state behavior, as opposed to the product of domestic politics.

These results constitute an important first step in validating the theory described in the previous chapter. The explanation of energy security policy advanced in this project is intended to provide a comprehensive explanation of oil stockpiling behavior in all countries. Given the heterogeneity of IEA countries and the scale of changes that have taken place in the global energy market in the decades since the IEA was founded, a quantitative analysis is a useful tool to isolate policy drivers which are transcendent across time and space. This does not mean that the preceding results come close to providing a full explanation of oil stockpiling behavior. The process through which energy vulnerabilities are translated into energy security policy is a messy one. The concepts operationalized in this model are not all widely understood, which means that the linkage between them and policy outcomes cannot be expected to be seamless. The multi-methodological approach taken by this dissertation is well suited to investigating this area. The case analysis that follows will unpack exactly how the discourse on energy security policy unfolded in response to the drivers presented here.

Chapter 4: Oil Stockpiling in the United States

The U.S. Strategic Petroleum Reserve is the largest energy security asset on earth. Over four decades, the United States has spent tens of billions of dollars on developing SPR facilities and purchasing oil to fill them. This constitutes a major commitment to energy security in a country that holds substantial indigenous energy resources. The SPR is wholly owned by the U.S. Government, placing the American approach to energy security on the far end of the spectrum of government involvement in oil stockpiling. What led to this massive resource expenditure to defend the nation against oil supply disruptions? This dissertation argues that the answer to this question for all IEA members is rooted in the nature of the energy vulnerability that they face and the market power conferred by their level of strategic oil stocks. Economic vulnerability to oil price shocks represents the primary threat to American energy security. The scale of the SPR's inventory and release capability affords it the power to substantially impact the global oil market. The model developed here would predict that these factors determine the resource-intensive U.S. approach to oil stockpiling. However, the process through which the United States arrived at this strategy was not straightforward. The decision to pursue a government-owned stockpile was preceded by considerable discourse.

This analysis will explain the process through which the United States chose to develop a government-owned oil stockpile. In the decade that followed the 1973 Arab oil embargo, U.S. policymakers developed a new understanding of energy security in a globalized oil market. As they climbed the learning curve in this newly critical policy area, the need for the nation to hold a large stockpile of petroleum became a predominant view. However, both academics and practitioners vigorously debated the exact form that

such a reserve would take. Over the course of the dialogue that led to the creation and fill of the SPR, economic vulnerability eclipsed physical supply security as the primary driver of energy security policy. Throughout this discussion, awareness of the unique position in the world oil market occupied by the United States and the importance of its ability to influence the market also sharpened. Further, the relative efficacy of an (expensive) government-owned oil stockpile in addressing energy security threats also became clear. Conclusions that can be drawn from this conversation support a hypothesis advanced in this dissertation's explanatory model: that countries focused on energy security threats related to economic vulnerability which wield large market power will pursue government-intensive oil stockpiling strategies.

This section will proceed as follows: First, it will lay out the explanatory factors for the American case in basic terms, making clear the scale of the SPR's market power and the economic nature of energy security threats faced by the United States. Next it will survey the initial discourse on the developing the SPR, chronicling the choice to build a government reserve and highlighting the importance of market power and economic vulnerability. Finally, a discussion of more recent SPR policy debates illustrates the continued prominence of these concepts and a continued U.S. commitment to their resource-intensive stockpiling model. The conclusion will summarize this project's explanation of U.S. stockpiling policy.

Explanatory Factors

Table 2.4 presents a stylized model of oil stockpiling behavior driven by two explanatory factors: market power and the nature of threat that a nation faces. This section will explain why the market power of the U.S. Strategic Petroleum Reserve is

extraordinary and why economic vulnerability concerns are paramount for the United States. Objective facts are presented to illustrate that the United States should be coded as a country in the top left quadrant of table 2.4. The way in which policymakers have interpreted these concepts is discussed in the subsequent sections.

Market Power

The market power of a national oil stockpile can be defined as its ability to independently impact the world oil price or play a preponderant role in an IEA collective action to impact the world oil price. This capability is determined by both its inventory and the rate at which it can release barrels into the market. Countries with substantial national oil stockpiles are critical to the success of IEA collective actions to mitigate oil supply crises. These nations also possess the capability to balance the world market unilaterally in some cases. The U.S. Strategic Petroleum Reserve possesses immense market power. As discussed in the theory chapter, the SPR holds around 700 million barrels and can be drawn down at a rate of 4.4 million barrels per day for 90 days and at a reduced rate for much longer. The inventory could replace oil output of Iran for close to six months and the drawdown rate is larger than the daily oil output of all but four major crude producers.[70] In its current configuration, the SPR is a uniquely powerful energy security asset, whose capabilities are only rivaled by Japan's program.

Clearly, policymakers could not precisely quantify the market power of the SPR before it was built. That said, the requisite scale of any American stockpile was always evident. Two measures which were available during the early debate on the SPR make clear that any reserve meeting minimum U.S. requirements would necessarily wield

[70] According to EIA, Iran produced around 4 million barrels per day in 2016. The top four crude oil producers in 2016 were Russia, Saudi Arabia, the United States, and Iraq.

immense market power: days of oil import cover and total petroleum consumption. The United States signed the International Energy Program treaty in 1974 which founded the IEA and envisaged that all member states would hold stocks equivalent to 90 days of net imports. In 1973, U.S. net imports of petroleum products totaled 6.025 million barrels per day, which would imply an SPR of 542.25 million barrels. Based on the requirement that the United States signed onto, its strategic stock volumes would need to be substantial. Decision makers and analysts focused on SPR policy at the time knew that whatever asset the U.S. developed, it would be enormous.

The United States has always consumed more oil than any other IEA member. In 1984, the first year for which data are widely available, U.S. oil consumption totaled 15.7 million barrels per day, more than three times that of Japan, the next most prolific oil consumer. In fact, American consumption represented about half of the total consumption in IEA countries in the 1970's and 1980's. IEA collective actions require that members contribute oil to the market based on the share of total IEA consumption that they represent. This implies that in an IEA coordinated release, the United States would be responsible for about half of the total volume supplied. Given this notional requirement, it was clear that the SPR would need to possess substantial drawdown capability to meet its international obligations. Although the exact drawdown rate of the reserve, which is a function of design specifications, was not finalized until the 1980's, the original SPR plan in 1976 called for an SPR drawdown rate of 3.3 million barrels per day.[71] At the time, this rate was larger than the oil production of every country in the world, except for the United States, Saudi Arabia, and the Soviet Union.

[71] FEA, 1976.

The United States has always occupied a unique role in the world oil market, insofar as it always been a major producer and consumer. Even before the SPR was built, it was evident that an American strategic oil reserve would need to need to be a massive asset to match the scale of the nation's petroleum flows. This section has made clear that the market power of the U.S. SPR is uniquely large and that this requisite scale has always been evident. Based on the scale of American consumption and net imports, the reserve was always going to possess the capability to materially impact the global oil market. This treatment of the SPR's market power establishes, as a baseline, that this concept has always had the *potential* to factor into U.S. oil stockpiling decisions. It does not, however, establish that this concept drove U.S. policy. To make this case, the analysis of the discourse on establishing the SPR will show that, not only was market power a prominent concept, but that policymakers and analysts embraced market power in their deliberations on a government-intensive stockpiling strategy.

Economic Vulnerability

This dissertation argues that the second dimension that drives oil stockpiling policy is the nature of the energy security threat that a nation faces. For the United States, the potential economic impact of an oil price shock represents the primary source of energy vulnerability. This section will outline the major reasons that economic vulnerability is a more significant issue than physical access to oil: secure imports, substantial indigenous oil production, and acute, demonstrated economic vulnerability to the impact of oil shocks. In the contemporary U.S. dialogue on energy security, it stands as a forgone conclusion that the nation participates in a globalized oil market and that any disruption of oil supplies will be transmitted to U.S. consumers through the price

mechanism. Although access concerns feature prominently in the U.S. reaction to the 1973 Arab oil embargo, evidence suggests that the primary impact of this crisis was economic in nature. As was the case in the preceding discussion of market power, this section will not address how policymakers' understanding of economic vulnerability evolved and shaped SPR policy, rather it will make clear the empirical reality that physical access to oil is not a major threat for the U.S. and that this was the case when the SPR was formed.

Access to oil can be compromised by a transportation interruption, a supply crisis in a producer country, or a deliberate embargo.[72] None of these access threats constitute major vulnerabilities for the United States. Other than Canadian pipeline shipments, American oil imports arrive via marine transportation. The Canadian barrels, which represent the largest source of U.S. imports by far, are secure both because the United States maintains a collegial relationship with Canada and because the North American logistical system prevents a substantial amount of Canadian production from reaching other markets. The waterborne barrels are not at risk because of the dominant capability of the U.S. Navy. Based on the current global constellation of naval power, it would be virtually impossible to impose a blockade on American oil imports or completely cut off U.S. maritime oil imports.[73] In the context of a liquid and globalized oil market, a supply disruption would result in a price increase but not a curtailment of physical shipments (except to the extent that prices moderated demand). The same holds true for a targeted embargo on the United States, which would not work unless every participant in the

[72] Typology of interruptions developed in Glaser, 2013.
[73] Posen, 2008; Hughes and Long, 2014.

global oil market decided to stop selling the country oil at the same time. To summarize, access to imported oil is incredibly secure for the United States.

Not only are American imports extremely secure, but the impact of an import cutoff would be less severe in the United States because of substantial U.S. oil production and refining capacity. Physical access to oil matters less in countries with indigenous oil production. In countries which import most of their crude oil, a curtailment in foreign oil supply can bring a society to a standstill, compromise a nation's military capability, and leave it open to coercion. Domestic production attenuates these problems. Curtailed global supply, reduced imports, and higher product prices can harm a nation's prosperity (sometimes severely), but they will not cause a society to cease to function. The United States has been a major producer of crude oil throughout the petroleum age. In the extremely unlikely event that oil imports were completely cut off, the nation would be able to meet a large portion of its basic needs with domestic production. A supply curtailment of this nature would be potentially devastating for American prosperity, but it would not have the same impact as an import cut off for a country without indigenous supply sources.

Although physical supply access in not a major concern for the United States, the American economy is extremely sensitive to fluctuations in the oil price. Oil price shocks reduce output, discourage investment, exacerbate inflation, reduce disposable income and consumption, and cause frictions in the economy associated with the reallocation of resources. They also lead to substantial wealth transfers to oil-exporting countries. These mechanisms are particularly severe in the United States, which consumes more oil than any other OECD country and has relatively oil-intensive patterns

of transportation and economic output. Nine out of ten Post-World-War-II recessions in the United States have been preceded by a sharp rise in the price of oil. Energy economists have demonstrated that this relationship holds in a variety of circumstances in the United States.[74] A full treatment of this topic is beyond the scope of this dissertation. In terms of the model advanced here, the key takeaway is that energy security is primarily a prosperity issue for the United States and a severe one.

The relative importance of economic vulnerability compared access vulnerability is clear based on current conditions, but has this always been the case? The answer is, for the most part, yes. The 1973 Arab oil embargo represents the closest thing that the United States has ever experienced to oil access crisis. Imports did decrease during the embargo and prices skyrocketed. Further, the global spot market was not yet fully developed, which made the decision by Arab OPEC producers to embargo specific countries a more potent strategy. However, the access threat proved to be transitory in nature. The local supply shortages and gas lines that made the 1973 oil shock a "crisis" were mostly a function of inefficiencies created by government price and allocation controls coupled with hysteria brought on by uncertainty about the duration of the embargo.[75] The country was never going to run out of oil: in 1973 the United States produced 9.2 million barrels of oil per day and imported 3.2 million barrels per day.[76] American crude oil imports did not surpass domestic production until 1994, when the global spot market was well institutionalized and market power in the upstream sector was far less concentrated. Further, the economic impact of the 1973 oil shock was

[74] The seminal study in this area in Hamilton, 1983. The literature is fully reviewed in Vincent, 2016.
[75] For a discussion of the 1973 oil shock see Yergin, 1991; Beaubouef, 2007, and Duffield, 2015.
[76] EIA, 2017a.

severe. The United States suffered its largest economic downturn since the great depression. Even when oil access concerns were most prominent in the American conversation on energy issues, American energy security was primarily a prosperity issue. The experience of the 1979 Iran crisis re-affirmed this: access concerns, exacerbated by price and allocation controls, drove initial the initial panic, but the long-lasting damage came in the form of reduced economic output.

Economic vulnerability to oil price shocks is more of a threat to the United States than the potential for oil access to be compromised. The United States Navy makes a true supply cutoff virtually impossible, the country produces a large portion of its consumption, and most supply outages would be transmitted through the global market. Oil price shocks hold the potential to materially harm the U.S. economy and this has long been the case. However, the centrality of prosperity issues to American energy security was not immediately clear to policy makers and analysts. The following sections will illustrate how this concept moved to the center of American debates on energy policy as policymakers climbed the energy market learning curve. It will show that this this threat profile, coupled with the market power that a U.S. oil stockpile would provide, led to the decision to pursue an incredibly resource-intensive energy security strategy.

Government-Intensive Oil Stockpiling in the United States

This dissertation makes the case that the explanatory factors outlined above drove the American approach to strategic oil storage. The country clearly possesses enormous market power and it faces primarily economic energy security threats; so it chose a government-intensive approach. These facts alone, however, do not validate this dissertation's explanatory model. To support the claims advanced here, the process

through which the United States chose their approach must be unpacked. The following analysis will show how and why American decision makers decided to expend the resources for a government-owned SPR. It surveys the policy landscape in which the SPR was first debated, highlighting how a consensus on the need for oil stockpiling developed and why government ownership of the strategic oil stocks was deemed necessary, even upon re-examination in the early days of the SPR program. The case explains how market power has always played a key role in SPR debates and how SPR decisions quickly came to be viewed in primarily economic terms. The early and continued prominence of these concepts suggests that they are the drivers of energy security policy in the United States.

The Arab Oil Embargo and the Initial Strategic Oil Storage Debate: 1973-1976

The development of the Strategic Petroleum Reserve is rooted in the United States' response to the 1973 oil crisis. In October, 1973 Arab members of OPEC decreased production and banned sales of oil shipments to the United States and to the Netherlands. The "Arab oil embargo" and its impacts over the following six months would influence the contours of energy policy debates for the better part of a decade. This crisis represented the first major supply shortage that the United States could not address with domestic spare production capacity. American petroleum imports dropped by close to 2 million barrels per day and the prices bid for globally traded cargoes skyrocketed.[77] President Nixon extended oil price controls, which lead to a disjuncture between domestic and international oil prices and ultimately required the imposition of oil allocation controls. These measures exacerbated the regional shortages.[78] Escalating

[77] NPC, 1974; Yergin, 1991.
[78] Ikenberry, 1988.

retail gasoline prices, shortages at filling stations, gas lines, and fighting over allocation all contributed to a sense of national crisis.

The United States first addressed the oil crisis on the international stage. Henry Kissinger, by no means an energy expert, sought to maintain solidarity among oil-consuming nations and establish a consumer cartel as a counterweight to OPEC.[79] Kissinger quickly realized that the leverage which oil afforded OPEC nations could upend the world order. In a meeting with President Ford he was particularly emphatic about this:

> *"On the energy situation, we have to find a way to break the cartel. We can't do it without cooperation with other consumer. It is intolerable that countries of 40 million can blackmail 800 million people in the industrial world."*[80]

To act as a counterbalance to OPEC's newfound power, Kissinger maintained that Western solidarity was critical. Throughout the negotiations that led to the founding of the IEA he hammered this point, arguing at a Camp David meeting of ministers that energy bilateralism could "destroy the cohesion of the Western world."[81]

Forging cooperative approach to the energy crisis entailed challenged. While the embargo adversely impacted all OECD nations, the April 1974 Washington Energy Conference highlighted differences among importers on how to best address the crisis. Many European members favored a less aggressive stance vis-à-vis OPEC nations,

[79] Kissinger, 1982; Yergin, 1991.
[80] National Security Council, 1974.
[81] U.S. Department of State, 1974

preferring to negotiate their own deals with oil exporters. The International Energy Agreement, signed in September of that year, constituted a compromise outcome that demonstrated consumer solidarity, but focused primarily on resiliency. The treaty founded the IEA and mandated that member countries develop programs to withstand a 60-day cutoff in petroleum supplies using any combination of demand restraint, fuel switching, surge production, or oil stocks (either government or industry). The requirement would soon be expanded to 90 days. It also established the International Energy Program, in which members would share oil in the event of a crisis that curtailed any member's imports or total IEA imports by seven percent.[82]

In an ideal world, the IEA's sharing system would buttress the energy security of all member states. The United States recognized this possibility. In its 1974 *Project Independence* report, the Federal Energy Administration (FEA) argued that the most effective energy security strategy would be the use of strategic oil stock in concert with oil sharing among IEA members.[83] However, the ultimate efficacy of this program was far from assured. Because the oil market had yet to fully globalize and targeted embargoes were still viewed as a grave threat, early commentators highlighted the possibility of attrition under certain scenarios. If hostile producers successfully embargoed an individual IEA members, other members would be expected to lend them volumes. In extreme cases, replacing the lost imports of a member under duress could begin to significantly reduce buffer stocks in other IEA countries, endangering their energy security. After a point, sharing strategic stocks could prove more costly than

[82]Krapels, 1980.
[83] FEA, 1974.

leaving the organization.[84] Further, the sovereignty costs associated with being compelled to comply with policy directives from the IEA secretariat, such as forced demand restraint, could prove to be too much for member countries, all of which were democracies.[85] In this uncertain international context, the efficacy of domestic energy security measures was critical.

Officials put forth numerous ideas in response to the first oil crisis – the SPR was one of the very few widely agreed upon by both American political parties. The Ford Administration submitted its Energy Independence Act to Congress in 1975, which called for a phased removal of price controls, increased production from naval oil fields, an oil import tariff, a relaxation of environmental laws, a synthetic fuels program, increased use of coal in the power sector, as well as the development of the SPR. The democratically-controlled Congress rejected most of these ideas. The Energy Policy and Conservation Act (EPCA), passed in 1975, established the SPR as well as U.S. Corporate Average Fuel Economy Standards and restrictions on crude oil exports.[86]

Notably absent were Ford Administration provisions which would have forced consumers to digest more of the impact global price fluctuations through the removal of price controls. Unlike many IEA members, the U.S. did not legislate a draconian system of emergency conservation measures to employ in a crisis. EPCA also spared industry from being forced to hold surplus production capacity.[87] These outcomes were partially the result of politicians' hesitancy to raise consumer fuel prices and partially the result of

[84] Krapels, 1980.
[85] Alm, Colglazier, and Kates-Garnick; 1981; Nye, Deese, and Alm, 1981.
[86] Beaubouef, 2007.
[87] This idea was raised by some analysts (see Newlon and Breckner 1975), but was rejected in the Project Independence Report because it would reduce overall domestic output.

a recognition that, in the American context, demand-side measures held the potential to cause severe economic harm. Unlike other IEA members, the United States enjoyed extremely low fuel prices throughout the post-World-War-II era. During much of this time, the country was a net petroleum exporter. This led to energy-intensive patters of mobility and economic output that the United States could not escape overnight. Compared to other developed oil importing countries, many of which had relatively high levels of fuel taxation and less-energy-intensive economies, forced emergency curtailment of fuel consumption would harm all sectors of the economy. The only policy tool that could address oil supply shortages and their resulting economic damage was a large strategic oil reserve.

Many of the basic features of the SPR fell in line with the recommendations of the National Petroleum Council (NPC), which was tasked by the Administration with developing a notional plan for the building, operation, and financing of the reserve.[88] EPCA established a crude oil reserve to be stored in salt caverns in the Gulf Coast and connected to the extant logistical system, which was to reach an inventory of 500 million barrels by 1982. The legislation mandated that the SPR would be government-owned and gave the FEA budget authority of $1.1 billion dollars to initiate the program.[89] The initial architecture of the SPR, which remains in place today, is notable for both its physical scale and the extent of the nation's resource commitment.

EPCA also left the door open for developing an Industrial Petroleum Reserve (IPR). Many congressional leaders advocated for an IPR during the initial discussion or oil stockpiling in the United States as a means of defraying the costs of inventory

[88] NPC, 1974.
[89] Weimer, 1982; Beaubouef, 2007.

building. EPCA gave FEA discretionary authority to require importers to hold stocks equivalent to up to three percent of the previous year's imports and required the FEA to analyze the potential efficacy of an IPR in the initial SPR plan.[90] If fully implemented, this would have amounted to an industry reserve of around 185 million barrels, which would have counted towards the inventory goal of 500 million barrels.[91] In terms of validating the explanation of American oil stockpiling choices here, as well as this dissertation's underlying assumption government-owned oil stocks are viewed as a more effective energy security tool that private stocks, the dialogue focused on the initial proposal for industry storage yields important insights.

The industrial reserve concept owed much of its initial support to the fact that this approach to stockpiling was already in use in European countries and Japan. Many European nations established minimum stockholding requirements for industry after the 1956 Suez Crisis and the European Economic Community began mandating these obligations prior to the 1973 crisis.[92] This explains accommodations made for industry stocks in the original negotiations on establishing the IEA. Forcing firms to hold extra inventory was a far more tenable approach to strategic storage in countries where the government controlled the oil industry.[93] In countries such as France and Japan, national oil companies played a predominant role in the domestic oil sector and answered to the government. For these IEA members "industry" storage options still afforded national governments authority over their national oil stockpiles. The IPR model also faced

[90] Ibid.
[91] FEA, 1976.
[92] NPC, 1981.
[93] For an extended discussion of the role of firms in oil market governance, see Hughes, 2014. For a treatment of how these arrangements impacted oil stockpiling, see Krapels, 1980.

challenges in the United States associated with the complexity of the logistical system. The size of the American land mass, and the breadth of its petroleum sector and petroleum transit system, meant that the level of operating stocks needed to keep the system moving was substantial.[94] These issues impacted the conversation on building an American IPR, but larger issues associated with the efficacy and efficiency of a government-owned stockpile would prove decisive.

Industry came out strongly against an IPR in the 1974 NPC report *Petroleum Storage for National Security*. The report noted that strategic oil stocks did not represent a normal investment which could generate a return on capital. Once acquired, the IPR barrels might not ever be sold and, in the era of price controls, companies could be forced to sell them at a loss. Although American oil companies were not sympathetic figures in the wake of the 1973 oil crisis and gouging them might have even proved popular, NPC made the important point that this burden would take capital away from projects that would increase domestic production. The legislation's focus on oil importers, meant that the requirement would have differing impacts on firms, depending on the extent to which they participated in global petroleum trade. It granted the FEA Administrator the authority to grant exemptions if the mandate generated hardships or inequities. Implementing an IPR plan in the vast and diverse U.S. oil sector, they concluded, would require a massive administrative apparatus.[95]

The FEA spent a year evaluating the merits of an IPR following the passage of EPCA. They began the process by commissioning a feasibility study and formally soliciting comments from industry. The study made the potential difficulties of IPR

[94] Krapels, 1980.
[95] NPC, 1974.

implementation clear and industry responses were broadly hostile to the idea. The 1976 *Strategic Petroleum Reserve Plan* concluded that the United States should not develop an IPR. FEA concluded that because industry would need to build new storage capacity to accommodate new barrels and because companies would likely file lawsuits to fight the requirement; this option could slow down the development of an oil stockpile.[96] Rapid initiation of a stockpiling program was especially important, given the political imperative to respond to the vulnerability laid bare by the oil crisis. The report also notes that developing a centralized SPR would be a more efficient and effective means of achieving energy security because of the economies of scale that centralized storage would provide. It framed these benefits in economic terms, making the case that "An IPR is likely to result in higher costs to the national economy as a whole."[97]

This rationale was part of a broader recognition that a strategic oil stockpile was a public good to defend the nation. It followed that developing such an asset was a function for the government. NPC was most forthright about this issue, arguing that role of the SPR was "analogous to a major weapons system" and that government control of the stockpile was necessary for it to be effective.[98] The disjuncture between private incentives and the public good that could arise in an oil supply crisis drove this line of reasoning. Firms do not factor social costs and benefits into their inventory decisions. Further, when companies face uncertainty about the nature and duration of a supply interruption, they make decisions based on a strictly circumscribed analysis of risks and rewards.[99] In many cases, this could result in firms hoarding their inventories during a

[96] FEA, 1976.
[97] Ibid, p. 134.
[98] NPC, 1975, p. 20.
[99] Nye, Deese, and Alm, 1981; Bohi and Montgomery, 1982.

crisis in anticipation of future prices escalations, as was the case in the 1973 crisis.[100] At the time of the SPR debate, allocation and price controls accentuated this threat because of the added uncertainty that they introduced. In the event of a supply outage, companies that anticipated an easing of price or allocation controls in the future would likely be inclined to hold their inventory.[101] All of this pointed to the need for government ownership of the nation's oil stockpile in the United States, which would need an effective stockpiling program to stabilize the global market.

Industry's objections to the IPR concept influenced the U.S. decision to develop a government-held reserve, but not in the direct way that open economy politics assessments of international politics would predict. Industry played more of an information-provision role than an aggressive lobbying role in the early discourse on the SPR. Their input framed policy makers' understanding of how and why a government-owned reserve would be more effective. Distribution impacts were secondary. The problems associated with administering an IPR, developing industry stocks in the U.S. logistical system, and taking away capital from upstream projects would hamper the successful implementation of an industry-based stockpiling system, no matter how such a policy impacted individual companies. Under the crisis circumstances of the time, policy makers focused on system efficacy more than distributional consequences, especially for the much-maligned oil industry. The oil sector helped clarify the pros and cons of a various stockpiling strategies, but they did not decisively impact the U.S. course of action.

[100] FEA, 1974.
[101] Newlon and Breckner, 1975.

The 1973 oil crisis forced the United States to confront a new threat to its prosperity. Decision makers needed a tool to respond strongly to future interruptions of petroleum supply. It became clear that restructuring supply and demand patterns would not be feasible in the short term and that the nation would continue to be dependent on oil imports. The United States opted to build a massive stockpile of crude oil which would empower it to stabilize prices in a crisis. In the discourse that lead to this outcome, U.S. decision makers considered and rejected the idea of mandating industry participation in the development of an oil stockpile. However, as the challenges of building a government reserve became clear, proposals for an IPR would resurface.

Slow Progress, another Oil Crisis, and the IPR Reconsidered: 1977-1985

Developing the world's largest oil stockpile proved far more difficult in practice than government planners had envisioned. With the economy still reeling from the impact of the 1973 oil shock, a sense of urgency surrounded building the SPR. The FEA, which became the U.S. Department of Energy (DOE) in 1977, met this urgency with a parade of setbacks. To put the disjuncture between the envisioned and actual pace of SPR development into perspective, EPCA called for the SPR's 500 million barrels in the SPR's caverns by 1982; in 1980 the reserve's inventory stood at only 108 million barrels.[102] A combination of physical constraints, budgetary pressure, and concerns about the oil market impact of the SPR fill caused numerous delays. The 1979 Iranian oil supply outage heightened concerns about the status of the reserve and revealed new realities about the emerging global oil market. During this period, scholars and practitioners re-examined the concept of an IPR as a means of hastening American oil

[102] EIA, 2017c.

stockpiling. In line with the expectations of this dissertation, the continued discourse on the SPR, in which market power and economic energy security concerns featured prominently, ultimately served to cement the United States' government-intensive approach to oil stockpiling.

The Carter Administration established ambitious timetables for SPR development and set about acquiring sites in Texas and Louisiana. Local politics, environmental concerns, and management problems hampered this process. After procuring its initial "Early Storage Reserve" sites from commercial entities, DOE could only develop capacity as fast as it could mine salt caverns.[103] In addition to problems associated with developing SPR facilities, DOE faced considerable barriers to acquiring crude oil for the SPR in the early years of the program. The Iranian oil supply crisis, which removed close to five million barrels per day of production from the world market between 1978 and 1979, caused the United States to stop filling the reserve in the spring of 1979. With oil prices rising, fuel shortages gripping the nation, and commercial operators rapidly building up inventories in anticipation of a prolonged crisis, the Carter Administration did not want to exacerbate the supply situation by taking barrels off of the market. Adding to this pressure were concerns that Saudi Arabia, who opposed the development of the SPR, would throttle back their production in retaliation.[104]

During these early years of the program, concerns mounted about the cost of developing an oil stockpile. The Government Accountability Office (GAO) first raised this issue in 1977. Citing concerns about the program's costs, they argued that SPR

[103] Beaubouef, 2007. EPCA limited the ESR caverns to a volume of 150 million barrels. DOE was responsible for mining the remaining caverns.
[104] Plummer, 1982; Weimer, 1982.

development should be financed through a tax on gasoline or imported oil.[105] This option went nowhere, as it would have increased consumer fuel costs. Legislators also proposed alternative financing vehicles, such as oil-backed bonds which would be repaid when the reserve was drawn down.[106] Much of the back-and-forth about blunting the fiscal impact of the SPR involved proposals that would have kept the basic government ownership structure of the reserve intact. This is important, because many legislators seeking alternative funding sources for the reserve still supported the concept of a shared national asset to defend U.S. energy security.

Some proposals did advocate for more industry involvement as a means of defraying costs and speeding up the pace of SPR development. DOE's early ineptitude at stockpiling, coupled with the renewed urgency surrounding energy security driven by the 1979 Iran crisis, revived interest in the IPR concept. Paradoxically, the Iran crisis also demonstrated problems with relying on industry to defend the national economy in the face of an oil shock. Much of the 1979 price escalation derived from panic purchases on the spot market that went into inventory. Individual firms hoarded oil in the face of uncertainty, basing their decisions on short-term profits as opposed to the long-term health of the national economy.[107] The NPC made this clear:

> "*In the event of an oil supply disruption…there is a natural tendency to maintain control of scarce resources to maximize return on investments and/or to ensure the continuity of operations for the expected duration of the shortage."*[108]

[105] GAO, 1977.
[106] Beaubouef, 2007.
[107] Alm, Colglazier, and Kates-Garnick, 1981; Plummer 1982; Plummer, 1984.
[108] NPC, 1981.

Without draconian regulation, private actors could not be expected to defend the nation from oil shocks. The Iran crisis made clear that any American approach to oil stockpiling would require government control to be effective.

In response to growing pressure to speed of development of the SPR, DOE evaluated three approaches to increasing industry involvement in oil stockpiling in 1980. First, the department reconsidered the regulatory approach outlined in EPCA of mandatory industry storage. In addition to the industry objections and practical difficulties that persisted when this option was initially proposed, the Iran crisis made clear that industry mandates would require impractical rules for when the inventories would be drawn down that would be difficult to implement in practice. Officials warned that companies would likely classify their working stocks as strategic stocks, without adding any inventory. DOE also examined a system of tax credits and subsidies to incentivize private storage. Not only would this approach have entailed only limited fiscal benefits, but the risk existed that firms could game the system. Further, it had the potential political cost of looking like a giveaway to industry at a time when oil companies were reviled by the general public. Finally, DOE evaluated the merits of establishing a quasi-public oil storage corporation modeled after the German stockpiling agency. This option would have been competitively neutral and potentially efficient, but it would have required new legislation, further slowing the process of SPR development.[109] Critically, the more control over the inventory that a proposal would allow, the more traction that it attained in policy circles.

[109] These proposals were evaluated in a 1980 DOE report. They are discussed in Nye, Deese, and Alm, 1981; Plummer, 1982; Sweetnam, 1982; Plummer, 1984; and Horwich and Weimer, 1984.

Ultimately the United States did not pursue any of these options. After a long internal debate about SPR funding that included the consideration of IPR options, the Reagan Administration solved the SPR funding issue by spending public funds on the barrels, but not including the purchases in the budget totals of the U.S. Government.[110] This fiscal sleight of hand, which entailed setting up a separate SPR petroleum account and selling a separate tranche of government bonds to cover oil acquisition, kept SPR purchases from adding to a ballooning deficit. More importantly, it signaled a willingness of U.S. officials to prioritize energy security. As the SPR's development continued, the government-owned model became institutionalized in the United States. The oil glut of the 1980's and resulting price crash reduced the pressure for rapid SPR development and lowered the cost of oil acquisition. SPR purchases were moved back onto the budget in 1985.[111] The following section illustrates that the key concepts in this dissertation's explanatory model played a preponderant role in driving this decision.

Market Power and Economic Vulnerability in the Early SPR Debates

The first section of this case evaluation establishes that the U.S. Strategic Petroleum Reserve possesses immense market power and that United States faces primarily economic threats to its energy security. It also suggests that these facts were evident during the initial debates on the SPR. The subsequent sections chronicle the U.S. decision to pursue a government-intensive oil stockpiling strategy in which the need for an effective energy security asset outweighed concerns over the requisite resource commitment. As American policy makers' understanding of energy security grew in sophistication, these concepts came to frame the discussion of the SPR. Decision makers

[110] Beauboeuf, 2007.
[111] Ibid.

realized that a critical element of the SPR's efficacy would be its ability to moderate price increases in the global market. They also framed the value of the SPR in terms of averted economic losses. This section discusses the role that these concepts played in the early discourse on the SPR.

In analyzing the American response to the oil crises of the 1970's, observers must recognize that the many of the concepts that the energy policy community now takes for granted were only beginning to take shape. Responding to the first oil crisis entailed climbing an energy learning curve for analysts and public officials alike.[112] Three baseline concepts emerged which were particularly relevant to the development of the SPR. First, the oil market was in the process of globalizing in the 1970's and recognition of this was just emerging. After decades during which oil output was controlled by a handful of companies, new sources of output were coming online and the international spot market was developing.[113] The Nixon Administration's 1974 *Project Independence Report*, which envisaged freeing the United States of petroleum imports by 1980, acknowledged the importance of the global oil price mechanism and initially outlined the concept of a stock release balancing the world market through global petroleum trade. The report also rejected an energy security strategy based on cultivating bilateral relationships with friendly producers, noting that "oil is a commodity that can be bought

[112] The concept of social learning as it impacts the policy process is best explicated by Hall (1993). Social learning doubtlessly played a role in the development of the American response to the 1973 oil crisis. U.S. energy policy clearly underwent experience the type of "paradigm shift" about which Hall writes. While the development of the SPR highlights some of these concepts, this theory does not explain differences between national stockpiling trajectories. All Western importing nations experienced a paradigm shift in the 1970's, as did Eastern Bloc oil importers in the 1990's. All of these nations socially learned, but they adopted variegated approaches to oil stockpiling. Conceptualizing oil stockpiling as state behavior and assessing how capabilities and threats impacted this behavior offers a more comprehensive explanation of energy security outcomes.

[113] Gholz and Press, 2010; Hughes and Long, 2014.

by the highest bidder," which meant that energy bilateralism would ultimately prove ineffective.[114] This reflects an early appreciation for the interdependence that came with participation in world oil trade.

The concept of a global oil market was becoming clear, but coming to terms with this difficult for some policy makers. It took years for legislators to remove crude oil export restrictions[115] and domestic price controls designed to de-link the United States from the world market. The government employed these counter-productive price regulation to shield U.S. consumers (who had never experienced petroleum scarcity) from the impact of oil shocks. Price controls domestically produced oil output simultaneously subsidized consumption and discouraged production. This sent the wrong market signals to both domestic oil firms and American energy consumers. Price controls represented a core component of the fuel shortages of the 1970's and ultimately served to highlight the importance of global market forces. As long as the United States had to import barrels, it could not hide from the global market. The key takeaway here is that recognition of the fungibility of oil, the growing liquidity of the oil market, and the implications of the market for energy security, were concepts in play as opposed to bedrock assumptions in this early debate.[116] As they became clear, so did the importance of the SPR's market power.

During this period decision makers also learned the difference between dependence (the extent which the United States relies on other countries for oil) and vulnerability (the extent to which fluctuations in global oil flows harm the United States).

[114] FEA, 1974, p. 401.
[115] Crude oil exports were not fully liberalized until 2015.
[116] Plummer, 1982; Bordoff, 2016.

Dependence evoked strident reactions from citizens and legislators, but the simple existence of U.S. imports was not the core problem. Many of the early policies proposed in response to the oil supply crises focused on reducing dependence, which amounted to increasing domestic output and reducing imports. These measures often failed to address vulnerability, which would persist regardless of import levels given U.S. participation in a global market.[117] To truly defend the country from harm related to oil supply, the United States needed to address vulnerability. In the decade following the Arab Oil Embargo, vulnerability slowly eclipsed dependence as the focus of U.S. energy security policy, as the country adopted a more market-based approach to energy governance.[118] This evolution is critical to understanding the role that the SPR's market power and economic value played in the decision to build an expensive, government-owned strategic reserve.

Lastly and related, the distinction between short-term and long-term energy policies was just taking shape. Several goals developed in response to the oil supply crisis aimed to reshape consumption patterns and develop new energy sources. These measures would take years to implement and would fail to quickly address the immediate vulnerability that the nation faced.[119] Contemporary observers take the short-term inelasticity of oil supply and demand for granted, but these attributes were not perfectly understood in the immediate aftermath of the oil supply crisis. The timeline for achieving anything close to "energy independence" forced policy makers to focus on measures that would address supply crises on the near horizon. Short-term vulnerability

[117] NPC, 1981; Nye, Deese, and Alm; 1981.
[118] Weimer, 1982.
[119] NPC, 1974; Weimer, 1982.

to oil shocks meant that the United States needed a deployable energy security asset that operated within the confines of the extant petroleum-import-based economy of the time.

In the context of policy makers and analysts awakening to the realities of U.S. vulnerability in a global oil market, the importance of market power was becoming clear. The first acknowledgement of market power in the context of energy security decision making came in the early discussions of the IEA. In its initial conceptualization of a strong consumer organization, the United States sought to develop monopsony power, which can be defined as the ability of a preponderate buyer or group of buyers to impact a given market. An early Ford Administration memo on the topic makes this logic clear:

> *"Moreover, by controlling some 80 to 90 percent of world demand in a crisis, we should be able to moderate greatly the price explosion of the sort which occurred during the last embargo."*[120]

This early desire to establish a monopsony supports a key component of this dissertation's explanatory model: that the ability to influence the world market was seen as a critical energy security goal of the United States.

The importance of market power also underpinned early debates about developing a national oil stockpile. The extraordinary market power of a planned strategic reserve played an important role in the development of SPR policy. Any strategic oil stockpile developed in the United States would need to be big enough to defend the nation not just from import shortages, but also from price shocks in the global market. The *Project Independence Report* first discussed the importance of an oil stockpile as a defense against price increases. In its analysis of U.S. participation in the International Energy

[120] International Energy Review Group, 1974.

Program, it noted the potential for the United States to benefit from cooperation with other nations in stabilizing the world market. Because the U.S. stockpile releases could cause international cargoes to be diverted, the reserve would have a beneficial impact on the international petroleum flows, which might warrant a large reserve:

> "*Given this dynamic interaction between the United States stockpile and the world market, the United States may be motivated to acquire increasingly larger stockpiles to protect itself."*[121]

This illustrates that from the outset of the American response to the 1973 oil crisis, there existed an awareness that the ability to impact world prices was an important function of an oil stockpile. The market power of the SPR would continue to play a role in discussions of how the reserve would operate in practice.

After EPCA became law and FEA began building the SPR, the goal of being able to impact the global market was operationalized. Much of the original *SPR Plan* focused on minimizing the adverse oil market impacts of oil acquisition, which represents an acknowledgment of the impact that a massive reserve could have on the oil price. The plan also spoke directly to the ability to avert price escalation in its discussion of SPR drawdown policy, contending that minimizing an oil shortfall in the early stages of a supply interruption, "would help prevent panic buying of spot oil at highly inflated prices on the world market."[122] This attention to world prices is striking considering that the United States had yet to jettison price controls. The United States recognized that its influence on the world oil prices was important even before the country ceased its futile attempts to de-link from the world oil market,

[121] FEA, 1974, p.389.
[122] FEA, 1976, p. 160.

Market power persisted as a consideration in planning the reserve's drawdown and distribution policies. In 1979, DOE set about developing a release policy and distribution procedures for the SPR which went beyond the broad contours outlined in ECPA. Some favored a predictable trigger mechanism while others supported more presidential discretion. This debate weighed a trigger's ability to reduce market uncertainty against the flexibility that vague language would give the President.[123] Both of these sides were framed in terms of the impact that the SPR would have on the market. This issue was not resolved until 1982, when the Reagan Administration transmitted an amendment to the SPR plan to Congress which called for a competitive auction process for the sale of SPR oil and specifically rejected a formal trigger mechanism.[124] In committing to this this approach to SPR sales, the United States solidified a market-based approach to oil supply security. Paradoxically, a government-controlled oil stockpile anchored this strategy.

In terms of validating this dissertation's explanation of oil stockpiling in the United States, the most important aspect of this discussion of market power was that it was unique to the United States. In the early years of the IEA, only the United States could expect to impact the world market with its reserve. Other member counties developed their oil stockpiles based on adherence to the IEA's 90-day requirement and EEC guidelines. In smaller countries, a 90-day stockpile would cover short-term domestic needs, but it would not impact the world oil balance and the oil price. Unlike smaller importers, the United States focused on potential disruptions, their market impact, and what capabilities a U.S. reserve would need to attain to address these

[123] Weimer, 1982.
[124] Beaubouef, 2007.

vulnerabilities.[125] These considerations included price; an early comparative analysis of oil stockpiling in IEA countries explains this clearly:

> "*If it had its projected billion-barrel SPR, the United States might feel it could afford to use stocks to deal with unilateral price increases; but countries with small emergency reserves would be undermining their security against sudden sharp supply disruptions by using their stocks as a weapon against price increases.*"[126]

The massive scale of an American oil stockpile would give it the ability to impact the world oil price, which heightened the importance of having an effective oil stockpiling program. Lawmakers recognized this and mustered the resources to develop a government-owned reserve.

The development of a public stockpile, the utility of which was largely derived from the market power that it conferred, was rooted in responding to economic vulnerability. As discussed in the first section, the primary energy security threats to the United States are economic and this has always been the case. More importantly in terms of the explanatory model advanced here, the early discourse on the SPR came to be dominated by economic considerations. To be sure, national security imperatives and oil access concerns played a large role in drawing attention to the issue of energy security and securing the passage of EPCA. The reduced foreign policy flexibility based on the imperative of maintaining oil flows and newfound leverage enjoyed by OPEC constitute real strategic problems. However, the SPR program moved forward because of its

[125] Krapels, 1980.
[126] Ibid, p. 113.

justification on economic grounds.[127] The primacy of cost-benefit analysis in informing decisions on the SPR's size and drawdown capability from the very beginning of the program suggests that addressing economic vulnerability has always driven U.S. stockpiling policy.

This does not mean that the United States did not consider military and national security considerations in determining SPR policy. Rather, the country ultimately determined that its warfighting capability, even under the direst circumstances, would not be fundamentally compromised by curtailed oil access. The National Security Council convened a Special Coordinating Committee in 1978 to evaluate SPR size options. In assessing whether the reserve should ultimately hold 750 million or 1 billion barrels, the group made the following assessment of military considerations:

> *"No participant contended that [extreme] supply interruptions would endanger U.S. National Security if the SPR were limited to 750 [million barrels] of USG-held oil. In such circumstances, vital U.S. military and economic requirements could be met by allocation measures. Rather, the issue was to be judged to be economic and political: how much popular inconvenience and lost production could be avoided by the extra 250 [million barrels]?"*[128]

The United States critically evaluated the national security impact of various SPR configurations, but these considerations were secondary – not because national security drivers mattered less than economic drivers, but because the United States military complex would be energy secure under all circumstances. This distinction is important in

[127] Weimer, 1982.
[128] Special Coordinating Committee, 1978.

terms of this dissertation's explanatory model, which differentiates countries in terms of the primary threat their national oil stockpiles address. This project does not argue that military considerations were subordinate to economic considerations in the United States – only that economic threats constituted the primary impetus for developing an expansive, government-owned SPR.

Refining SPR policy became a discussion about economic vulnerability. EPCA initially called for a 500 million barrel reserve to be developed, but the legislation tasked FEA with conducting a cost-benefit analysis of smaller and larger reserve options. The framework for evaluating SPR benefits in this report examined the likelihood of supply interruptions, the economic impact of those supply interruptions, and the efficacy of various reserve sizes in averting these economic losses. The report validated the 500MMB size directive based on its expected economic benefits.[129] More importantly, it established the paradigm for analyzing SPR parameters that would inform U.S. government oil stockpiling choices for decades. In the decade following the Arab oil embargo, academics and practitioners authored dozens of SPR "size studies" in an effort to inform the trajectory of SPR development.[130] These analyses grew in sophistication, but the fundamental premise that the SPR's value derived from the GDP loss that it could avert was ubiquitous.

The economic benefits of an oil stockpile emerged as the fulcrum of early SPR debates. When the trajectory of the SPR was questioned following the Iran crisis, DOE employed a dynamic programming model to solidify support for the Reagan

[129] FEA, 1976.
[130] Early size studies were listed and reviewed in NPC, 1981.

Administration's expansion of the reserve.[131] SPR policy was contentious, but the contention came in the form of disagreements about the scale and nature of economic benefits, as opposed to the economic framework for viewing the value of the SPR. Much of the internal administration deliberations in the early 1980's came in the form of arguments between DOE and OMB about the appropriate economic assumptions for SPR size analysis.[132] The primacy of cost-benefit analysis in the debate over the SPR supports the conclusion that economic vulnerability quickly eclipsed access concerns in the United States and that this vulnerability drove U.S. oil stockpiling policy.

The distinction between these access threats and economic threats became more explicit as the SPR debate matured. Not only was the primacy of economic vulnerability becoming the most important consideration in SPR policy, but some argued that lingering considerations related to access would hinder optimal use of the reserve. To address this issue, analysts began to emphasize the importance of economic concerns over access concerns:

> *"While oil supplies for military operations and for essential security functions must represent the highest priority, the amounts required are not large unless defense needs are defined as mobilization for a large and protracted world conflict. Unless the shortage is extremely large or for political reasons the market is not allowed to work, the SPR would not be needed to offset physical supply shortages. The major purpose of the SPR is to reduce the price impacts from an oil supply interruption."*[133]

[131] Sweetnam, 1982.
[132] Weimer, 1982.
[133] Alm, 1984, p. 16.

In the face of obsolescing access concerns, the United States continued to pursue a resource-intensive approach to oil stockpiling driven by economic vulnerability and cost-benefit analysis. While policy makers and analysts did not discount the importance of physical access to oil, the ultimate justification for the SPR came from its ability to avert economic losses.

The early history of the SPR corresponded with the early history of the American dialogue on energy policy. As the reality of U.S. economic vulnerability in a global market took shape, so did the importance of the market power of the nation's oil stockpile and the economic losses that it could avert. After coming to terms with the futility of pursuing energy independence, the United States adopted a market-centered approach to energy security anchored by a strong, government-owned oil stockpile. This section has illustrated the prevalence of market power and economic vulnerability in the early debate on the SPR. After taking root in the 1970's and 1980's, the ability to influence the oil market and avert economic losses have undergirded all subsequent discourse on oil stockpiling in the United States.

An Economic Security Asset: SPR Policy from 1985 to Present

After the first decade of the SPR's existence, the question of how the United States would approach energy security was largely settled. Policy makers committed to the concept of a large government-owned oil stockpile to ensure energy security and eschewed industry mandates. Deviating from this path became increasingly difficult after the initial resource commitment. However, various policy issues arose in the decades following the SPR's establishment associated with use of the reserve, its size, and the implications of expanding U.S. oil output for the SPR program. Examination of these

debates affirms the importance of the SPR's market power, the centrality of economic vulnerability to American energy security, and support for a government-controlled reserve given the unique capabilities of the SPR.

To be clear, debates on the reserve have been few and far between in the last three decades. The SPR, and energy policy more generally, retreated from the center of public debates during the 1980's, a period of low oil prices. Off-budget financing and cheap oil allowed for rapid filling of the reserve, which reached its 500 million barrel goal in 1986 and expanded to 580 million barrels by the end of the decade. Some observers suggested that the world market's muted response to the decade's major oil supply crisis, the Iran-Iraq war, was due to an increasingly robust system of strategic stocks.[134] Even without the threat of an immediate energy crisis, the United States sustained its commitment to a government-owned oil stockpile.

The oil market tranquility enjoyed by the Reagan Administration abruptly ended in August, 1990 when Iraqi troops invaded Kuwait. The conflict and the oil market havoc that it caused briefly returned oil prices, energy security, and the SPR to the center of public debate. The combination of disrupted Kuwaiti output and sanctions placed on Iraq removed more than four million barrels of output from the world market and sent prices skyrocketing. Unlike the outages of the 1970's, this disruption took place in an extremely liquid and globalized market, which meant that news of the conflict translated into price escalations well before the market was short of barrels. The outage did not significantly impact physical supplies to the United States, due to a combination of diverting oil shipments on the water and record levels of industry inventories.

[134] McClure, 1988.

Throughout the remainder of 1990, Congressional leaders clamored for an SPR drawdown. The Bush Administration hesitated to release barrels in the absence of a physical supply shortage.[135] This restraint was driven by a strict reading of EPCA's release requirements (which still referenced an import interruption), a desire to work with Saudi Arabia to balance the market, and concern that the size of the supply outage could expand before the conflict was over.

In January, 1991 the SPR conducted a drawdown in collaboration with other IEA member countries that coincided with Operation Desert Storm. Oil prices quickly receded – analysts would argue for years about the extent to which the SPR release contributed to this price decrease.[136] The Gulf War drawdown, which many analysts would later describe as "too little, too late", served to support the SPR's economic raison d'être.[137] The 1990 crisis represented the first time that the United States experienced a major price spike without any notable physical shortage. The nation did not face gas lines, but the painful price escalations followed by a severe recession made American economic vulnerability clear. The authorities governing SPR use made it difficult for United States to effectively leverage the SPR's considerable market power and proactively address catastrophic price escalations in the global market.

The failure of the administration to promptly address this price escalation spurred congress to action. While the reserve had been justified in economic terms for years, the SPR's authorizing legislation was still written based on the energy crises of the 1970's in which price shocks coincided with import curtailments. Congress addressed this through

[135] Beaubouef, 2007.
[136] Ibid
[137] Goldwyn and Patron, 2013; Difiglio, 2014.

two different legislative adjustments to EPCA, which greatly broadened the President's authority to use the reserve. The EPCA amendments of 1990 specified that the SPR's limited drawdown authority could be drawn down to address domestic outages and that it could be used in advance of a crisis. The amendments also directed DOE to develop a plan to expand the reserve to one billion barrels.[138] A larger reserve would obviate concerns about exhausting the reserve's inventory that contributed to President Bush's hesitancy to use the reserve. It would also solidify the market power of the SPR, which had emerged as central to the reserve's value.

SPR provisions in the Energy Policy Act of 1992 completed the legislative institutionalization of the SPR as an economic security asset. The criteria for authorizing an SPR release were updated to explicitly include price and economic vulnerability. American law now defines a "severe supply interruption" as:

> *"A) an emergency situation exists and there is a significant reduction in supply which is of significant scope and duration;*
>
> *(B) a severe increase in the price of petroleum products has resulted from such emergency situation; and*
>
> *(C) such price increase is likely to cause a major adverse impact on the national economy."*[139]

As discussed in the preceding sections, the economic nature of the American energy vulnerability was clear very early on in the SPR debates. However, it took a crisis without a shortage to spur legislators to make this explicit. This does not mean that policy makers only realized the economic nature of U.S. vulnerability in 1992. Rather it

[138] Beaubouef, 2007.
[139] *Energy Policy and Conservation Act Amendments of 1990*, section 161(d).

signifies another step in policy makers' education in how the global oil market works. Oil shocks have always constituted an economic threat, but they had always been accompanied by the loss of physical barrels. The Gulf War crystalized the fact that an oil supply outage anywhere would cause a price increase everywhere and that participation in the global market meant that the United States would be vulnerable no matter how much oil it imported.

The oil market remained calm throughout the 1990's, which made for an uneventful decade in terms of SPR policy. Outside of two small sales to finance deficit reduction held by the Clinton Administration, the reserve's inventory remained relatively stable between 560 and 590 million barrels.[140] The 2000's began with a recognition that the oil market was tightening and that buttressing the SPR and the IEA stockpiling system would serve the national interest.[141] The Bush Administration called for an expansion of the SPR to 700 million barrels shortly after the September 11th terrorist attacks. To pay for this inventory increase, the administration implemented the royalty-in-kind program in which revenue owed to the government for federal Gulf of Mexico oil leases would be payed to the government in the form of barrels for the SPR. The United States acquired 162 million barrels of oil through this program, which increased the inventory to more than 700 million barrels.[142] Once again, a Republican President pursued a hawkish SPR policy by employing a fiscal sleight of hand. Unlike previous periods of SPR expansion, however, industry storage options received little attention. The United States was firmly committed to a government-intensive stockpiling strategy.

[140] Andrews and Pirog, 2012.
[141] CFR, 2001.
[142] Andrews and Pirog, 2012.

The limited SPR discourse of the 1990's and 2000's demonstrated the importance of the importance of the SPR's market power in two ways. First, President Clinton explicitly discussed using the reserve to manipulate the oil market.[143] While he used this power sparingly, his treatment of the reserve makes clear that policy makers recognized that United States could unilaterally influence the world market. Second, SPR fill activities generated attention as the world oil market became menacingly tight in the mid-2000's. With prices escalating, legislators questioned whether the fill activities were to blame for price increases. Careful analysis suggested that the fill activities were not to blame for high prices, but these questions reveal an awareness of the SPR's role in a global market.[144]

The oil market witnessed its worst tumult in the since the 1970's during the 2000's, but not for reasons that the SPR could address. Oil prices began the decade around $30 per barrel, escalated through the middle of the decade, and peaked in 2008, with West Texas Intermediate crude trading at $145.16 on July 14th of that year, only to fall back to around $30 the following year.[145] Unlike previous shocks to the oil market, demand growth was the primary cause of this price escalation as opposed to an identifiable supply outage. Economic growth in non-OECD countries cause oil demand to outpace supply in the 2000's. Because this escalation was underpinned by positive economic trends, it was not as harmful to the economy as previous outages.[146] Price escalations during the 2000's did contribute to the great recession at the end of the

[143] Beaubouef, 2007.
[144] Considine, 2006; Considine and Dowd, 2006.
[145] EIA, 2017b.
[146] Kilian, 2009; Vincent, 2016.

decade, but analysts disagree as to what extent.[147] The oil market volatility of this decade, and the return of $100 oil in 2011 with the advent of the Arab Spring, served as a reminder of the United States vulnerability in a global oil market.

Increasing prices, coupled with technological advances, facilitated a dramatic increase in U.S. oil production during the years of the Obama Administration. U.S. crude oil output rose from 5.4 million barrels per day in 2008 to 9.4 million barrels per day in 2015. This trend, coupled with relatively flat consumption, caused U.S. oil imports to plummet.[148] The chimera of American energy independence resurfaced, leading some policy makers to question the continued value of the SPR. Many casual observers of the program argued that the reserve should be downsized because the total days of import cover represented by the SPR increased dramatically during this period. The reserve represented 75 days of cover in 2009 and 149 days of cover in 2015.[149] The administration pushed back against this line of argumentation, noting the importance of the SPR's role in a global market. Secretary of Energy Ernest Moniz encapsulated the administration's focus on economic vulnerability and the reserve's market power:

> *"…the value of the SPR should be measured less by days of import protection and its ability to move physical supplies to inland and much more by its capacity during a major disruption to satisfy domestic demand while diverting imports into the global oil market in order to mitigate harm to the U.S. economy."*[150]

[147] Hamilton, 2009.
[148] EIA, 2017a.
[149] Author calculation using EIA data.
[150] Senate Committee on Energy and Natural Resources, 2015.

The ability to impact the world market to defend the national economy against prices shocks still underpinned U.S. thinking on energy security, even in the face of waning imports.

Despite this position on the economic value of the SPR, the Obama Administration ultimately agreed to sell some of the reserve's inventory. Three separate pieces of legislation signed late in President Obama's second term authorize the sale of 190 million barrels of crude oil between 2017 and 2025 to fund highways, deficit reduction, medical research, and SPR modernization.[151] While this clearly demonstrates reduced concern about energy security among policy makers, the inventory reductions will not fundamentally alter the nature of the reserve or America's approach to energy security policy. The reserve will remain under government control, its use will continue to be based on averting economic harm to the United States, and even after the mandated sales are carried out it will remain the world's largest oil stockpile.

Upon closer examination, the debate surrounding the recent SPR sales suggests that the drivers of stockpiling policy presented here still underpin the United States' approach to energy security. The $2 billion SPR modernization that will be funded through these sales will go toward extending the life of the SPR's surface infrastructure and the constructing dedicated marine terminals. These new facilities will be built to shore up the SPR's distribution capability, which is compromised due to pipeline and terminal congestion in the U.S. Gulf Coast. The United States is applying considerable resources towards maintaining the ability to impact the world market, even as U.S. imports are decreasing. Further, both the reduction in inventory and the resource

[151] DOE, 2016.

commitment to SPR modernization are justified in economic terms. DOE's *Long-Term Strategic Review of the SPR* includes a cost-benefit analysis of the marine terminals and shows that the economic benefits of the reserve level off above an inventory of 500 million barrels.[152] The decision to reduce the SPR's inventory stemmed not just from the reductions in oil imports during the Obama years, but from a recognition that the economic vulnerability to oil shocks was becoming less severe.[153] Market power and economic concerns have continued to determine American SPR policy even as the oil market and U.S. economy have evolved.

This recent analysis falls in line with a large body of economic literature and government reports evaluating SPR capabilities. Since the flurry of analysis that took place during the early years of the SPR program, the policy community's basic approach to evaluating the SPR has been the same. To assess the value of the SPR and prescribe SPR policy, analysts focus on the likelihood and nature of oil supply disruptions, the consequences of those disruptions for the oil market, and the consequences of oil market movements for the national economy. The SPR's value derives from its ability to stem these losses. This approach to evaluating the U.S. stockpiling program, highlights the importance of the determinants of energy security policy outlined in this dissertation's model. The SPR's primary reason for existing is the vulnerability of the American economy to oil shocks and its value is based on its ability to mitigate this vulnerability by calming the oil market when needed.

Not only have market power and economic vulnerability been affirmed as the major drivers of SPR policy over the last three decades, but the government-owned

[152] Ibid.
[153] Council of Economic Advisors, 2014; Vincent, 2016.

approach to stockpiling has rarely been questioned. Throughout this period, policy analysts rarely wrote about the SPR. Most treatments of the SPR policy focuses on buttressing and/or modernizing the extant approach to stockpiling.[154] Occasionally some energy analysts have suggested getting rid of the program entirely.[155] Even these treatments frame their discussion of the reserve in terms of cost-benefit analysis based on the reserve's ability to avert economic losses – they just make different assumptions in their valuation of costs and benefits. The American dialogue on energy security continues to be framed in economic terms. Its chief outcome is a sustained commitment to a government-intensive approach to oil stockpiling.

Case Summary

This dissertation argues that the market power conferred by a national oil stockpile and the nature of energy security threat that a nation faces determine the choices that governments make in building strategic oil reserves. The model predicts that, among countries that face primarily economic threats, only nations whose stockpiles afford them substantial market power will pursue a government-intensive stockpiling strategy. The preceding analysis of the United States supports this theory. The U.S. Strategic Petroleum Reserve is the largest oil stockpile in the world and it can be drawn down at an extremely high rate, which gives the reserve enormous market power. Even in the planning phases of the SPR, it was always clear that an American oil stockpile would enjoy the ability to move the world market. Economic vulnerability is the predominant component of energy security threats to the United States. Despite some elements of

[154] Jaffe and Morse, 2001; Jaffe and Soligo, 2002; Edmunds and Singh, 2013; Goldwyn and Patron, 2013; Difiglio, 2014.
[155] Taylor and Van Doren, 2005; Loris, 2015.

access concerns in the U.S. reaction to the energy crises of the 1970's, oil supply shocks have always primarily been a prosperity issue for the United States.

Market power and economic vulnerability played central roles in the decision to build a large, government-owned oil stockpile. In the early dialogue on energy security policy, decision makers realized the most critical component of the energy security threat that the nation faced was the economic contraction that oil price shocks could cause. To address this, the United States needed an energy security asset that had the power to influence the world oil market. Private entities could not be expected to defend the interests of the national economy – only a stockpile that could be used at the government's discretion could defend the country from a major oil supply crisis.

Throughout its history, decision makers have evaluated the SPR's value based on its ability to avert economic losses by stemming oil price escalations. This framework for cost-benefit analysis is unique to the largest IEA members – smaller nations could not expect to be able to influence the world market. For minor oil importers, the contribution that their inventories make to the global market in a crisis are far less consequential and the benefits that they enjoy are less clear. The linkage between oil stockpiling policy, the world oil market, and the national economy is direct where stockpiles confer substantial market power. Four decades of SPR policy debates in the United States make this clear.

The explanation based on this dissertation's model makes a far more compelling case for U.S. stockpiling policy compared to an explanation based on domestic interest group politics. While the industry informed early SPR debates, they did not decisively influence U.S. policy. The evidence presented here demonstrates a clear focus market power and economic vulnerability. These factors, and the desire to develop an effective

strategic reserve, outweigh concerns about the distributional consequences of energy security policy for the oil business. This makes sense – at the time the oil industry was reviled in the United States, which would make them relatively less likely influence policy.[156] Further, studies of the period document the difficulty that the oil industry had in speaking with a unified voice.[157] This further reduces the viability of an OEP-style explanation based on narrowly defined economic interests.

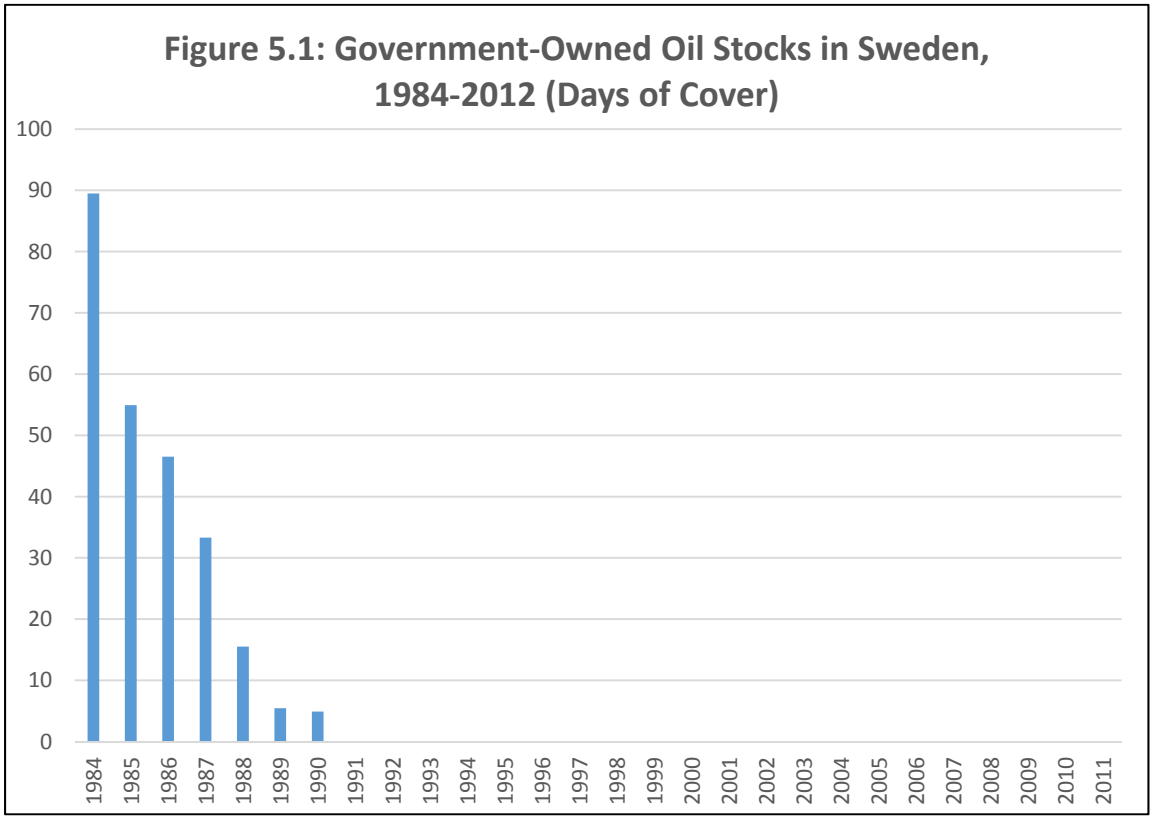
[156] Jacobs, 2016.
[157] Ikenberry, 1988; Hughes, 2014.

Chapter 5: Oil Stockpiling in Sweden

The model proposed here argues that nations' approach to oil stockpiling is driven by the nature of the energy security threats that they face and by the market power conferred by their national stockpiles. Most IEA members, whose strategic reserves are relatively small based on the scale of their petroleum imports, cannot decisively influence the efficacy of an IEA collective release or unilaterally balance the world oil market. Among these countries with small market power, the nature of their energy vulnerability varies. Countries which import oil via marine shipments or pipelines through friendly transit partners can purchase oil in a massive, liquid global market. For these nations, oil access is a relatively small concern and energy security is primarily a prosperity issue. This dissertation argues that these countries will pursue oil stockpiling strategies with limited government involvement and resources. This approach places the burden of strategic oil storage on industry, and both minimizes the costs and limits the efficacy of national oil stockpiles. Cost minimization prevails in IEA member states where energy security is not treated as a national security concern warranting substantial resources. Small importers are economically vulnerable to oil supply shocks, but these countries can enjoy the economic benefits of an IEA collective action regardless of the efficacy of their own contribution to global effort.

Sweden typifies the cost-minimization approach pursued by many small Western European IEA members. It meets the entirety of the 90-day IEA stockholding obligation through industry mandates. The Swedish Energy Agency (SEA) enforces storage

requirements on industry and lifts these mandates in the event of a crisis.[158] This low-resource approach to oil stockpiling represents a decisive transition for Sweden. The Swedish government heavily subsidized private sector oil stockpiling as consumption increased following World War II and, following the 1973 Arab Oil Embargo, enacted a plan to acquire 90 days' worth of government-owned stocks.[159] Beginning in the 1980's, the country divested these stocks and moved to an industry-based approach. Figure 5.1 illustrates this striking policy reversal:



Sweden deliberately changed course in oil stockpiling policy. This decision was made in the context of significant shifts in the Swedish energy space that altered the country's real and perceived energy vulnerability profile. In line with the expectations of

[158] IEA, 2014.
[159] Carlsnaes, 1988.

this dissertation's explanatory model, Sweden's divestiture of strategic oil stocks followed a marked decrease in the country's petroleum consumption that mollified concerns about physical access to oil. This case analysis will first establish that Sweden indeed occupies the bottom-left quadrant of table 2.4: it wields minimal market power and faces primarily economic energy security threats. The assessment will then chronicle oil stockpiling policy in Sweden, showing that as the country reduced oil consumption and imports, energy security concerns decreased in importance leading to a cost-minimization approach to oil stockpiling.

Explanatory Factors

This section outlines the structural factors of the Swedish energy sector that place the country in the bottom-left quadrant of Table 2.4. Sweden's market power is minimal and a physical access to oil is not a major concern for the country in today's globalized oil market. These factors are summarized here. The role that they have played in the Swedish discourse on energy policy is discussed in the following section.

Market Power

No matter what oil stockpiling strategy Sweden adopted, the country would not be able to impact the global oil market with a stock release. Sweden consumes around 300,000 barrels of oil per day, making it the median IEA consumer. This represents 0.3 percent of total world consumption and 0.7 percent of IEA consumption. The latter measure determines the level of contribution tat Sweden would be required to make to an IEA collective oil release. To put Swedish capabilities into perspective, in an IEA collective action that put 5,000,000 barrels per day on the market, Sweden's required contribution as a member would be around 35,000 barrels per day. In terms of stabilizing

the world oil market, the difference between a release rate of 5,000,000 barrels and 4,965,000 barrels is negligible. Even if Sweden was able to release oil at a rate equal to its full consumption level, the country would not play a decisive role the ameliorating the supply and price impacts of a world oil shortage.

Further, any attempt by Sweden to unilaterally influence prices would be futile. Unlike large IEA members, the country is exclusively a price taker. This has fundamental implications for what the country's oil stockpile can and cannot accomplish. Swedish strategic reserves can address a physical shortage to national imports, but they cannot do anything about a massive swing in the world oil prices. Sweden's extremely small market power means that no matter how (in)effective its oil stockpiling arrangement is, the economic consequences of an oil supply shock will be determined by the IEA's collective ability to address a disruption in the global market. While Sweden has remained in good standing with the IEA since joining the organization, the country can effectively can free-ride on the capabilities of larger members in terms of economic defense. It follows that, unlike in the United States, the benefits of the ability influence world oil prices never factored into Swedish energy security debates.

Economic Vulnerability

Sweden's physical access to oil is relatively secure. Sweden imports all of its crude oil, but all of these imports arrive via tanker, which limits the direct leverage that individual exported can wield over them. The fungibility of oil and the liquidity of the global market affords Sweden considerable protection. Russia accounts for the largest share of Swedish imports at 42 percent; this share has increased in recent years.[160]

[160] IEA, 2014; Larsson, 2008.

Importing waterborne barrels from Russia makes economic sense for Sweden, given the two countries' geographic proximity. If Russia, or any other supplier for that matter, attempted to curtail shipments to Sweden, the country could replace the lost barrels on the global market. This might reduce the efficiency of refinery operations, but it would not be catastrophic. Further discussion of Sweden's energy relationship with Russia follows below. The only way that Sweden's physical access to petroleum could be limited would be through a naval blockade. For a country that maintains a foreign policy posture of neutrality, this outcome is highly unlikely.

Two other factors buttress Sweden's overall energy security: its robust refining sector and the efficiency of its economy. The Swedish refinery fleet has a combined crude distillation capacity of 435,000 barrels per day – the country's net refined product exports total 138,000 barrels per day.[161] This capability further intertwines Sweden with the larger global petroleum market and, in a situation where some component of the country's oil supply system were disabled, it could still produce transportation fuels for domestic consumption assuming that receive crude oil inputs. More importantly, Sweden is one of the most efficient IEA economies in terms of oil consumption. The share of fossil fuels in the Swedish energy mix is the lowest among IEA members. As measured in this dissertation, Sweden's oil intensity of economic output is less than half of that of the United States.[162] Efficiency moderates both the potential impact of a physical supply shortage as well as the potential economic impact of a global supply disruption. Taken together, these factors suggest that Sweden is extraordinary energy secure. Empirical

[161] IEA, 2014.
[162] The measure in this project is constructed with data from EIA and the World Bank.

analysis bears this out: a 2008 study of 26 of the geopolitical oil risk faced by 26 different oil importing countries found Sweden's risk level to be the lowest in the sample.[163]

Sweden did not always enjoy this level of energy security. In 1973, when the first oil crisis struck, imported oil represented 70 percent of Sweden's total primary energy consumption.[164] At the time this substantial consumption share, coupled with the fact that the world oil market was not fully globalized, engendered great concerns about Sweden's exposure to an oil supply disruption. The potential for a physical supply cutoff seemed plausible and the consequences of such an outage would have been dire. The following section will illustrate how Swedish energy policy in the years following the 1973 oil supply crisis succeeded in fundamentally shifting the nation's energy consumption patterns. In terms of potential access threat, the country evolved from being an importer with major concerns, to an unusually efficient oil consumer with a diversified import portfolio. In term of this project's typology, as Sweden shifted from the bottom-right quadrant of Table 2.4 to the bottom-left quadrant. The following section chronicles the impact of this transformation on oil stockpiling policy.

Industry-Mandated Storage in Sweden

This dissertation predicts that, as an oil importer with no meaningful market power and no threats to physical oil access, Sweden would rely on industry stocks to meet its IEA stockholding obligations. This is now the case. However, Sweden initially pursued government-intensive strategy and subsequently changed course. The process

[163] Gupta, 2008 developed a measure that accounted for net oil import dependence; concentration of supply sources; political risk in supplying countries; ability of a consuming country to switch between different suppliers; and share of oil in total primary energy supply. The sample IEA oil importers, China, India, and the Philippines.
[164] Lonnroth, Johansson, and Steen, 1980.

through which Sweden arrived at this strategy, after embracing full government ownership for a time, sheds light on the importance of the explanatory factors put forth here. This section will place Swedish stockpiling choices in the context of broader movements in the nation's energy policy. Sweden's policy response to the 1973 oil crisis profoundly shifted the country's energy consumption patterns. This caused concerns about oil supply security to fade and ultimately led to a cost-minimization approach to oil stockpiling.

Crisis Response and Government Storage: 1973 to 1984

In the years between World War II and the Arab Oil Embargo, the Swedish economy boomed and energy consumption boomed with it. Between 1950 and 1973 energy consumption more than doubled, driven by population growth, expanding industrial output, and increased automobile use in the transportation sector.[165] Low import prices meant that rising oil consumption did not generate controversy. Swedish energy debates focused on the environmental aspects of hydroelectric dams and what technological approach to take to nuclear power development.[166] In this low-risk environment, supply oil shortages did not represent a pressing policy concern for the government. During this period Sweden adopted a laissez-faire approach to energy security, relying on the global market at international corporations to provide a stable supply of energy.[167] These policies, which were reasonably undertaken given the

[165] Johansson, et. al., 1983.
[166] Löfstedt, 1993; Carlsnaes, 1988. Indeed, the most consequential energy debates in Swedish history, both before and after the Arab Oil Embargo, focused on Sweden's approach to nuclear power. A thorough treatment of this issue can be found in these works as well as Jasper, 1990 and Nordhuas, 1997.
[167] Pearson and Nyden, 1980.

circumstances of the period, led the preponderant share of imported oil in the Swedish energy mix which would become an acute vulnerability.

When the 1973 Arab Oil Embargo hit the Swedish economy, the government quickly took extraordinary steps to address the crisis. Although OPEC did not directly target Sweden, the country relied on imported oil for 70 percent of its energy consumption. This dependence, coupled with the fact that Sweden produced virtually none of its energy supply indigenously, made oil supply security an existential threat to the country. Immediately following the 1973 embargo, the government initiated and subsidized an intensive conservation campaign that enabled households and industry to reduce their oil consumption by 15 percent and 10 percent, respectively.[168] It then established price and allocation controls in 1974 and managed fuel distribution through a national Fuel Board and Board of Economic Defense, intended to represent the interests of both consumers and industry. A massive public outreach campaign buttressed these efforts. The government established 8,000 energy study groups of 10 citizens each which both gauged public opinion on energy issues and disseminated knowledge on energy fundamentals.[169] The initial response to the crisis suggests that Sweden was poised to apply considerable resources to energy security and that Swedish society supported this effort.

Notwithstanding a united body politic and committed government, the oil crisis placed Sweden in an intractable situation. While analysts expected the pace of energy demand growth to slow as the economy transitioned less energy intensive enterprises, all

[168] Sahr, 1985.
[169] DOE, 1977; Pearson and Nyden, 1980; Jasper, 1990.

forms of energy available to Sweden entailed externalities.[170] Nuclear and hydroelectric power generation raised environmental concerns that caused the government to favor oil in the 1950's and 1960's. Now the vulnerability associated with imported petroleum was laid bare. To address longer term energy concerns, the Swedish government commissioned scientific studies to examine the potential for conservation and renewable fuels to meet Swedish energy challenges.[171] None of these options would enable the country to jettison petroleum use in the transportation sector, so the imperative of defending the nation against oil supply interruptions would necessarily be a component of Sweden's overarching policy response to energy insecurity.

The Swedish government's long-term approach to addressing the energy crisis was codified in the 1975 Energy Bill passed by the Riksdag. This legislation, which incorporated public opinion gathered in the energy study groups discussed above as well as cost-benefit analysis conducted by government officials, had four key pillars:

1.) Decrease the growth rate of energy demand to 2 percent per year.
2.) Pursue an "active oil policy" by decreasing fuel demand, importing other fossil fuels for thermal power generation, establishing a state petroleum company, searching for oil in the Baltic Sea, and increasing the stockpile of oil.
3.) Increase the number of nuclear reactors from 11 to 13 to boost power supply.
4.) Join the International Energy Agency.[172]

[170] Johansson, et. al., 1983.
[171] Lonroth, Johansson, and Steen, 1980.
[172] Carlsnaes, 1988; Jasper, 1990.

The most notable components of this legislation proved to be the demand reduction and the limited expansion of nuclear power generation (which would soon dominated Swedish energy debates). Unlike aspirational conservation initiatives in the United States, Sweden's efforts to save energy were underpinned by resources and embraced by the wider society.[173]

While it is now clear that this legislation initiated shifts which would fundamentally redefine Sweden's energy security position, the government was not sure of this outcome at the time. A (well-grounded) skepticism of energy forecasting and an acknowledgement of the inherent uncertainty in future energy trends underpinned Swedish policy making in the 1970's.[174] It followed that in addition to a potentially transformational long-term energy strategy, Sweden would need to take short-term measures to address the country's immediate oil supply vulnerability. Given that none of the other oil components of the 1975 Energy Bill could quickly and comprehensively address petroleum security concerns, oil stockpiling became a key priority for the Swedish government.

Since before World War II, Sweden had mandated that companies store oil beyond commercial operating levels. This policy reflected moderate concerns about fuel access, although major supply outages remained a distant possibility for Sweden. As petroleum consumption increased, the Swedish government increased the amount of fuel that importers were required to store for military emergencies and other contingencies in the 1950's and 1960's. Commercial operators paid for these stocks and storage facilities with preferential loans from the Swedish government and eventually a levy on motor

[173] Sahr, 1985.
[174] Jasper, 1990.

fuels. Authorities delineated between stocks which would be used for solely military purposes and stocks which would be used for non-military crises. Notably, the language used to describe Swedish stocks categorized both military and non-military fuel supply interruptions as a national security issue.[175]

The government substantially expanded these storage requirements in the 1970's. Following the direction of the 1975 Energy Bill, the Swedish parliament enacted the recommendations of a commission on petroleum stockpiling that provided for the acquisition of oil stocks to meet the 90-day requirement of the international energy program in 1977. These stocks would be acquired over seven-year period and owned outright by the government. Sweden would maintain this strategic stockpile *in addition to* large volumes held by industry operators for various types of domestic crises. The government also outlined the circumstances under which each type of stock could be released and maintained control over release policy.[176] Sweden was both expending public resources to maintain a public stockpile as well as compelling industry to expand their holdings. This decisive effort to address petroleum supply security accords with the acute vulnerability perceived in Sweden at the time.

Unlike the oil stockpiling debate in the United States, the ability to impact the world oil market did not play a role in the Swedish debate in this area. In general, European importers did not attempt depress world prices in their response to the 1973 oil crisis.[177] Despite an analysis-heavy approach to energy policy, Sweden did not assess

[175] Carsnaes, 1988
[176] Ibid.
[177] Pearson and Nyden, 1980.

their oil stockpile in terms of its market power. In reference to the stockpiling goals established in 1977, one observer noted:

> *"…at no point has a serious analysis been made to determine the sufficiency of this level as far as Sweden is concerned; nor if, in a crunch, it will indeed constitute a practicable instrument for domestic price stabilization."*[178]

Domestic prices could not be durably stabilized by a small national oil stockpile in a massive world oil market. This stands in stark contrast to the United States, where much of the discussion of the Strategic Petroleum Reserve focused on the ability to influence the world oil price. This makes sense in the case of Sweden, because the country does not possess the capability to stabilize world prices, which ultimate determines costs to Swedish consumers.

So why did Sweden pursue a government-intensive oil stockpiling policy? This resource-intensive approach to strategic oil storage, which was part of a larger push to reduce energy-related vulnerability, accords with this dissertation's predictions about oil stockpiling as a form of state behavior. Because of the preponderance of imports in the Swedish energy mix at the time of the Arab Oil Embargo, oil supply security concerns rose to the level of an existential national security issue. While the country is not a captive market in terms of physical geography, in the 1970's Sweden imported most of in petroleum from the Middle East and the world oil market was not nearly as liquid and resilient as it is today.[179] The consequences of an import shut-off would be dire.

[178] Carlsnaes, 1988, p. 113.
[179] DOE, 1977.

This sheer level of external dependence represented a major driver behind Sweden's resource-intensive energy policy.[180]

Two other factors magnified the importance of Sweden's oil supply security. First, many policy makers felt that acute dependence on imported fuels compromised Swedish neutrality, the cornerstone of the country's foreign policy. Sweden defined this posture, which dates to the 19th century, as "freedom from alliances in peacetime aiming at neutrality in the event of war."[181] Until the 1973 oil crisis, economic interdependence mostly strengthened Sweden's neutral position by improving the country's economic performance. During the Cold War, the Sweden sought mutually beneficial ties with both the Soviet Union and Western nations. For Swedish neutrality to be *credible* the country needed to be both military and economically self-sufficient to maintain freedom of action.

Vulnerability to an oil supply outage compromised this. The downside of economic interdependence presented major problems for a small trading state. It follows that Sweden addressed the 1973 oil supply crisis in national security terms. The Swedish government broadened its definition of war to encompass crises that entailed primarily economic consequences, such as the Arab Oil Embargo. In 1979, Sweden adopted a "total defense policy" which encompassed economic security – the policy specifically referenced fuel stockpiling as a defense measure.[182] It was during this time that the government was pursuing public ownership of the nation's strategic oil reserves.

[180] Andersson, 1986.
[181] Dohlman, 1989a; Dohlman, 1989b. For further discussion of Swedish neutrality see multiple contributions in Sundelius, 1989 and or Agius, 2012 for a more recent treatment of the topic.
[182] Ibid.

In addition to physical import vulnerability and its impact on Swedish neutrality, the intensive stockpiling policy adopted by the Swedes was also driven by shortcomings of the IEA. The American perspective on the IEA, especially in the present day, is rooted in the organization's ability to stabilize the world oil market. However, at the organization's founding, the oil sharing mechanism, which would be triggered in the event of a seven percent shortfall of imports in a given country, represented the IEA's primary supply-side approach to addressing oil supply disruptions. When one member state experienced a shortage, other members were notionally expected to come to the rescue. Theoretically, if the IEA could provide an additional layer of supply security, domestic resiliency measures might take on slightly less importance.

The 1979 oil supply crisis caused by the Iranian revolution made it clear that Sweden could not count on the IEA for supply security. In February 1979, Sweden reported a 17 percent supply shortage to the IEA governing board, clearly sufficient to trigger the IEA's oil sharing mechanism. The IEA secretariat responded by blaming the shortage on winter weather conditions told Sweden to adjust their calculations for seasonality. The adjusted calculation showed a 9.8 percent shortage and Sweden again requested assistance in May of that year. The IEA governing board still declined Sweden's request, suggesting that the country should remove price controls and purchase barrels on the spot market at a premium. This failure of the IEA's quantitative trigger initiated internal deliberations among members about the organization's approach to oil supply security.[183] For Sweden, the lesson of this episode was clear: the nation could not

[183] Chakarova, 2013; Keohane, 1982. Much of Keohane's 1984 discussion of the importance of the non-juridical, informal role of international organizations was derived from his analysis of the IEA's first decade in existence.

depend on outside actors to ensure its energy security. The IEA could potentially provide collective benefits by stabilizing the global market, but without robust participation by anchor members[184], it would not save individual small members from oil supply outages. In light of this, Sweden needed a robust long-term strategy to moderate structure energy vulnerability and a robust approach to strategic oil stockpiling to defend the nation's energy supply.

Decreased Vulnerability and Industry Storage: 1984 to Present

In the decade following the Arab Embargo, Swedish energy policy succeeded in moderating national oil consumption. Unlike parallel energy transformation attempts on other IEA countries, conservation policy succeeded in Sweden. After growing a rate of more than six percent during the 1960's, Swedish oil consumption fell by close to one percent per year during the latter half of the 1970's.[185] Between 1973 and 1985, the share of imported petroleum in total primary energy consumption fell from over 70 percent to under 50 percent.[186] The resulting decrease in imports lowered the volumes required to comply with the IEA's 90-day stockholding requirement. This moderation, coupled with low oil prices in the mid-1980's reduced the cost of maintaining a government-owned strategic petroleum reserve for Sweden. Still, the government ceased to prioritize energy security in terms of resource expenditures. In 1984 the Riksdag decided to sell off Sweden's government oil stockpile shortly after achieving 90 days of import coverage.

[184] At the time, the United States SPR program had barely gotten off of the ground. Many ascribe the IEA's early weakness to the initial weakness of the American oil stockpiling program. The linkage between the vitality of the IEA and the strength of the SPR supports many of the concepts noted in the U.S. case study in this chapter.
[185] Sahr, 1985.
[186] IEA, 2014.

The funds from the sale helped balance the Swedish budget and the country no longer considered strategic oil storage a necessary national security measure.[187]

The marked decrease in Swedish oil consumption after the Arab Oil Embargo played an obvious role in the decision to divest in the nation's oil stockpile. The success of energy conservation measures, couple with the rise of the global spot market and an understanding that oil it a fungible good, considerably alleviated the vulnerability that Sweden faced. While the country never developed indigenous petroleum supplies, it was clear by the mid-1980's that Sweden could depend on the world market for a stable supply of petroleum. A physical supply shortage no longer seemed plausible and reduced energy intensity reduced the catastrophic potential of an oil supply outage. In this context, Swedish policy makers began to conceptualize oil supply security in terms of price movements and their impact on economic output.[188] Energy security became an industrial policy issue as opposed to a national security issue. In line with the logic put forth in this dissertation for stockpiling behavior in countries with small market power, when Sweden ceased to perceive a threat to its physical access to oil, went from pursuing a resource-intensive oil stockpiling strategy to a policy that minimizes costs.

Swedish total energy consumption has remained virtually flat since 1985. The share of oil in total primary energy consumption has continued to decrease. The country now relies on hydroelectric and nuclear power for two-thirds of its total energy supply. It imports less oil than the European average and remains one of the most energy efficient economies in the world.[189] The country continues to meet its IEA obligation exclusively

[187] Carlsnaes, 1988.
[188] Carlsnaes, 1988; Cherp and Jewell, 2013; Johansson, et. al. 2013.
[189] Aalto and Tynkkynen, 2008; IEA, 2014.

through industry mandates. Sweden remains a member in good standing, but its contribution to the efficacy of the organizations actions has been minimal. For example, in the agency's plan to address the 1991 Gulf War through a 2.5 million barrel per day collective action, the Swedish contribution was 21,000 barrels per day of demand restraint.[190] As a small member, Sweden can enjoy the benefits of IEA collective actions while applying minimal resources to global energy security.

This adherence to a cost-minimization strategy is part of an overall energy posture that does not prioritize energy security concerns. Two significant aspects of Swedish energy policy illustrate the nation's confidence in terms of its energy security position. First, Sweden has been able to make the economically efficient choice to import increasing amounts of crude oil from Russia even as Russia's aggressive oil and gas export policy was causing severe consternation in most of the European Union.[191] Between 2001 and 2005, the Russian share of Swedish oil imports increased from five percent to 36 percent.[192] During this period Russia used energy exports to assert control over numerous countries in Central and Eastern Europe. While some analysts expressed concern about this trend, the increased imports did not represent a supply security issue for Sweden because of its access to waterborne oil imports[193]. The ability to freely source oil imports from the most efficient supplier stands in stark contrast to the energy position of countries which are captive markets. A country with a relatively sanguine outlook on energy security can afford a minimalist approach to oil stockpiling.

[190] Beaubouef, 2007.
[191] For a good synopsis of EU-Russia energy issue see Baran, 2007 or chapter 6 of this project.
[192] Larsson, 2007.
[193] Larsson, 2008.

Perhaps more importantly, in recent years Swedish energy policy has primarily focused environmental concerns. This approach to energy policy making is common among Scandinavian countries and materially impacts their approach to energy security.[194] The environmental issues surrounding nuclear and hydroelectric power have not gone away. Moreover, in recent years widespread concerns about carbon dioxide emissions have added a new challenge for Swedish policy makers. The government announced a goal of generating all of its electricity from renewable sources by 2040. This initiative, couple with research programs focused on pushing even more petroleum out of the transport sector, could come closes to removing oil from the Swedish fuel mix.[195] Given the country's history of success in transformative energy policy, this prospect seems quite plausible. In this context of obsolescing vulnerability, it makes sense that Sweden would minimize the resources that it spends on tradition energy security measure, such as strategic oil stocks.

Case Summary

This dissertation argues that nations' oil stockpiling policy is driven by the market power conferred by strategic oil stocks and the nature of energy security threat that a country faces. Sweden's oil stockpile clearly affords the country minimal market power. Swedish contributions to IEA collective actions will always will not impact the efficacy of a collective release and Sweden cannot unilaterally impact the world price of oil. Given this, Swedish stockpiling choices can be expected to be driven by the nature of threats to the nation's energy security. Although Sweden relies completely on imports to meet its oil demand, all of these imports arrive via marine vessel, which means that the

[194] Aalto and Tynkkynen, 2008.
[195] IEA, 2013.

global market provides secure access to crude oil. The primary energy security threat that Sweden faces, therefore, is economic vulnerability to oil price shocks. This project would predict that a country in this position would pursue a cost-minimization approach oil stockpiling, which is indeed the case.

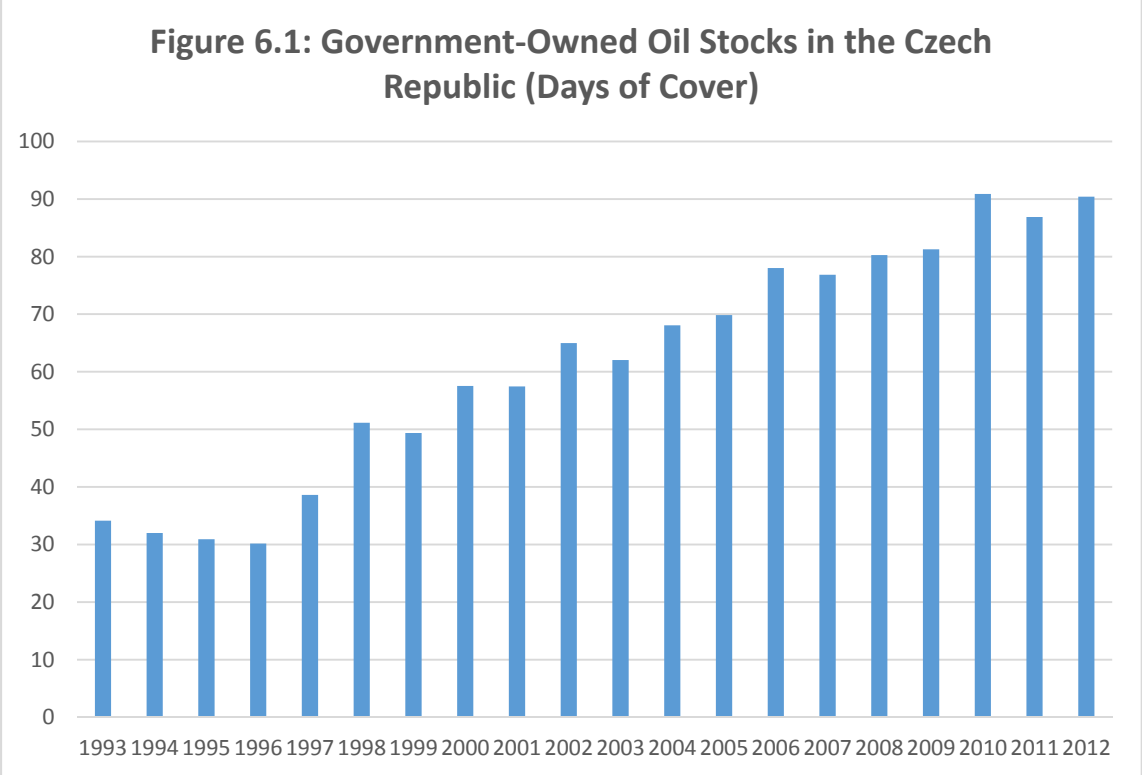
The process through which Sweden arrived at this policy choice supports this project's claims about oil stockpiling. When the 1973 Arab Oil Embargo struck, Sweden relied on imported crude to meet 70 percent of national energy consumption. The extent of this dependency caused Sweden to treat energy vulnerability as a national security issue. The country pursued an intensive conservation strategy, expanded the use of nuclear power, and developed a government-owned oil stockpile. Only after the former policies succeeded in moderating Swedish vulnerability to a supply interruption did the nation transition to an oil stockpiling policy that minimized costs. Even as energy security threats have evolved for most of Europe, Sweden continues to be able to rely on the global market and large IEA members to protect its economy from shocks to the world price of oil.

Chapter 6: Oil Stockpiling in the Czech Republic

This dissertation's explanatory model locates the determinants of oil stockpiling policy in the nature of security threat that a nations face and the market power associated with their strategic reserves. For most IEA countries, energy security is primarily a prosperity issue. In these cases, countries determine their approach to oil stockpiling based on cost-benefit analysis rooted in their ability to influence the global oil market. The stark difference between oil stockpiling in Sweden compared to the United States bears this out. For countries which treat the stability of energy supplies as a national security concern, the calculus is quite different. Small states in this category, which occupies the bottom right quadrant of Table 2.4, are likely to pursue a government-intensive stockpiling strategy even if they are not able to impact the world oil price with a stock release. While most oil importers can purchase oil in a liquid, global market, landlocked countries lacking indigenous liquid fuel resources must depend on pipelines.[196] This circumstance can provide an exporting states with substantial leverage. In cases where hostile exporters choose employ hydrocarbon supplies as a means of coercion, energy security considerations factor into the national security strategy of importing states. These states are more likely to expend public resources on securing energy supplies. The model advanced here predicts that they will pursue government-intensive approach to oil stockpiling.

[196] Some very small countries import fuel via train or truck, but these transit approaches are cost prohibitive in most cases. For most IEA members, the rail capacity to cover a meaningful fraction of oil imports does not exist.

For Eastern European nations that depend on Russia for imports of oil and gas, energy security is a critical national security concern. In the decades following Soviet rule, Russia has increased its use hydrocarbons as leverage over states in its near abroad. To varying degrees, Eastern European countries have poured government resources into strategic oil stockpiles and other energy security measures to mitigate this problem. The Czech Republic provides a clear example of this phenomenon. The country imports the vast majority of its oil and gas supplies and place a high priority on energy security. It began expanding its government-owned oil stockpile following independence in 1993. This build-up was part of a resource-intensive strategy to enhance the country's overall energy security. Figure 6.1 illustrates the sustained expansion of Czech stocks:



The Czech Republic's oil stockpiling strategy falls in line with the outcome expected by this dissertation. Despite the country's inability to balance the global market or materially impact the oil-price impact of a collective IEA release, the country has built a large, government-owned oil stockpile at considerable cost. This case analysis will first establish that the Czech Republic should be coded as small-market-power state in which stocks primarily address national security vulnerability. This requires a treatment of Czech geography and import infrastructure, as well as a discussion of Russia's aggressive disposition. The assessment will make the case that an energy supply cutoff constitutes a material national security threat to the country. The following section places Czech oil stockpiling policy in the context of the country's overall energy security and foreign affairs trajectory. In the decades immediately following the fall of communism and the country's "Velvet Divorce" from Slovakia, the Czech Republic experienced transformational change. It joined the North Atlantic Treaty Organization (NATO) and the EU, restructured its economy, and developed democratic institutions. Throughout the country's brief and eventful modern history, energy security has represented a pivotal issue to which the national has applied substantial resources.

Explanatory Factors

This section makes the case for locating the Czech Republic in the bottom-right quadrant of Table 2.4. After a brief discussion of the country's limited market power, it will outline the factors that make energy supply a national security issue for the Czech Republic. This coding involves a discussion of Czech geography and import infrastructure that renders the country vulnerable to physical supply cutoffs as well as a general discussion of Russia's use of hydrocarbons as a foreign policy tool. These

factors combine to render an energy supply cutoff a credible threat to the Czech Republic. This section does not discuss specific Czech interactions between Russia or the process through which this vulnerability has led to energy security policies. These issues are detailed in the following section, which discusses how the country has addressed this threat, including their accumulation of a government-owned national oil stockpile.

Market Power

Like Sweden, the Czech Republic is a small oil consumer that cannot impact the global market with its oil stockpile. At around 200,000 barrels per day, oil demand is smaller in the Czech Republic than in all but six IEA member states. This represents 0.4 percent of overall IEA consumption. This share determines the amount of oil that the country would be required to contribute to an IEA collective action in response to a global oil supply crisis. Using the example of a 5,000,000 barrel per day collective oil release, the Czech contribution would be 20,000 barrels per day, which is effectively rounding error in terms averting a catastrophic shock to the oil price. Even if the country were to release oil at a rate equal to its entire domestic consumption level, it would not decisively impact the world oil balance or meaningfully influence world prices.

Like Sweden and other small IEA members, this small market power fundamentally limits what the Czech Republic can accomplish with its oil stockpile. The country is a price taker and cannot do anything to impact the global market. The economic benefits from IEA collective actions to address supply crises will accrue to small IEA members, no matter how effective their participation. If the main determinant of oil stockpiling behavior in a small country is economic calculus, then they can be

expected to pursue the lowest cost option. In short, small oil importers (whether they are members of the IEA or not) have every incentive to free ride on the energy security investments of large IEA members. This is clearly the case for the Czech Republic, if only cost-benefit analysis based on economic vulnerability is taken into account. However, oil stockpiling in the Czech Republic has followed the completely opposite course. This puzzle, of why a county with no economic incentives to establish a robust oil stockpiling system, can be explained by explained Czech energy issues in the context of the country's national security.

Security Vulnerability

Coding energy vulnerability as a national security concern necessarily entails making some assumptions. In this project, the primary distinction between oil supply vulnerability which is coded as an economic threat and oil supply vulnerability which is coded as a security threat is based on whether a state's physical access to crude oil can be curtailed by another (hostile) state. For states that can access the global market through maritime shipments or through a friendly transit state, physical barrels are not at risk and oil supply outages primarily threaten prosperity through the price mechanism. For states in which physical shipments of oil can be cut off, an energy supply outage would go beyond an economic downturn caused by higher fuel prices. Without oil, an advanced industrial society would not be able to function. Transportation networks would fall apart, citizens would not be able to work, and a nation's warfighting capacity could possibly be impacted.

A cutoff of physical oil supplies fall within academic assessments of oil supply as a national security issue. In a discussion of oil and security, Glaser (2013) writes that, "A

state is more secure when it is less likely to be attacked; will suffer less damage if attacked; is less like to be successfully coerced because it is less vulnerable to attack; and is less likely to face threats to other vital interests, especially its prosperity, that could require large-scale use of force."[197] In this context, physical access to crude oil is a security concern because states at risk of a cutoff could have a vital interest threatened and, most importantly, could be targeted for coercion. The case for coding oil security as a national security threat is most clear when a hostile nation has previously attempted to employ access to hydrocarbons as a means of punishment or coercion. This assessment will make clear that in the Czech Republic, physical shipments of crude oil could indeed be curtailed, and that Russia, the country's primary supplier of crude oil, treats hydrocarbon exports as a weapon.

The Czech Republic is land-locked, which means that it must import crude oil via pipeline. International pipelines exemplify the complexity energy relationships between states. Many analysts have unpacked issues related to these assets, especially those that connect Russia and Eurasia to European customers. International pipelines can present myriad problems to both producer and consumer states – they impact the economic and strategic interests of multiple nations, they require substantial investment costs and can generate large economic rents, and there exists no over-arching legal authority to govern their use.[198] A proliferation of pipelines in Russia's near abroad in the 2000's drove analysts debate the relative importance of economic and geopolitical drivers of pipeline

[197] P. 117.
[198] Raballan and Esen, 2006.

construction.[199] Whether or not geopolitics drive pipeline development, they unequivocally impact the strategic circumstances of importing states.

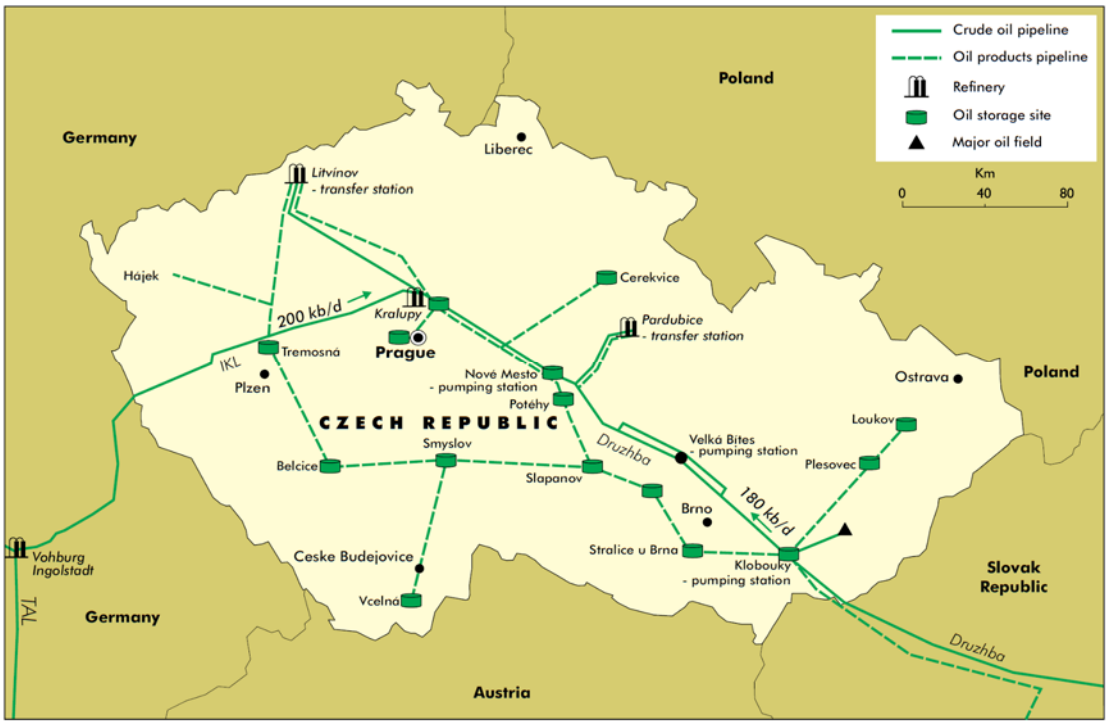
The Czech Republic imports most of its crude oil through the 2400-mile Druzhba (Russian for friendship) pipeline, one of the oldest energy transit assets in Europe. Russia, Poland, and Czechoslovakia originally agreed to build the line in a trilateral accord in 1958. Czechoslovakia and later the Czech Republic have received most of their oil shipments from Russia since the early 1960's.[200] The Druzhba splits into a northern line that traverses Poland and terminates in Germany and a southern line that terminates in the Czech Republic that also has a southern spur to Hungary.[201] Originally, the southern line directly connected Czechoslovakia to the Soviet Union. Following the breakup of the USSR, things became more complicated – the pipe now passes through Belarus, Ukraine, and Slovakia on its way to the Czech Republic. This proliferation of interested parties has caused disputes surrounding fees and volumes to multiply and reduced the reliability of Russian imports into the Czech Republic discussed below.[202] The Czech Republic can import up to 180,000 barrels per day through the Druzhba pipeline, although it normally runs below capacity.[203] The line is notoriously unreliable and at some point in the future Russia might consider shutting it down completely.

Russia held a complete monopoly over Czech oil supply until the completion of the Ingolstadt-Kralupy-Litvinov (IKL) pipeline in 1996. This pipeline connects the Czech Republic to the waterborne imports via the Trans-Alpine (TAL) pipeline that

[199] Ibid.; Baev and Overland, 2010.
[200] Reisinger, 1992
[201] IEA, 2014.
[202] Smith, 2014.
[203] IEA, 2014; Vlcek and Cernoch, 2013.

originates in Trieste, Italy.[204] Development of the IKL pipeline constituted a major pillar of the resource-intensive energy security strategy discussed below, but it did not solve the Czech Republic's oil supply security issues. Utilization of the IKL pipeline is particularly low and it only supplies around one third of Czech supplies. However, the utility of the IKL is capped by the availability of oil from the TAL system, which is currently 95% utilized. This limits the "surge capacity" of the IKL line and would likely preclude it from fully replacing Czech supplies in a deliberate outage. The Czech government has sought to increase its allocation of space on the TAL system and join the pipeline's ownership consortium, but these efforts have yielded few results.[205]

Figure 6.2: Crude Oil Pipelines in the Czech Republic



Source: International Energy Agency (2014)

[204] IEA, 2014.
[205] Binhack and Jaros, 2011; Vlcek and Cernoch, 2013.

The IKL system certainly improves Czech energy security, but it would not fully mitigate the impact of a deliberate supply interruption. A full cutoff of oil supplies through the Druzhba pipeline would still devastate the country. For purposes of classifying access to oil as a security issue for the Czech Republic, the potential for a catastrophic cut off of physical oil supply remains a meaningful threat from an infrastructure perspective. However, this is only a necessary, but not sufficient condition for coding the stability of oil supply as a national security issue. To locate a case in the bottom-right quadrant of Table 2.4, the supplier on the other end of the pipeline must demonstrate a willingness to use energy as an instrument of coercion. Russia fits the bill.

Following World War II, the Soviet Union worked to develop an Eastern Bloc energy complex across all elements of the energy sector. Subsidized natural resource exports constituted a major element of Soviet economic diplomacy.[206] Under this system, allied nations paid for Soviet oil with goods as opposed to hard currency and were expected to support projects in the Russian upstream sector with in-kind contributions. This allowed satellite states to avoid the worst impacts of price shocks in the world oil market before 1989, but it left them with ruinously inefficient energy consumption patterns. Following the fall of communism and the break-up of the Soviet Union, the Russian oil and gas sector experienced substantial problems and supply interruptions became a regular occurrence.[207] Throughout the 1990's, low oil prices and mismanagement caused Russian crude oil production to falter, further calling into question their reliability as a supplier. In the 2000's, prices and Russian production rebounded. More importantly for the discussion here, during this period the Russian

[206] Reisinger, 1992.
[207] Leff, 1997; Yergin 2011.

government began to once again regard hydrocarbon exports as a core component of their grand strategy.

Russia's new emphasis on oil and gas resources as a source of power coincides with the rise of Vladimir Putin, who took over as President in 2000. Putin has always found the concept of using Russia's natural resources as a means of leverage compelling – his master's thesis entitled "Mineral Raw Materials in the Strategy for Development of the Russian Economy" lays out a pathway achieving this.[208] In discussing this issue, Putin argues that, "Energy policy should be designed to meet more than civilian and commercial objectives alone and should be aimed at furthering the geopolitical interests and furthering the national security of Russia."[209] These sentiments are codified in official Russian pronouncements of energy strategy.[210] Russian use of hydrocarbons as a geopolitical tool has entailed three components: consolidating control over the upstream sector; attempting to divide partners in the midstream and downstream sectors; and actively punishing customers who act against Russian interests.

The privatization bonanza in the Russian upstream sector that followed the fall of the Soviet Union created billionaires overnight, but in materially weakened the Russian energy sector. Upon taking office in 2000, Putin set about re-nationalizing Russian energy companies to maximize state control of the upstream energy sector. The most notable example of this phenomenon occurred in 2003 when the Kremlin took over Yukos, Russia's largest oil company at the time. Putin's government jailed the

[208] Stegen, 2011.
[209] Quoted in Smith, 2014.
[210] Binhack and Tichy (2012) cite translations of *Strategy for the Development of the Energy Policy of the Russian Federation up to the Year 2020* published in 2003 and *Energy Strategy of the Russian Federation up to the Year 2030* published in 2009.

company's president Mikhail Khordokovsky, who was critical of the government, liquidated the firms, and absorbed its key assets into Rosneft, the state-owned oil company.[211] During Putin's early rule, state-owned firm moved to the center of the Russian upstream sector. Russian firms also attempted to consolidate control over oil and gas assets in former Soviet states during this period, signing long-term development contracts with Caspian oil and gas producers including Uzbekistan, Kazakhstan, and Turkmenistan.[212] These efforts solidified the Kremlin's control over Russian hydrocarbons and opened the door for their use as geopolitical tool.

The next pillar in Russia's use of energy as a foreign policy tool is the pursuit of bilateral energy relationships with European customers, based on control of transit assets. The logic behind Russia's pursuit of bilateral supply relationships is clear. Bilateral energy trade allows Russia to develop asymmetric interdependence with its trading partners in its favor – especially with landlocked states that depend on pipelines for oil and gas imports.[213] When a small importer, such as the Czech Republic, depends on Russia for all or most of its oil or gas imports, the costs of a supply cutoff are catastrophic. However, the costs of curtailing shipments to a single importer are minimal for a major exporter with other outlets for their crude.[214] Russia's ability to impose costs places captive importers, in an extraordinarily weak position.

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[211] Yergin, 2011; Stegen, 2011.
[212] Cohen, 2007; Stegen, 2011.
[213] Binhack and Tichy (2012) use the logic developed by Keohane and Nye (1977) to develop this point.
[214] This is a fundamentally different power position than a producer which sells all of its crude oil the global market. For example, if Saudi Arabia throttled back its production and the corresponding price increase did not cover the cost of missed revenue from the foregone production, the economic consequences of a production decrease could be worse for them than for their customers.

It is therefore no surprise that Russia has pursued an external energy policy towards its European neighbors that one analyst described as "divide and dominate."[215] To force European counterparts into bilateral engagement, Russia has aggressively pursued the acquisition and development of midstream assets to maximize their control of European hydrocarbon transit, acquiring numerous pipelines and oil terminals throughout Eastern Europe. Russian projects such as the Nord Stream gas pipeline, which directly links the country to Germany, necessitate bilateral bargaining and eliminate any leverage that could be wielded by transit states. Russia has also opposed projects which would help customers diversify their import sources, such as the Nabucco Pipeline, which would connect the Caspian Basin to Western Europe.[216] In both the oil and gas sectors, Russia has pursued captive markets maximize importers' dependence.

To counter these efforts, the European Union has pursued multilateral negotiations with Russia, based on free-market principles. EU nations and Russia signed the Energy Charter Treaty in 1998, which was intended to facilitate investment, institutionalize the free trade and transit of oil and gas, and provide a neutral forum for the settlement of oil and gas disputes. Russia has refused to ratify the treaty.[217] With the boom in production and prices in the 2000's, the country no longer need to submit to Europe's rules to attract investment – the profitability of even frontier Russian projects was too compelling to pass up in a high oil price environment. This left Russia in a powerful position in vis-à-vis numerous small European importers, including the Czech Republic.

[215] Smith, 2008.
[216] Cohen, 2007; Baev and Overland, 2010.
[217] Baghat, 2006; Belkin and Morelli, 2007.

Russia has also demonstrated a willingness to use energy to punish importing states. As former constituent states of the Soviet Union and Eastern Bloc began to gravitate towards Western institutions such as NATO and the EU in the 1990's, Russia made clear that this shift would increase its willingness to cutoff energy supplies to its former allies. These threats became a reality in the mid-2000's when, on multiple occasions Russia chose to flex its energy muscles. In late 2005 Russia dramatically increased natural gas prices to Ukraine in what many considered an attempt to destabilize the pro-Western government of Viktor Yushenko. When Kiev objected to the price hike, Russia suspended Ukraine's gas supplies. This caused a crisis in Ukraine and led to supply shortages in numerous European countries down the pipeline. A similar dispute took place with Belarus in 2007, in which Russia temporarily shut down the Druzhba pipeline causing temporary oil shortages in countries along the Druzhba, including the Czech Republic.[218] These episodes illustrate that threat of a supply cutoff is very real for any nation that finds itself structurally dependent on Russian imports.

In establishing the threat of Russian coercion, two caveats are in order. First, the preceding discussion has not differentiated between oil and natural gas. The goal of this section is to establish that Russia's approach to supplying natural resources to nations in it near abroad constitutes a potential security threat in nations which depend on Russian imports. Russia has displayed a willingness to use energy as a source of coercion with both oil and gas. Because a liquid global market for oil exists, fewer oil importers are vulnerable to bilateral coercion. That said, when oil importers are dependent on one supplier for all or most of their imports based on physical constraints (as is the case with

[218] Belkin and Morelli, 2007; Stegen, 2011; Vlcek and Cernoch, 2013.

the Czech Republic), the asymmetric power dynamics hold. The logic of coercion still applies. Second, none of the preceding discussion of Russian grand strategy argues that it *worked.* Indeed, Russia attempts to change policy and exert influence in its near abroad have yielded mixed success at best.[219] Market realities explain some of this outcome, but energy security countermeasures taken by European importers (including the development of strategic oil stockpiles) have played a major role in Russia's inability to become an energy superpower.

This section supports the coding of the Czech Republic as small-market-power nation whose oil stock primarily address national security threat. To locate the country in the bottom-right quadrant of Table 2.4, it established that as minor oil consumer, the Czech Republic does not enjoy the market power to influence the world market. To classify threat to Czech energy supply as a national security issue, the discussion outlines the characteristics of Czech import infrastructure that render it vulnerable to physical oil supply cutoffs and detailed how Russia, its primary oil supplier, has attempted to uses energy supplies as an instrument of coercion. The following section will discuss the Czech Republic's energy security policy since independence, highlighting the important role that energy issues played in the country's modern grand strategy and the resource-intensive approach to energy security that led it to develop a government-owned strategic oil stockpile.

Government-Intensive Oil Stockpiling in the Czech Republic

The preceding section established that oil supply constitutes a national security concern for the Czech Republic. This dissertation predicts that a country with this type of

[219] Stegen, 2011.

vulnerability will pursue a government-intensive oil stockpiling strategy, notwithstanding its inability to impact the world oil market. This section places Czech oil stockpiling policy in the context the country's energy use patterns and broader approach to energy security. Since its founding in 1993, the Czech Republic has treated energy as a matter of national sovereignty. The country has spent considerable resources on reducing dependence on Russia and increasing the resiliency of its energy sector. Energy security played a major role in many milestones in modern Czech history including post-communist economic reform and EU accession. Oil stockpiling represents an important component in a broader national strategy to reduce dependence on Russian raw materials and buttress the Czech Republic's ties with Western institutions.

Background: A Rapidly Changing Energy Sector

Decades of subsidized Soviet fuel imports bequeathed the Czech economy with extremely inefficient fuel consumptions patterns. Under communist rule, the country paid for oil and natural gas imports in kind and did not suffer the consequences of fluctuations in the world oil price. During this period, oil was a major input to industrial production. Managers could simply request a certain allocation of fuel, which removed any incentives to conserve. Immediately prior to independence, 90% of Czechoslovakia's oil and gas consumption came from Russian imports. Under these circumstances, energy security came from positive relations with Russia. In the early 1990's the country only maintained oil storage infrastructure to hold five days' worth of oil consumption.[220]

[220] Leff, 1997.

Three major evolutions in liquid fuel consumption have taken place in the quarter century following Czech independence. Most basically, oil consumption expanded. In the 1990's and 2000's, rapid economic growth and increased vehicle ownership drove an overall increase in fuel consumption from around 150,000 barrels per day at independence to around 200,000 barrels per day where it currently stands. This increase directly lead to increased imports, as the country produces only minimal crude oil domestically and does not possess reserves that can be exploited in meaningful quantities.[221] Consumption has leveled off, but the higher import number means that a full outage to Druzhba imports would be far less likely to be covered by a surge in imports through the constrained IKL pipeline.

Two other major post-independence shifts in energy consumption patterns hold major implications for Czech energy security, although they cut in opposite directions. On the positive side, the Czech economy became extraordinarily more energy efficient following the fall of communism. This comes as no surprise given the introduction of hard-currency oil purchases and the price signal. Based on the energy intensity measure used in this dissertation, which measures economic output per barrel of oil consumed, the Czech economy is more than four times more efficient today than it was in 1993. This positive development reduces the potential economic impact of an oil supply outage. It also contributes to physical supply security – if the rapid Czech economic expansion in the 1990's and 2000's had followed earlier energy consumption pattern, oil imports would have ballooned to unsustainable levels.

[221] IEA, 2014; Kavina, Jirasek, and Sivek, 2009.

The final shift in Czech energy consumption following independence decreases the country's energy security. Since 1993, oil consumption has shifted to the transportation sector, where demand is considerably less flexible. The first task in moderating fuel consumption after the fall of communism entailed pushing oil out of sectors in which other fuels could be used. This transformation took place in Western economies in the decades following the first oil shock, but not in Eastern Bloc nations. The share of oil consumption accounted for by heavy industry fell from more than half to less than a quarter between 1991 and 2011. During the same period the transportation share increased from around a quarter in 1991 to two-thirds in 2011.[222] This matters because other fuels can substitute for oil in industrial processes which require heat, but no substitutes for oil exist for oil in the transportation sector.[223] This means that an oil crisis could not be addressed through fuel switching. The 200,000 barrels per day that the Czech Republic currently consumes is a largely inflexible quantity. A prolonged curtailment of these imports would entail dire consequences for Czech society.

In addition to shifting energy consumption patterns, the Czech Republic also liberalized its energy sector following independence. Transitioning from a centrally planned, Soviet-style economy to one based on market principles presented a difficult balancing act for the Czech government. On the one hand the country needed to dramatically reduce the role of the state in the energy sector. On the other hand, it needed to reduce its energy dependence on Russia to facilitate stronger ties to Western allies and institutions. The Czech Republic navigated these challenges by liberalizing gas

[222] IEA, 2014.
[223] Natural-gas and electric vehicles could change this circumstance at some point, but they would not be available to address acute crisis. For purposes of assessing energy security decision making during the period under study, transportation fuel demand can be taken as largely inflexible.

and electricity markets, developing nuclear power plants, and privatizing major energy assets.[224] Importantly, the privatization of oil and gas companies in the 1990's and 2000's was completed bearing national security interests in mind. Russian companies did not acquire any major Czech energy assets during this period, despite repeated attempts. This left the country in a better energy security position than other Central European countries in which Russia was able to gain control of energy production and distribution facilities.[225] A full discussion of Czech privatization is beyond the scope of this project, but the fact that the goal of reducing dependence on Russia influenced the process supports the larger argument about the Czech Republic's approach to energy security.

Energy Security Dynamics in the Czech Republic

This dissertation codes the Czech Republic as an oil importer for which energy supply constitutes a national security issue based on its import infrastructure and Russia's disposition as an energy supplier. To fully explain the process that lead to a government-intensive oil stockpiling, however, more detailed discussion of Russia's bilateral energy relationship with the country is necessary. Since the fall of Communism, Russia has used energy threats to attempt to dissuade the Czech Republic from gravitating towards the West. The country has also suffered due to its location at the end of the Druzhba pipeline, which traverses through numerous countries which have tumultuous relations with Russia. Both popular and elite opinion in the Czech Republic reflect concerns about Russia's reliability as an energy supplier.

During the 1990's supply disruptions plagued Czech imports on the Druzhba pipeline. Technical problems accounted for some of these outages, but disagreements

[224] Vlcek and Cernoch, 2013.
[225] Nosko, 2013.

between Belarus and Russia and Ukraine and Russia also played a role in most of them.[226] These early events caused grave concern in the Czech Republic, as they took place before the energy security investments discussed below had come to fruition. Throughout this period, Russia made clear that it would not hesitate to use energy supplies as a weapon. In 1997, the Russian Ambassador directly linked hydrocarbon deliveries to the Czech Republic with the country's aspirations to join NATO – the country became a member two years later.[227] During discussions of Czech EU membership in the early 2000's, Russia made clear that it would be more likely to impose an energy cutoff if the country became an EU member.[228]

The most glaring example of Russia's use of energy as a coercive weapon against the Czech Republic came in the summer of 2008, when the latter signed an agreement that allowed the United States to station elements of the U.S. anti-ballistic missile system in Czech territory, despite strident Russian objections. Immediately following this development, Russia cut Czech supplies through the Druzhba pipeline by 50% due to "technical problems."[229] Because this outage only represented a partial outage, increased imports through the IKL pipeline enabled the country to make up the lost volumes and strategic stocks did not need to be released. This episode confirmed both the reality of Russia's willingness to employ the energy weapon and the importance of strategic investments in energy security.[230]

[226] Vlcek and Cernoch, 2013.
[227] Stegen, 2011.
[228] Nosko, 2013.
[229] Binhack and Tichy, 2012; Vlcek and Cernoch, 2013.
[230] Baev and Overland, 2010; Binhack and Jaros, 2011.

The threat of Russian energy coercion concerns both Czech leaders and citizens. In the 1990's elites in the early governments of the Czech Republic held fewer ties to Russia compared to their counterparts in other Central and Eastern European countries. This contributed to the priority placed on energy security during the privatization process.[231] Generally speaking, Czech policy makers hold negative views of Russia and at best view relations with their former ally as a pragmatic necessity.[232] As the country gravitated more towards the West, public opinion on Russia grew negative as well. A 2007 PEW survey asked Czech respondents if the country's dependence on Russian energy imports concerned them – 57% responded yes. This number rose to 72% in 2009 following the Druzhba cutoff discussed above.[233] Concern about the national security implications of dependence on Russia underpinned the country's costly, effective approach to energy security that included developing a government-owned oil stockpile.

Oil Stockpiling in Czech Energy Security Strategy

This dissertation argues that countries that treat energy supply as a national security issue will invest in publicly-owned oil stockpiles as opposed to pursuing approached to oil stockpiling that minimize costs. Nations facing severe energy vulnerability are more willing to expend public resources to ensure stable energy supplies. A preference for a robust government oil stockpiling program falls in line with this outlook. Since the fall of communism, the Czech Republic has pursued a national energy strategy focuses on maximizing independence and minimizing vulnerability to a supply curtailment. The country has diversified its import portfolio for both oil and gas

[231] Nosko, 2013.
[232] Misik, 2015.
[233] Nosko and Lang, 2010.

and eschewed Russian ownership of national energy assets. Regionally it has elevated energy security as a priority for the EU. This section places Czech oil stockpiling in the context of these broader efforts.

As soon as the Czech Republic came into existence, it began search for ways to reduce the country's imports of Russian oil and gas. Transit diversification became priority after independence. The government examined numerous pipeline options to break the Druzhba's oil import monopoly and settled on the IKL route because of the connectivity with the Western European oil transit system and waterborne barrels. The Czech government guaranteed the project, which was financed through a loan to Czech refiners from the European Bank for Reconstruction and development.[234] The project has clearly reduces Russian leverage over the country, as evidenced by the 2008 partial cutoff discussed above. The significance of this decreased leverage is not lost on Russia. In 2010, the Russian firm Lukoil unsuccessfully attempted to acquire an ownership share of Ceska Rafinerska – Czech refiner that owns the Kralupy refiner that sources most of its crude from the IKL line. Observers feared that this move would have led to closure of the plant and resurgence of Russian imports.[235]

These efforts to diversify import sources extend beyond oil. In the 1990's the Czech Republic agreed to build an interconnector pipeline that linked the country to Norwegian natural gas supplies through Germany. Imports of Norwegian gas never reached more than a quarter of Czech supply and currently all physical gas imports into the Czech Republic arrive from Russia.[236] However, the optionality that this connection

[234] Nosko, 2013.
[235] Binhack and Tichy, 2012.
[236] Binhack and Jaros, 2011; IEA, 2014.

affords the country clearly reduces Russian leverage. Neither the IKL pipeline nor the Norwegian gas agreement make sense on a purely economic basis. Russia is a cheaper supply source for both oil and gas. One observer notes that, "in strictly financial terms, the investment in this particular energy infrastructure is a net loss, or at best an expensive insurance policy."[237] This supports the notion that the Czech Republic employs more than economic calculus when evaluating energy policy – the county is willing to spend public resources on decreasing national vulnerability.

Notwithstanding this success at partial import diversification, energy supply remains a major concern for the Czech Republic. Because the IKL pipeline cannot fully address a supply outage and because Russia could potentially shift supplies to marine export routes, Druzhba imports might cease altogether in the long term. To address this, the Czech government has made efforts to develop pipelines connecting the Czech Republic to northern European ports in Gdansk, Poland or Rostock, Germany to continue the process of diversification.[238] The country has also attempted to access the NATO pipeline system, which distributes limited amounts on refined products for military purposes.[239] The continued importance of energy security is reflected in Independent Expert Panel Report to Assess the Long-Term Energy Needs of the Czech Republic:

> "*Oil is not contractually guaranteed in the long term. In this situation, we are more dependent on the global oil situation to which we must respond by monitoring the overall situation, good diplomatic relations with several*

[237] Baev and Overland, 2010, p. 1083.
[238] Binhack and Jaros, 2011; Vlcek and Cernoch, 2013.
[239] Nosko, 2013.

producers, [and the] extension of strategic reserves and by a savings program and by the next generation of biofuels"[240]

Biofuels will not fundamentally shift the energy security circumstance of the Czech Republic any time soon. Of the components of a national energy security strategy mentioned above, the development of strategic reserves has received the most resources.

As noted previously, the Czech Republic held virtually no oils stock at independence. The government quickly set about addressing this shortcoming. The initial institutional impetus to develop an oil stockpile came not from the IEA, but from the EU. When the organization expanded eastward, potential new members had to adhere to myriad EU rules governing the energy sector. For most countries, adherence to these rules meant fundamentally restructuring their statist energy sectors. Privatization and market liberalization during this period led to concerns about sovereignty in some new member states, which jealously guarded their new independence from the Eastern Bloc. However, developing an oil stockpile represented the most costly component of EU accession for most new member states. Under European Council rules, EU member states must hold petroleum stocks equivalent to 90 days' worth of *consumption* – a higher bar than that set by the IEA. This regulation allows nations to meet this requirement through industry mandates, tickets, or bilateral stockpiling treaties with other EU members. Because of the large costs associated with oil stockpiling, the EU granted many new members grace periods to ease the burden of compliance.[241]

In line with the expectations of this dissertation, the Czech Republic surpassed the baseline requirements laid out by the EU, and developed a comprehensive government oil

[240] Quoted in Vleck and Cernoch, 2013, p. 65.
[241] Tosun, 2011.

stockpiling program. Shortly after the country signed the 1995 European Agreement that laid out the process for EU accession, the country began developing its oil stockpile (see figure 6.1).[242] In 1999, the Czech Republic passed the Act on Emergency Oil Stocks 189/1999, which laid out an oil acquisition plan and established the Administration of State Material Reserves (ASMR) – the government agency that manages the nation's oil stockpile. In addition to administering strategic oil stocks, ASMR is also authorized to implement draconian conservation measures in the event of an oil supply crisis. Czech stocks are mostly stored in segregated tanks as opposed to being comingled with the domestic petroleum network.[243] This approach to locating the stocks is expensive, but it maximizes the emergency utility of the strategic reserves. This stands in stark contrast to oil stockpiling nations focused on minimizing costs. The strong role of government in strategic oil storage reflects the Czech Republic's dedication to energy security.

It could be argued that the robust Czech program simply reflects the country's goal of complying with EU and IEA stockpiling requirements as opposed to the strategic energy security imperatives facing the country. The premise of this dissertation, however, is that the robustness of nations' compliance strategies varies with the vulnerability that they face. In the case of the Czech Republic, the country's public oil stockpiling strategy reflects a willingness to devote resources towards energy security that goes well beyond the bare minimum expenditure that would be required to meet EU and IEA requirements. The argument that strategic imperatives drive oil stockpiling policy is also buttressed in this case by the fact that the Czech Republic goes above and beyond IEA and EU requirements.

[242] Vleck and Cernoch, 2013.
[243] IEA, 2014.

Three aspects of the Czech oil stockpiling program exceed(ed) the minimum thresholds for membership in the IEA and EU. In terms of timing, the country received a relatively short grace period for EU compliance and reached the necessary inventory levels ahead of time, well before many of their Eastern European peers.[244] The Czech strategic reserve also exceeds minimum quantity requirements. As of 2012, the Czech Republic held 104 days' worth of petroleum stocks as measured by the IEA methodology and 119 days' worth of stocks as measured the EU methodology.[245] The country plans to continue expanding its stockpile. This excess inventory means that the country can draw down some of their stocks to address a domestic crisis and still remain in compliance with IEA and EU storage minimum requirements. The Czech Republic can also draw down its stocks at a rate *larger* than its national level of petroleum consumption.[246] This flow capability far exceeds any fathomable contribution that the Czech Republic would be able to make to an IEA collective action. The overall strength of the Czech oil storage program, in which the country clearly "punches above its weight", suggests that it is driven strategic imperatives as opposed to institutional compliance.

In fact, it might be argued that the Czech Republic, along with other Eastern European "new" members, influence EU energy security policy as opposed to the other way around. Energy security increased in importance for the EU following the organization's 2004 Eastern enlargement, in which 10 Eastern European nations joined. Russian supply cutoffs, especially the 2005-2006 Ukraine crisis, further sharpened this focus.[247] Compared to any individual consumer, the EU would have far more leverage as

[244] Tosun, 2011.
[245] Vlcek and Cernoch, 2013.
[246] IEA, 2014.
[247] Baghat, 2006; Belkin and Morelli, 2007; Misik, 2016.

an importing party based on the scale of their market. To the extent that it could bargain as a unit, the EU could potentially flip the asymmetric interdependence with Russia that threatens nations like the Czech Republic.[248] Former Eastern Bloc nations therefore pushed to deepen EU integration on energy issues. The Czech Republic played an active role in this process. It focused much of its 2009 presidency of the European Council to solidify the organizations support of a common energy policy.[249] This contributed codification of EU energy security goals, as well as an affirmation of the importance of oil stockpiling, in the 2010 Lisbon Treaty.[250] A full assessment of EU energy security integration is related to, but beyond the scope of this project. However, entrepreneurial activity by the Czech Republic and other Eastern European nations in making energy security an EU priority highlights the importance of this issue for nations that are dependent on Russian hydrocarbons and supports the larger narrative presented here.

Case Summary

This dissertation argues that the market power conferred by strategic oil stocks and the nature of energy security threat that a nation faces combine to determine national oil stockpiling strategies. The Czech Republic's small oil stockpile cannot decisively impact the global oil market under any circumstances, which would recommend a cost-minimization energy security strategy based solely on economic calculus. However, the preceding analysis makes clear that that Czech energy vulnerability constitutes a national security threat that goes beyond prosperity concerns. Given the land-locked nation's oil import infrastructure, it is vulnerable to physical oil supply cutoffs that could cripple

[248] Binhack and Tichy, 2012.
[249] Szlagowski, 2011; Misik, 2016.
[250] Tosun, 2011.

Czech society. The threat of coercion looms large, as the country receives most of its imported oil and all of its imported natural gas from Russia, an exporter that regularly uses energy as an instrument of coercion. This dissertation would predict that, under these circumstances, the Czech Republic would pursue a costly government-owned oil stockpiling strategy, notwithstanding its inability to impact the global market.

Since achieving independence in 1993, the Czech Republic has treated energy security as a matter of national sovereignty and invested substantial resources reducing the nation's vulnerability to a supply cutoff. During the transformational period in which the country restructured its economy and began to gravitate towards the West, reducing the nation's energy dependence on Russia constituted a paramount national goal. To achieve this, the Czech Republic partially diversified its import sources, helped move energy security to the top of the EU agenda, and built a substantial government-owned oil stockpile. Czech strategic petroleum storage capabilities far exceed the minimum stockpiling requirements laid out by the EU and the IEA. National security imperatives drive this resource-intensive program, in line with the predictions of this dissertation.

Chapter 7: Conclusion

This dissertation presents an explanation for the oil stockpiling strategies pursued by IEA member. The project conceptualizes this practice as a form of state behavior. Some members undertake a government-intensive approach to developing strategic oil stocks, which constitutes a robust national approach to energy security. Other nations minimize program costs by placing the burden of strategic oil storage on industry. This approach meets the baseline IEA membership requirement, but it affords countries a far weaker policy instrument. To explain why states pursue each respective strategy, the model proposed here identifies two core determinants of stockpiling behavior: the type of vulnerability that oil stockpiles address and the scale of the market power that oil stockpiles confer.

Strategic oil reserves defend states against two broad categories of vulnerability. Oil-importing nations face economic vulnerability from the risk of oil price shocks caused by supply disruptions. A collective release of IEA strategic stocks can mitigate price shocks. Where strategic oil reserves primarily address economic vulnerability, states with small market power can be expected to minimize costs, because they can enjoy the collective benefits of market stabilization whether or not their stockpiles effectively contribute to a collective action. In the face of significant economic vulnerability, states with large market power can be expected to pursue resource-intensive government stocks. These nations materially impact the success or failure of IEA collective stock releases. The cost of an effective oil stockpiling program is justified by the ability to increase the collective benefits provided by stock releases.

Strategic oil stocks also defend nations against national security threats associated with physical supply cutoffs. Landlocked nations that depend on a hostile supplier for most of their crude, or states whose waterborne imports can be cutoff by a naval blockade, are vulnerable to oil coercion. In these countries, energy security represents a matter of national sovereignty. Where oil stocks address national security vulnerability, states can be expected to pour resources into publicly held oil stockpiles even when they cannot impact the market. If a country face the threat of supply cutoffs and wields significant market power, it can be expected to pursue a vigorous stockpiling strategy that includes both state owned strategic reserves and substantial stockpiling requirements for industry.

This dissertation tests this theory using both quantitative and qualitative approaches. Chapter three presented the results of a statistical analysis of time-series, cross-sectional data on oil stockpiling in IEA countries for the period from 1984 to 2012. This analysis clearly illustrated the relationship between government oil stockpiling and dependence on hostile sources. The results also demonstrate the importance of market power. Conversely, variables representing domestic energy consumption patterns and energy policy do not prove to be significant. Given the complexity of the concepts addressed in this project, qualitative analysis was required to buttress these results.

Three case analyses provide evidence in support of the theory developed here. In the United States, economic vulnerability and the ability to influence the global oil market quickly became focal points in the decision to build an enormous government-owned reserve. For Sweden, the obsolescence of physical supply threats and the inability of a small national stockpile to impact the world market led the country to comply IEA

requirements through industry mandates. In the Czech Republic, which faces the threat of energy coercion from Russia, the country pursued a resource-intensive government oil stockpiling strategy notwithstanding its inability to impact the world market. Together these cases highlight the importance of both vulnerability type and market power in determining energy security policy.

Contribution

This dissertation makes an empirical and theoretical contribution to political science and to the study of energy security. Most importantly, this is the first study of oil stockpiling that conceptualizes the development of strategic reserves as a form of state behavior. Most sophisticated analyses of oil stockpiling are rooted in the economics literature. Studies focused on the market impact of these assets enrich the discourse on energy security, but they fail to present a complete picture of why states make the stockpiling choices that they do. By assessing the constellation of vulnerabilities that various nations face and the disparate capabilities that their oil stocks confer, an enriched understanding of what drives this practice emerges. This project makes clear that leveraging ideas rooted in the international relations literature to better comprehend energy security and energy policy is a fruitful analytical strategy.

In addition, presenting a novel approach to study oil stockpiling policy, this project enriches the study of energy security in two ways. First it enhances the precision in this area. Based on the catchall definition of "a reliable and affordable supply of energy," energy security is an extremely broad concept.[251] This makes pinpointing the drivers of energy security policy quite challenging. As noted in chapter two, most of the

[251] Deutsch, Schlesinger, and Victor, 2006.

energy policy choices that governments make serve multiple purposes. Funding energy research and development, taxing liquid fuels, lowering national speed limits, and maintaining a blue-water navy all enhance nations' energy security in some form or fashion. However, the determinants of these policy outcomes are variegated. In contrast, oil stockpiling is clearly an *energy security* policy. In evaluating the drivers of this practice, this project offers a more precise conceptualization of energy security policy than could be achieved by focusing on other policy areas.

Secondly, this project clearly delineates between the economic and national security energy threats by explicitly examining how these distinct types of vulnerability impact policy outcomes. Many observers make the blanket assertion that "energy security is national security," even though this is not really the case for many countries. Nations in which secure energy supplies primarily represent a prosperity issue take a completely different approach to energy security than do nations in which energy is treated as a matter of national security. Unless the prosperity imperative is compelling enough to lead a nation to war, policies to defend energy security will be undertaken based on economic costs and benefits. Where energy security is equated with sovereignty and freedom from coercion, it is clearly a national security issue. This drives a resource-intensive approach to supply stability. This project helps clarify that categorizing energy security as a national security issue requires specific national circumstances. It suggests that expectations of state behavior vis-à-vis secure energy supplies should be rigorously calibrated by assessing the nature of energy threats than nations face.

Theoretically, this assessment of the determinants of energy security policy yields some insights into the relative importance of state-level factors and domestic factors in determining policy outcomes. Open economy politics (OEP) treatments of energy policy, which hinge on the role of domestic interest groups, often provide the most convincing explanation of energy policy. In this case, however, these theories fall short. The relatively small distributional consequences of oil stockpiling policy render the bedrock assumptions about the impact of interest group behavior tenuous in this policy area. Further, the OEP approach is primarily designed to address economic issues. Interest group models cannot adequately address issues of security.

In providing a cogent explanation of oil stockpiling policy based on state-level determinants, this dissertation demonstrates the continued relevance of nations' array of threats and capabilities in determining energy policy outcomes. As the field of political science continues to expand its treatment of energy issues, particularly energy security, scholars will need to focus on both traditional conceptualizations of the national interest as well as domestic political economy factors to fully explain outcomes in the global energy policy space. In the case of oil stockpiling, the fundamental geographic and economic circumstances of states clearly explain variation in IEA members' strategy. This suggests that the lens provided by security studies adds value to the treatment of energy in policy areas where national security concerns (as well as national-level macroeconomic concerns) are in question.

This dissertation also validates some of the discipline's foundational thinking about the provision of public goods. The model presented here contends that states facing economic vulnerability will expend resources on government oil stockpiles when

they can to meaningfully impact the global market. The focus on economic benefits and market power in the discourse on the American SPR validates this assertion. This accords with the expectations of Mancur Olson's *The Logic of Collective Action*, which suggests that large nations will pay for an outsized share of a collective good if they derive a large portion of the benefits.[252] The cost-minimization strategies pursued my many small IEA members also fall in line with Olson's expectations about the incentives of small nations to free-ride on the efforts of others.

This project thus highlights the fundamental challenges of providing a collective good and confirms expectations of when states will expend resources on the pursuit of a collective good. As the discipline of political science begins to address global climate change, collective action issues will become even more important. Although this project's logic does not perfectly translate to evaluating climate policy[253], it does show that consequential states will base the extent of their resource support for the provision of a public good on the benefits that they expect to accrue. While oil market stability does hold the same normative content as climate change mitigation, this national-interest-focused outlook should inform political science treatments of climate change going forward.

Policy Implications

This dissertation also yields policy implications. Within the IEA, small nations can be expected to continue their approach to oil stockpiling in the medium term. Small

[252] Olson, 1971.
[253] States with small market power in terms of $C0_2$, whose fundamental existential national interests are impacted by climate change (e.g. The Maldives), cannot improve their circumstance by pouring resources into climate policy instruments the way that captive importers can bolster their energy security through oil stockpiling.

importers facing primarily economic vulnerability will likely continue to focus on minimizing the costs of their programs. These countries will continue to benefit from the collective market defense mechanism provided by the IEA, which suggests that they will not weaken the organization by withdrawing from the IEP treaty. Australia's plan for compliance provides some evidence for the organization's staying power in the face of a changing global market. Until a transformational shift fundamentally reduces the role that oil plays in national economies, these nations will continue to support energy security measures, albeit in the cheapest way possible.

For captive importers, the picture is somewhat more dynamic. The logic presented here will continue to hold – where the curtailment of oil supplies represents a national security threat, nations will invest heavily energy security assets. However, the picture could change for the Czech Republic and its Eastern European peers, depending on the future of European midstream infrastructure. If Russia shuts down the Druzhba pipeline in an effort maximize waterborne trade and oil shipments to Asia, circumstances will shift dramatically for countries dependent on this artery. Given Russia's approach to energy exports discussed here, this seems unlikely. A more plausible scenario that could reshape the energy security landscape of Eastern Europe is increased midstream buildout. American exports are adding liquidity to Atlantic Basin crude oil market, which could improve the economics of the proposed pipeline routes that would connect Eastern European importers to the Baltic Sea. If this takes place, and Russia loses the ability to coerce these nations by threatening a supply cutoff, the national security imperative to maintain a robust oil stockpiling system will decrease. In this event, based on the logic of the model here, these countries will likely move to a cost minimization strategy.

In the near future, this dissertation's model suggests that a greater potential transition could take place in the United States. Unlike Japan, the other IEA member with decisive market power, the United States can meet its IEA days-of-cover obligation even if it dramatically reduces the amount of oil held by the government. The shale revolution's transformation of the American energy landscape could lead to a tectonic shift in the way that the United States views energy security. Increased oil production has reduced both the real and perceived economic vulnerability to oil supply shocks. Despite the fact that a degree of economic vulnerability it will persist based on high oil consumption, policy makers likely do not consider external energy supply shocks to be the grievous threat that they once were. This dissertation predicts that if a state with large market power shifts from high economic vulnerability to low economic vulnerability, it will transition to a cost-minimization approach to oil stockpiling. In the United States, this is beginning to take place.

As discussed in chapter four, the U.S. Congress passed legislation in 2015 and 2016 that will reduce the size of the SPR. Even after these legislated sales, the United States would hold the largest strategic oil stockpile in the world and wield a formidable drawdown capability that can address almost any energy contingency. Given that these inventory reductions will, in part, finance SPR modernization, they could even be viewed as evidence of a desire on the part of the United States to sustain the SPR's market power. However, a mandatory budget proposal put forth with the Trump Administration's 2018 budget calls for liquidating half of the SPR's remaining inventory and closing two of the SPR's Gulf Coast storage sites.[254] If Congress enacts this

[254] OMB, 2017.

recommendation, it would reduce reserve's drawdown capability and undercut the IEA's capability to respond to a catastrophic supply disruption. At the time of writing, the future of this proposal is unclear. It suggests however, that as American policymakers begin to link American prosperity more with oil production than with a stable supply of oil imports, the U.S. outlook on energy security could dramatically change.

The impact of an American retreat from defending global energy security would amplify a critical issue facing the IEA: the shrinking share of global oil consumption represented by its members. Over the next quarter century, oil consumption in OECD countries is projected to remain essentially flat while non-OECD consumption will likely increase dramatically.[255] As the share of world oil consumption represented by IEA countries decreases, the IEA stocks will represent a smaller and smaller share of world output.[256] Over time, this will reduce the organization's ability to address large-scale supply disruptions, assuming that supply from unstable regions grows in proportion with global demand. In the future, addressing large-scale oil supply disruptions will require the participation of non-IEA members in the world's crisis response. Recognizing this, the IEA has sought to build ties with major non-IEA importers through its Association Initiative, which institutionalizes collaboration and information sharing with non-members.[257]

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[255] EIA's *International Energy Outlook 2016* projects that global oil consumption will grow from 90 million barrels per day in 2012 to 31 million barrels per day in 2040. Of the project 31 million barrels added to global oil consumption, 30 million barrels will be consumed in non-OECD countries.
[256] The references to IEA and OECD members are used interchangeably here. Omitting consumption growth from the handful of OECD countries that do not belong to the IEA (Chile, Iceland, Israel, Mexico, Latvia, and Slovenia) would not dramatically change any of the above conclusions.
[257] IEA, 2017. At the time of writing, participating Association Initiative countries include China, Indonesia, Thailand, Singapore, Morocco, and India. This program involves limited participation in IEA meetings, data sharing, emergency preparedness training, and other collaborative activities.

The increasing preponderance of non-OECD demand means that strategic oil stockpiling in non-IEA nations will play a pivotal role in global energy security in the coming decades. The model developed in this dissertation can illuminate how these countries might approach oil stockpiling. Smaller countries with access to maritime imports have every incentive to minimize costs and free ride on the efforts of larger nations. The most advanced discussion of oil stockpiling in small importing nations has taken place among member countries of the Association of Southeast Asian Nations (ASEAN).[258] While these nations together make up a substantial consumption block, no single member of the group could meaningfully influence the world oil market. As the model in this project would predict, ASEAN members have not invested substantial resources into government-owned stockpiling programs. Industry holds basic operating stocks in these countries, but not much more. The logic underpinning the cost-minimization approach to energy security is particularly compelling for developing countries which have limited resources and are still striving to meet their citizens' basic needs.

The national security logic behind government-intensive oil stockpiling for small, captive importers can also be expected to hold outside of the IEA. That said, the population of small countries which face potential coercion stemming from the threat of a fuel supply cutoff is small outside of Eastern Europe. Botswana represents a notable non-IEA example of a nation developing a strategic oil stockpile purely based on strategic threats. After the land-locked African republic suffered through various embargoes of goods from Southern Rhodesia in the 1970's, it developed a Strategic

[258] Shin and Savage, 2011.

Petroleum Reserve based on the threat of a petroleum supply cutoff from the apartheid government of South Africa.[259] Because relations with South Africa have improved, Botswana has not augmented its inventory of strategic stocks since the fall of apartheid, but it still maintains a government reserve. This example demonstrates the external validity of the security logic presented here.

The most important issue for global energy security moving forward is the trajectory of oil stockpiling in China and India, both of which would wield considerable market power if they fully developed oil stockpiles commensurate with their consumption levels. India is building a government-owned strategic reserve that will eventually hold 90 days' worth of crude oil imports.[260] If India's SPR grows apace with its oil consumption, it will be among the largest in the world in the coming decades. This will provide the country with the ability to decisively impact the world oil market in a crisis. Given India's expanding import levels, the structure of the economy, and the country's growth trajectory, it will become increasingly vulnerable to shocks in the world oil market. As this dissertation would predict, the combination of economic vulnerability and large market power are leading to a government-intensive approach to oil stockpiling. That said, the country is still in the very early stages of establishing its program and it faces many of the resource constraints faced by other developing countries.

China's oil stockpiling program is far more advanced. China has made considerable progress on a large SPR and seeks to expand it. Many policy makers in China view the threat of a physical supply cutoff as a material concern. This, coupled

[259] Dale, 1995.
[260] EIA, 2016a.

with the country's immense market power, suggest that China is likely to apply massive resources to energy security based on this project's logic. Given the critical importance of Chinese oil stockpiling as a policy issue and the fact that China is the only country that matches the large-market-power, security-vulnerability archetype developed here (the top-right quadrant of Table 2.4), the following section will seek to validate the model's logic outside of the IEA context through with a brief treatment of China's SPR program.

Forecasting Out of Sample: Oil Stockpiling in China

Since China became a net importer in 1993, the security of oil supplies has played a major role in the country's global strategy. China is now the world's largest net importer of crude oil and is expected to remain in this position for the foreseeable future.[261] Stable oil supplies supported the energy-intensive economic growth that has catapulted China to its prominent position on the world stage. The security of China's maritime oil imports is guaranteed by the United States Navy, which controls the world's sea lines of communication (SLOC's). Both economic vulnerability to global oil shocks and the security vulnerability of a potential oil supply cutoff inform China's thinking about energy security. This dissertation would project that, given these vulnerabilities and the market power that China's SPR will ultimately provide, the country can be expected to put an extraordinary amount of resources towards oil stockpiling *and* place a large strategic storage burden on industry.

Explanatory Factors

In terms of this project's explanatory model, coding China as having an SPR with large market power is straightforward. The exact inventory of China's SPR is not known,

[261] Ibid.

but the country is estimated to hold close to 200 million barrels.[262] This would already make China's stockpile the third largest in the world after those in Japan and the United States. China has explicitly stated its plans to eventually build a reserve equivalent to 90 days' worth of imports. Based on net import levels of close to seven million barrels per day, this would amount to a reserve of more than 600 million barrels.[263] If China continues on a path to 90 days, when the United States completes its legislated SPR sales China will hold the world's largest strategic reserve. The exact release capacity of China's SPR is not clear, but given its distributed nature within China's logistical system, it can be assumed to be able to pump out volumes which approach China's daily import rate. The country would be able to play a major role in buttressing IEA efforts to address a major oil supply crisis.

Pinning down the exact inventory size and drawdown capability of China's SPR is unnecessary for purposes of this analysis. The market power of a nation's SPR matters here as it relates to strategic decision making. Once an oil importer attains the capability to play a meaningful role in stabilizing the world oil market, the economic benefits of avoiding price shocks become an input variable in a nation's cost-benefit analysis of oil stockpiling. This fundamentally alters the calculus for energy security policy decisions. China clearly wields this capability based on the scale of their SPR. This project's model suggests that this capability, coupled with high economic vulnerability, would lead a country to develop a large public oil stockpile based purely on economic cost-benefit analysis.

[262] Wong and Aizhu, 2016.
[263] Import data from Wu and Nakano, 2016.

China is presumably economically vulnerable to oil price shocks, although the extent of this vulnerability is not completely clear. Compared to the highly developed understanding of the relationship between the market and macroeconomic growth in OECD countries, little is known about how the Chinese economy reacts to high oil prices. The handful of studies on this topic present a sanguine view of China's economic vulnerability.[264] This likely stems from the fact that the world has not experienced a catastrophic supply crisis in the decades since China became a net importer. The largest price escalation during the period, which occurred in 2008, was attributed to Chinese demand caused by a booming economy. Economic research suggests that demand-side shocks cause far less damage to national output.[265] A supply shock in the world oil market would almost certainly impact China's output. This is especially true given the liberalization of the country's domestic crude oil market, which is now full co-integrated with the global market.[266] As China continues on the path of liberalizing its refined product markets, this vulnerability will only increase.[267]

Coding China as facing national security threats related to oil supplies requires two steps. First, it must be established that the country's physical access to petroleum could conceivably be compromised by an adversary. Second, the extent of this threat needs to be characterized based on China's relationship with the relevant adversary. This discussion will focus on the former. Only the United States could compromise China's

[264] Cong, et. al. (2008) show that oil shocks did not harm China's stock markets from 1996 to 2007; Du, Yanan, and Wei (2010) find that oil shocks from 1995 to 2008 correlate *positively* with China's GDP growth
[265] Kilian, 2009.
[266] Li and Leung, 2011.
[267] Li and Leung, 2011 and Leung, 2011 discuss the China's efforts to move away from subsidizing consumer fuel prices. As Chinese businesses and consumers face are forces to shoulder the burden of an oil price shock, the mechanisms through which oil shocks harm the economy become more severe.

physical access to crude oil in a meaningful way. Unlike Russia, limiting resource access is not a cornerstone of American foreign policy. Assessing the likelihood of an American naval blockade of China would require a deep-dive into U.S.-China relations that goes beyond the scope of this dissertation. That said, the possibility of such a cutoff is unambiguous based solely on capabilities.

China is extraordinarily dependent on waterborne crude oil imports. The country produces around four million barrels per day, making it the world's sixth largest oil producer.[268] However, China's production has been declining in recent years and an increasing share of the country's oil needs will need to be met with imports going forward. China relies on imports for about two-thirds of its oil consumption.[269] Despite efforts to expand pipeline imports from Central Asia, the lion's share of oil shipments arrive via sea routes from the Middle East.[270] Petroleum traveling from the Middle East to China must pass through the Straits of Malacca, which many view as a critical chokepoint for Asian supply.[271] If the United States Navy wanted to curtail oil shipments into China, it could. This would be costly and difficult, but within the realm of American capabilities.[272]

A cutoff of oil would entail dire consequences for China. Although domestic crude oil output and refinery runs would be able to supply core military and industrial

[268] EIA, 2017a. This is based on crude oil and lease condensate production only. The top five producers are Russia, Saudi Arabia, the United States, Iraq, and Iran.
[269] Wu and Nakano, 2016.
[270] EIA, 2015.
[271] If the Strait of Malacca was compromised, oil tankers could be rerouted. This would cause temporary shortages and increased transport costs, but it would not remove a significant quantity of barrels from the world market for an extended period of time. This does not stop officials from worrying about it.
[272] Erickson and Collins, 2010 state this clearly in the *Naval War College Review*. The capability component of this issue represents a working assumption for all analysts in this area and Chinese policy makers.

functions, widespread supply shortages would cripple the country. China's domestic stability rests on the provision of a decent standard of living for a critical mass of the country's population. Forced fuel rationing could lead to precisely the type of unrest that the Chinese Communist Party fears most. Whether or not a severing of Chinese petroleum supplies is likely, the consequences of such a threat are dire enough to elevate the stability of oil supplies to a core national security issue for. In terms of this dissertation, energy supply stability in China can be coded as a national security issue for China. As the following section details, security concepts have played a prevalent role in China's discourse on oil stockpiling.

Oil Stockpiling and Chinese Energy Security

This section will demonstrate that the concepts highlighted in this dissertation have played a role in China's decision to build a large, government-owned SPR. The Chinese government opted to pursue this strategy in the context of a high-level strategic discourse on how to navigate the energy vulnerability linked with the becoming a significant net oil importer. As this dissertation's model would project, the ability to impact the global oil market as well as the vulnerability of oil access both played a major role in Chinese energy security decision making and in the decision to build a public oil stockpile. As China has learned about and adapted to the realities of the global oil market, the importance of a robust oil stockpile has become clearer to Chinese decision makers. Going forward, the vulnerability delineation in this model will be key to understanding the trajectory that China's SPR program will take.

In decades following China's transition to a net oil importer in 1993, the country has climbed the learning curve in terms of its understanding of the global oil market. As

was the case for the Western countries discussed in this project, many Chinese officials initially equated energy security with self-sufficiency. Other participants in the discourse more readily accepted that, as a major importer, China participates in a globalized, liquid oil market that affords the country stable peacetime supplies, but also renders it vulnerable to price fluctuations.[273] Part of the early skepticism of global market's ability to address China's energy needs stemmed from the fact that the United States dominates this market and provides the security guarantee that allows it to function.[274] A similar division arose in the West's assessment of China's energy policies. China's efforts to defend their energy security could fit into either a "strategic competitor" narrative or a "peaceful rise of China" narrative depending on one's outlook.[275] The tension between these two outlooks animates the Chinese dialogue on energy policy.

Petroleum stockpiling is one of three broad oil-security strategies that China has employed in recent decades. The other two approaches to ensuring stable oil supplies – the "going out" strategy and supporting the construction of interstate pipelines – are costly and largely ineffective. A substantial component of China's learning in the oil space has involved coming to terms with the folly of both of these policies. A brief treatment of each of these components of China's energy security strategy can shed light on the China's substantial commitment to energy security and make clear that a robust oil stockpile will do more to shield China from energy vulnerability than any other supply-side measure.

[273] Downs, 2004.
[274] Kennedy, 2010.
[275] Cao and Bluth, 2013.

China's "going out" strategy, in which China has prioritized preferential energy supplies in it diplomatic relations with producer countries and sought equity participation in international upstream oil plays, constitutes the most controversial aspect of the nation's quest for energy security. Since the 1990's China has invested more than $170 billion in exploration and production projects around the world.[276] The Chinese government has supported the international activities of national oil companies and facilitated their access to international projects through high-level engagement with producers.[277] Much of this activity entailed serious diplomatic costs, as China has been willing to do business with rogue regimes (e.g. Sudan), compromising international efforts to isolate them.[278] While China might not share Western normative concerns about engaging global malefactors, the country does not benefit from diplomatic tensions. Many Chinese observers have expressed concern about the primacy of energy supply in China's foreign affairs.[279] At best, this approach to energy security entails strategic costs.

Moreover, the "going out" strategy is a categorically ineffective approach to energy security. Equity investments abroad neither insulate the country from a price shocks nor defend China's supplies from a physical cutoff. China's (often inefficient) equity ventures do not add barrels to the world market which would not otherwise be there. Supplies from these projects trade at global prices, which means they will be subject to the same price fluctuations that occur in the wider market.[280] Moreover, equity barrels do nothing to hedge against a physical supply cutoff. Given that producers

[276] Wu and Nakano, 2016.
[277] Leung, 2011; Tessman and Wolfe, 2011; Wu, 2014.
[278] Jaffe and Lewis, 2002; Thomson and Horrii, 2009; Smith, 2016.
[279] Kennedy, 2010; Kong, 2011.
[280] Leung, 2011.

embargoing exports to China is extremely unlikely in a globalized oil market, the key potential threat to physical supplies comes from a possible cutoff of marine imports. Physical cargoes into China can be interdicted by a foreign military whether or not Chinese companies played a role in producing the crude.[281] Unlike strategic stocks, these investments do nothing to stabilize the global market nor to defend China's national security.

The construction of interstate pipelines is little better. The Chinese government has supported numerous pipeline projects in recent decades, most notably linking the western part of the country with Central Asia. These assets reduce China's dependence on maritime imports, but they do little to advance the country's energy security. Many of the oil pipelines into China are uneconomic without government support.[282] They do not add meaningful quantities to the world market and nor do they ameliorate the country's economic vulnerability to price shocks. Unlike state-supported pipeline projects in Eastern Europe that reduce nations' susceptibility to oil coercion, pipelines accomplish little to advance Chinese national security. Although these assets reduce the portion of China's imports that arrive via water, pipelines and the related pumping infrastructure make easy targets. In a situation in which the United States was willing to take the step to cut off China's maritime oil supplies, they would also potentially be willing to target these assets as well.[283]

The "going out" strategy and the pursuit of pipeline access to crude oil do not accomplish much for China. However, these measures do demonstrate a significant

[281] Downs, 2004.
[282] Erickson and Collins, 2010; Leung, 2011.
[283] Erickson and Collins, 2010.

commitment of resources towards energy security. A major effort to build a national oil stockpile falls in line with these efforts. China's strategic oil storage program, accords with the expectations of this dissertation. This project's explanatory model posits that a country which faces national security threats related to energy supplies *and* possesses the market power to address economic threats related to energy consumption will pursue the most resource-intensive approach to oil stockpiling possible. Not only has this been the case in China, but both market power and security vulnerability have featured in the discourse on China's SPR.

The early debate over oil stockpiling in China's took place in the late 1990's and early 2000's. This discourse unfolded as the Chinese energy bureaucracy was playing catch-up in terms of building the capability to address the massive energy challenges brought on by rapid economic growth.[284] During this period, different factions within the government took different positions on the SPR. Some argued that, as a developing country, China could not afford the luxury of strategic reserves. This contention was compelling – at the time of the early SPR debates China's GDP per capita was around $1000 per person.[285] The same concerns about the low likelihood of a drawdown and stockpile financing that arose in IEA countries also played a role in the SPR debate in China. Despite cost concerns, China included the development of an SPR in is 10th Five-Year Plan (2001-2005).[286] The country's ultimate willingness to invest in energy security notwithstanding a relatively low level of economic development highlights the importance that China ascribes to energy security.

[284] Kong, 2011.
[285] World Bank, 2017.
[286] Downs, 2004.

Since the initial decision to build an SPR, the security of China's physical supplies has featured prominently in China's energy security discourse. As is the case for many IEA countries, China's outlook on oil security is partly grounded in historical experience. Following the outbreak of the Korean War in 1950, the Coordinating Committee for Multilateral Export Controls embargoed oil exports to China from the West. The Soviet Union made up the supplies until the Sino-Soviet split. Before domestic Chinese production took off with the discovery of the Daqing oil field, the shortages caused by the curtailment of foreign supplies had a severe impact in China, forcing the country to use alcohol in motor vehicles and limit military activities.[287] After 30 years of self-sufficiency in oil, China's return to importer status re-introduced concerns about this type of threat.

China's security-related concerns about oil access extend beyond contingency planning for an acute petroleum cutoff. Fundamental unease about the country's dependence on the United States for protecting the SLOC's also plays a role in Chinese decision making. In 2003, President Hu Jintao publicly bristled at China's reliance on "certain major powers" for protecting navigation through the Strait of Malacca.[288] Discomfort with American naval prominence has driven more than just energy policy. Chinese defense officials point energy concerns as a component of the justification for shifting resources from the army to the navy in pursuit of "Far Sea Defense."[289] China now plays a more active role in combatting international piracy on the high seas and some planners argue for increased involvement in defending shipments from the Persian

[287] Leung, 2011; Kong, 2011.
[288] Zhang, 2011.
[289] Kennedy, 2010.

Gulf. Concerns about a potentially reduced American footprint in the Middle East buttress arguments for a China playing a larger role in defense of global commerce.[290]

The role of energy security in Chinese military strategy makes clear that, not only does China objectively face energy security threats based on its geography and energy consumption patterns, but also that policymakers recognize this and make decisions accordingly. This has played a direct role in China's SPR planning as well. A critical component of the case for oil stockpiling stems from the fact that only strategic stocks can truly protect the country from a blockade in the event of a deliberate embargo.[291] Similar to captive importers in Eastern Europe, China treats its SPR as a tool for the maintenance of national sovereignty. This makes a strong case for building a government oil stockpile before economic considerations are taken into account.

In addition to the threat of a supply cutoff, Chinese policy makers also weigh concerns about economic vulnerability into energy security policy choices. Price fluctuations and their potential to harm the economy likely constitute a material threat to Chinese prosperity. Many analysts point to economic vulnerability as playing a meaningful role in China's decision to build a substantial SPR.[292] This outlook persists even as China is undertaking major efforts to move its economy away from energy-intensive output patterns.[293] Per the logic of this dissertation's model, however, economic vulnerability on its own does not drive countries to expend resources on a public oil stockpile. For prosperity concerns to drive a significant resource expenditure oil stockpiling, strategic reserves must also afford a country the market power to balance

[290] Odgaard and Delman, 2014.
[291] Tessman and Wolfe, 2011.
[292] Downs, 2004; Tunsjo, 2013; Wu, 2014; Odgaard and Delman, 2014.
[293] Wu and Nakano, 2016.

world oil supply and avert price shocks. In purely economic terms, China would be better off free-riding on the efforts of IEA countries if its own stockpile did confer the capability to unilaterally produce collective benefits.

Similar to the United States, market power has played a role in the discourse on China's SPR. Chinese scholars have produced a multitude of quantitative studies on Chinese SPR policy since the program was initiated in the early 2000's.[294] Like many of the early studies on the U.S. SPR, these analyses assess the impact that China's SPR fill activities have on the global market. They also evaluate the country's ability to avert a global price spike in the event of a supply crisis. This suggests an awareness of the market power that China's massive stockpile confers. Cursory analysis cannot determine the exact role that these academic treatments of China's market power play in SPR decisions, but the presence of this capability almost certainly plays a role in the country's evaluation of the benefits of oil stockpiling.

Given China's array of threats and capabilities, as well as the priority that the country has placed on energy security, this dissertation would project that China would spend substantial resources on a government-owned oil stockpile *and* compel industry to stockpile oil in substantial quantities. This is indeed the case. China has embarked on an extraordinary oil stockpiling effort. After formalizing its plan to build an SPR in the tenth five year plan, China set about constructing facilities in three phases. The country completed building its phase one sites, with a combined storage capacity of 103 million barrels, in 2008. As the time of writing, work is underway to add another 169 million barrels of capacity in phase two, which will include China's first underground oil storage

[294] Representative articles include Wu, et. al., 2008; Bai, et. al., 2014; and Li and Chen, 2016.

sites. Upon completion, phase three is planned to take the total capacity of China's SPR to 500 million barrels, which would make it the largest (or second largest[295]) oil stockpile in the world once filled.[296]

China's SPR is wholly owned by the government. This makes their reserve a more effective energy security tool and demonstrates a pronounced commitment to energy security. This dedication of resources to energy security is all the more striking bearing in mind that China initiated these investments when the country was still relatively poor. Further, China was willing to shoulder far steeper acquisition costs that many IEA countries. In June, 2009, China reported an average cost per barrel of $58 per barrel – roughly twice the acquisition cost of oil in the U.S. SPR.[297] While Chinese acquisition activities are conducted with market movements in mind, the decision to build a large stockpile in a high price environment supports the contention that the country treats energy security as a critical national priority.

In line with the expectations of the theory of oil stockpiling advanced here, China is also pushing other entities to acquire oil. Since the beginning of China's oil stockpiling program, the country has also compelled oil companies to hold stocks beyond commercially efficient minimum levels. The majority of these stocks are held by Chinese national oil companies, which remain largely under government control.[298] When commercial stocks, and barrels held by local governments, are counted, China's

[295] As stated previously, the exact inventory trajectory of the U.S. SPR is not clear at the time of writing.
[296] Wu, 2014.
[297] Tunsjo, 2013; DOE, 2017.
[298] Wu, 2014.

total inventory of strategic oil stocks is massive.[299] The scale and scope of its energy security efforts fits this dissertation's expectation.

China's SPR program addresses both national security vulnerabilities and economic vulnerabilities. As the model here would project, the country is developing a large government-owned stockpile and compelling industry to expand their inventories. The more interesting question with regard to China, however, relates to which type of vulnerability will predominate in China's approach to international energy security engagement going forward. If security vulnerability comes to play a larger role in China's strategic calculus, then oil stockpiling could support a "fortress China" policy. If economic vulnerability drives Chinese thinking in this area, the country will increase its global engagement, which would greatly enhance the oil-importing world's ability to respond to a supply disruption. Early signs point to the latter outcome.

If China primarily seeks to reap the economic benefits of strategic oil stocks, the most important step for the country would be to deepen its relationship with the IEA. For decades Western observers have argued that China should join the IEA or at least participate in IEA's energy security activities.[300] This would increase the IEA's response capabilities and add to the protection that the organization affords the global market. China signing onto the IEA Association initiative represents a step, but it remains unclear how far this cooperation will go. Historically China has preferred bilateral and regional engagements. Further, even if China were able to join the IEA, adhering to the rules of

[299] Odgaard and Delman, 2014.
[300] For example see Jaffe and Lewis, 2002; Kennedy, 2010. Technically, China cannot fully join the IEA unless it is an OECD member (unless the IEA moves to waive this requirement).

the organization could ultimately reduce the country's clout in decision making related to global energy security.[301]

If China predominantly seeks economic benefits from its oil stockpile, but favors a bilateral approach to energy security engagement, the country could accomplish many of the same goals through bilateral cooperation with the United States. Many contend that working with the United States to facilitate the free global flow of oil constitutes the best energy security strategy for China.[302] This falls in line with a larger trend of energy cooperation between the two countries. In a very complex relationship, energy represents an area in which China and the United States can truly benefit from working with one another.[303] This is especially true in an area like global energy security, where working together would increase each countries' benefits from a collective good. In line with this thinking, China and the United States signed a Memorandum of Understanding to on SPR cooperation in 2014.[304] It remains to be seen how this unequivocally positive step will be impacted by shifts in American SPR policy.

Areas for Future Research

As this project represents the first political science treatment of oil stockpiling, it necessarily on represents only a start for unpacking this topic. Many policy questions surrounding this topic remain unanswered. Will the United States completely drain the Strategic Petroleum Reserve? How will other IEA members react to this? Will China begin to play a leadership role in global energy security? The model advanced here provides a solid foundation for understanding how nations approach the development of

[301] Kong, 2011.
[302] Downs, 2004; Erickson and Collins, 2010.
[303] Smith, 2016.
[304] DOE, 2014.

strategic oil stocks. As the vulnerabilities facing oil-importers evolve, it can be leveraged to under assess strategic energy choices that these countries make. This will prove to be a valuable avenue of policy research in an era when the world oil market is undergoing substantial change. Further, little is known about oil stockpiling outside of the IEA beyond China. Given data availability, a broader study that assessed oil stockpiling across all countries would be a fruitful endeavor.

Beyond further study of this empirical area, the logic in the model here could be employed to assess other forms of state behavior. This project has shown that states are more willing to expend resources to support the provision of a global good if their contribution meaningfully influences the shared benefits that they receive. This line of reasoning could be employed to evaluate how states' approach climate change and other global policy challenges. The idea that the national security elements of energy security are more likely to engender a robust policy approach could inform the treatment of other energy security strategies. This could ultimately lead to a better understanding of when states can be expected to undertake major policy measures to meaningfully change their energy consumption patterns.

Most generally, this project has shown that energy security policy can be understood as a form of state behavior. This conceptualization allows for a more robust assessment of what drives countries to pursue the energy policies that they do. Future academic treatments of energy policy would do well to assess the energy decisions that nations make as a product of their capabilities and interests. In utilizing this lens to investigate energy questions, analysts can improve the understanding of the energy strategies that states undertake in a variety of areas.

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