Arctic Shock: Utilizing Climate Change to Test a Theory of Resource Competition

Online Appendix

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Introduction to the Online Appendix

The supplementary material presented in this document provides additional evidence supporting the core claims made in the article, "Arctic Shock: Utilizing Climate Change to Test A Theory of Resource Competition." The main article and appendix references the materials included here. I present additional empirical evidence in support of my key findings and address counter-arguments. I also provide more detail regarding how I operationalize my theoretical constructs. The R code, data and code necessary to replicate the key figures and tables are available at https://doi.org/10.7910/DVN/GWAWJD.

A. Measuring the Independent Variable: The Economic Structure of the State

Previous research seeking to incorporate the characteristics of a state's governing coalition to explain their foreign policy preferences has struggled to identify a state's coalition types *ex ante*. Identifying the economic interests of the individuals in the coalition is difficult, as we cannot directly observe *ex ante* which individuals are in or out of the coalition. The measurement strategy I employ here solves this problem by identifying the economic interest of the individuals in the states' governing coalition by looking to the source of their income.

The income source of a state's governing coalition is conditioned by the *economic structure of the state*. My theory focuses on a single dimension of the economic structure of the state—the degree to which the economy is organized to generate income from land, as opposed to producing goods and services. States on either extreme of this dimension I call *land-oriented (aka resource-dependent)* and *production-oriented (aka non-resource dependent)*. Recall that, for the sample of states that I focus on in this study, I use the terms land-oriented and resource-dependent interchangeably. I follow Markowitz et al in categorizing resource-dependent states a sub-category of land-oriented states (Markowitz et al. Forthcoming).

Given the supposition that income can only be generated from land or by producing goods and services, any income not generated from land must be created from the production of goods and services by deduction. Therefore, the production-oriented sector's share of the economy is simply the income remaining after subtracting income derived from land.

Measures that indicate the *share* of a state's economy generated from the land-oriented sectors are employed as proxy measures for both the structure of the state's economy, (i.e. how land-oriented the state economy is inArct terms of the degree to which it is structured to extract income from the control of territory) and the economic interest of the state's governing coalition. The key assumption here is that there is a relatively tight relationship between the means by which wealth and income are

generated and the political representation within a state's governing coalition. The more society derives income from land, the more representation the land-oriented sector will have in the state's governing coalition.

This assumption is plausible because money generally finds its way into politics. As explained below this can happen through two pathways; money either captures the state or the state captures money.

Pathway 1: Money captures the state. Those who control the wealth in the state generally invest in securing political influence to assure that the government pursues policies favorable to their economic interests. The greater their share of the state's wealth, the greater their ability to invest in outbidding other sectors of the economy that are competing for this influence. Political economists refer to this as capture because the entities intended to regulate a sector are instead being controlled by it.

Pathway 2: The state captures the money. States often appropriate the commanding heights of the economy, especially in the case of resource wealth, thereby making state interests and industry interests one and the same. For my theory, whether these resources are owned by the state or privately owned makes little difference. The state will still act to protect the economic interests of those who control it.

It is important to clarify I am not arguing that there is perfect correlation between the size of an economic sector and its political representation within the state's governing coalition. Rather, I only assert that states with more land-oriented economies will have governing coalitions in which the land-oriented sector has a greater influence on the preferences and policies of the state relative to states with less land-oriented economies.

In order to measure the degree to which the economic interests of the coalition are reliant on land rents, I adopt indicators used by scholars of the resource curse, specifically resource rents as a percentage of GDP from the World Bank Development Indicators (Collier and Hoeffler 2009). As a

robustness check on this measure, I also include data on several measures of the flow of income generated from land, including fuel and oil exports as a percentage of GDP (See Table 1 below). All of these additional indicators tend to strongly co-vary, further increasing my confidence that the measure is capturing the degree to which a state is economically dependent on resource rents. As an additional robustness check on these quantitative indicators, I also rely on area specialists' qualitative assessments of the economic interests of individuals in the governing coalition.

Table 1: Coding of Resource-Dependence is Robust to Inclusion of Alternative Measures of Resource Dependence.

Country	**Oil Exports % of GDP***[1]	**Fuel Exports % of GDP*****[2]	**Resource Rents % of GDP*****(The World Bank 2018)
United States	0.325	0.171	1.01
Canada	1.04	4.88	3.75
Denmark	0.766	2.04	1.15
Norway	9.72	19.1	8.38
Russian Federation	**9.44**	**16.5**	**15.5**

*Data only available through 2001 [average 1991-2001]
*** Average 1997-2007

Why Not Use Government Revenue?

I choose to operationalize the economic structure of the states and the interests of the governing coalition using a set of indicators that capture the degree to which the state's economy is dependent on resource rents. This is a better indicator than government revenue, or whether the state owns the energy sector. The reason for this is that a highly influential sector of the economy might choose to use their influence to privatize state resources and/or lower the tax rate on their industry. For example, the United States' economy is dominated by production-oriented industries, which vastly

outspend extractive industries in terms of political contributions. It is perhaps not a coincidence that gas companies, like Exxon and Chevron, pay the second highest tax rates of any industry, while information technology firms, like Apple and Google pay the second lowest rate of any industry (Bostock et al. 2013). If we looked for the influence of the sector by whether it was controlled by the state or the degree to which the state depended on it for government revenue, we might incorrectly conclude that the sector was not very influential when rather the opposite is true.

Russia also provides an excellent illustration of why whether a sector is public or private might not matter in terms of its influence on state policy. In the 1990s, Russia was led by a group of land-oriented oligarchs who used their influence to privatize the state's resources and bend state policy to benefit their extractive industries at the expense of the production-oriented sector and the rest of society. Today, most of Russia's resource wealth is owned by the state, which is controlled by a small group of ex-KGB officials who manipulate state policy to benefit extractive industries and subsequently collect rents. In both cases, the extractive sector influenced state policy and rents flow to individuals in the governing coalition. This relationship applies not only to states with autocratic political institutions, but democratic ones as well.

The key difference between autocracies and democracies is not whether the dominant sectors will receive preferential treatment, but whether the profits will be narrowly enjoyed by a small political elite or broadly distributed throughout society. For example, in both Russia and Norway, the state owns the resource wealth, giving both states a stronger interest in pursuing policies that benefit the extractive sector of the economy. However, in contrast to Russia where they are distributed amongst a narrow group of oligarchs, Norwegian profits earned from extracting oil and gas are more broadly distributed throughout society in the form of higher levels of public goods provision.

B. Defense of the Timing and Use of the Shock.

The case studies offered in this subsection focus on assessing how states responded to the exogenous shock of climate change. I identify the shock as beginning in June of 2007, when data revealed that the area of Arctic sea ice was already below the trajectory from the previous record-low set in 2005. While 2005 had been a record-setting year, the ice level recovered in 2006, making it difficult for scientists to discern whether 2005 was an outlier or part of a broader shift in the speed at which the ice was melting. Furthermore, the record low set in 2007 was *much* lower than the one set two years earlier. In 2005, the low was 5.32 million square kilometers of ice cover, compared to 4.13 million square kilometers in 2007. To provide some context, from 1979-2005 the average minimum ice cover was 6.74 million square kilometers. This means that in 2007 the area of the Arctic covered by ice was 2.61 million square kilometers less than the average—an area larger than Texas and California combined (National Snow and Ice Data Center 2007).

Because actors could have made inferences about the trajectory of Arctic ice disappearance after June of 2007, for coding purposes, I designate the post shock period as beginning on July 1, 2007. The shock is the revelation of information that the Arctic might be melting much faster than previously anticipated and that vast stocks of resources might be exploited much sooner. Therefore, any activity that occurs after that date is post-shock. One might argue that the shock period should not begin until September 2007, when Arctic ice hit record lows. This would be inappropriate, as it would assume that actors were not forward-looking and strategically anticipating that the Arctic ice was on a trajectory to reach record lows.

For context, the cases cover each Arctic state's foreign policy from the end of the Cold War to the present era. Assessing policy before the shock is important because it illustrates the baseline level of each state's Arctic interests, claims, military activity and force structure. However, the years directly before and after the shock will be most informative to compare. This is because, as time elapses, we can be less certain that changes in state behavior were driven by the exogenous exposure

of resources, as opposed to some other potentially confounding factor. For this reason, I focus more intensely on assessing changes in each state's foreign policy behavior and military activity in the Arctic in the immediate pre- and post-shock period.

I define the pre-shock period as running from January 1, 2005 to June 30, 2007 and the post-shock period from July 1st, 2007 to December 31, 2009. I adopt a two-and-a-half-year cut-off instead of two, because the shock occurs in June, approximately the middle of 2007. This helps guard against the possibility that the levels of state interest, investment and activity were unusually high or low in a single year. To guard against the possibility that states' Arctic military activity was unusually high in 2009 and then regressed to the mean soon after, I also chose to code an additional year of data, 2010. There is little evidence that this is the case as there were 37 events in 2009 and 47 in 2010. Thus, if I were to extend the analysis to include 2010, it would strengthen my conclusion that states' Arctic military activity increased after the shock of 2007.

Additionally, to guard against the possibility that a change in a state's foreign policy was temporary or driven by anomalous events, I extend the qualitative analyses and the quantitative indicators for ice-hardened warships and bases from January 1, 1997 to December 31, 2017, approximately 10 years before and after the shock. This approach has the additional advantage of allowing us to assess the continuation in each state's Arctic foreign policy and whether their renewed interest was temporary or whether they followed through on their commitments to build bases, ice-hardened warship and icebreakers. The tradeoff is that we can be less certain whether their foreign policy behavior is driven by the shock or by other factors.

A major potential threat to the validity of any research that compares the behavior of actors over time is that changes in the actor's behavior could be driven by confounding factors that varied over the period of analysis. This is especially concerning when trying to assess the impact of states' preferences on their foreign policy behavior over time because behavior might not be driven by their

preferences, but rather by changes in relative power or the nature of their strategic environment. To control for potential confounds, scholars can select research designs that examine the behavior of actors over shorter periods of time where one variable changes rapidly, but other possible confounds change more slowly or are held constant. This allows scholars to control more effectively for the impact of potentially confounding variables.

The speed of the Arctic shock allows me to approximate these conditions, providing me with leverage that can be used to rule out competing explanations. By comparing the behavior of states directly before and after the exogenous shock, I can limit the impact of potential confounding explanations. This is because for a change in a confounding variable to be driving the behavior of the Arctic states, it would need to have co-varied with the shock. The most powerful alternative explanations rely on variables that shift slowly, such as relative power, or concerns over status. Since these variables can effectively be held constant in the years directly before and after the shock, I am able to cleanly isolate the effect that the exposure of Arctic resources had on states' foreign policy behavior. The speed of the shock provides evidence that each state's behavior was more likely to be motivated by factors I identify, such as the exposure of resources, rather than other long-term factors, such as concerns over status or power. This allows me to demonstrate how state behavior in the Arctic is consistent with the explanation presented in this study.

Alternative explanations propose that states' motivations for projecting power to the Arctic do not stem from the exposure of resources but rather, from geographic nationalism, a desire for status, shifting power or other confounding factors. It is important to clarify that I am not claiming factors such as geostrategic concerns, nationalism, a desire for status or shifting power do not matter or, that they cannot explain variation in the baseline level of each state's Arctic interests and military presence. For example, Russia's unique history and geography likely explain why Russia's pre-shock baseline level of Arctic force structure and military presence was higher than most states. However,

these factors cannot explain the rapid change and dramatic increase in the level of Russia's Arctic force structure and military presence immediately after the shock.

By comparing the behavior of states in the years before and after the shock, I am able to hold these confounding factors roughly constant. This is because these factors are either constant, such as geography, or slow-moving, such as shifts in power, nationalism, or a state's desire for security and status. Because they do not change substantially between the years surrounding the shock, they cannot explain the rapid changes in states' level of interest and investment in their Arctic military presence that began in the summer of 2007.

C. Summary of Competing Theories Predict that Norway Should Have A Weak Preference to Secure Control Over Territory

Norway is not only democratic, but also possesses an economy that is highly advanced, capital and contract intensive, energy modern, trade dependent and fully integrated into the global economy. Theories of the democratic peace suggest that Norway should have a weaker preference to control additional territory given their highly democratic political institutions. Moreover, virtually every theory that uses economic structure and trade to explain states' foreign-policy preferences would expect Norway to have a weak interest in seeking territory. Those such as Rosecrance (1986) and Brooks (2005) who suggest that economically-advanced trading states should not be interested in territory cannot explain this divergence (Rosecrance 1986; Brooks 2005). Neither can most variants of the Capitalist Peace explain this, given that Norway is contract intensive (Mousseau 2005; Collier and Hoeffler 2009), energy modern (Colgan 2015), wealthy and financially integrated into the global economy (Gartzke 2007; Gartzke and Rohner 2011). The only strain of the Capitalist Peace that can explain some of Norway's behavior is provided by McDonald (2009) who suggests that states with large amounts of public property should be more willing to pursue assertive foreign policies because

the public goods act as a source of revenue to fund military investments and buy off domestic political opposition (McDonald 2009). While McDonald can explain why Norway's large stock of public goods might allow it to pursue a more assertive foreign policy, he cannot explain why it chose to be assertive with one foreign-policy objective over another. More specifically, the question I am interested in is not why Norway became more assertive, but rather why Oslo chose to become more assertive with regards to securing control over Arctic resources.

D. Why Norway's Level of Military Activity Might be Underreported

Since the shock, Norway has increased its patrols around Svalbard and its military presence in the Barents Sea. My interviews with Norwegian journalists revealed that since the shock, Norway began to deploy not just lightly-armed Coast Guard vessels, but also heavily-armed Aegis Frigates to the waters around Svalbard (Nilsen 2016). According to the same reporters, Norway has been careful not to broadcast these deployments in order to avoid antagonizing Russia, but they are occasionally captured by local media, such as when Norway deployed KNM Thor Heyerdahl–Norway's newest warship–to demonstrate its presence in the waters around Svalbard.[3] This explains why we are less likely to observe reports of Norwegian Arctic military activity that might be viewed as provocative by Russia. These deployments are also easier to hide from the press in comparison to large scale Arctic military exercises that take place on Norwegian territory. While the same desire to hide military activity from Russia might be a factor resulting in reduced reports of Danish Arctic engagement, it is unlikely given we do not observe Denmark making major investments in boosting their Arctic military exercise, bases or ice-hardened ships. Thus, Denmark's lack of Arctic military activity is consistent with its lack of investment in projecting power to the Arctic more generally, and not anomalous like it is for Norway.

E. Addressing Counter Arguments Relating to Norway

A critic might argue that Norway invests more in projecting power to the Arctic than Denmark, not because it has a stronger preference to secure resources, but because it has a larger percentage of its population living above the Arctic Circle. This might explain why Norway had a higher level of interest in and commitment to the Arctic than Denmark before the shock, but it cannot explain the change in Norway's level of investment in the region after the shock. This is because the number of Norwegian citizens living above the Arctic Circle is relatively constant, but Norway's level of investment increased substantially post-shock.

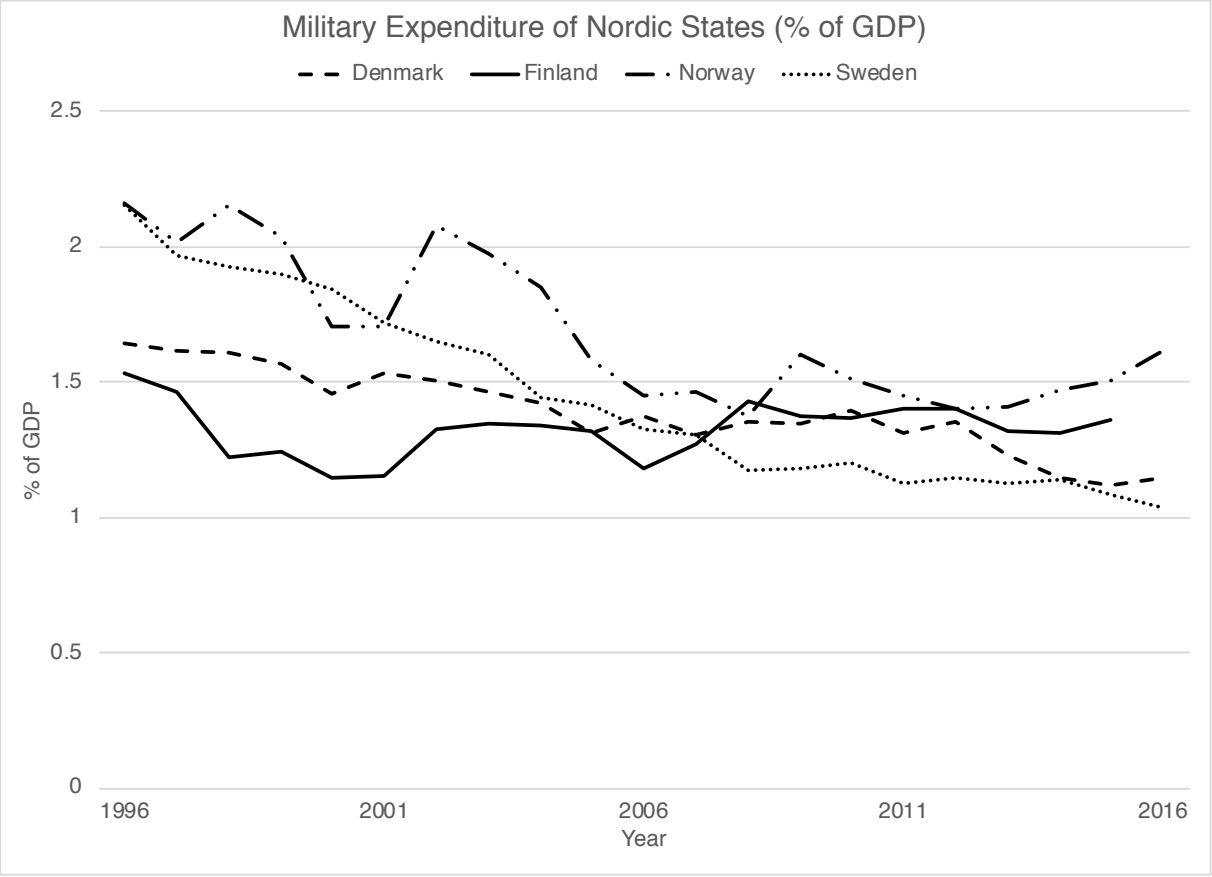
Perhaps Norway invests more in projecting power to the Arctic because it shares a border with Russia, while Denmark does not. Once again, the shared border is a constant and explains why Oslo had a higher-level baseline level of investment than Denmark before the shock. But, it cannot explain the change in the level of investment growth after the shock (i.e. why the change in Norway's level of investment was so much greater than Denmark's). However, Russia invested much more in projecting power to the Arctic after the shock. Thus, a critic might suggest that Norway's shared border, combined with Russia's newly assertive Arctic foreign policy, drove Norway to enhance its Arctic military presence to defend against an overland territorial invasion rather than threats to its maritime resources. There are two reasons to doubt this alternative explanation.

First, if a more assertive Russian Arctic foreign policy is more threatening to Arctic states that share a border with Russia, then we should observe other small Nordic states that share a border with Russia also investing in projecting more and boosting their Arctic military presence right after the shock. Here the comparison between Norway and Sweden and Finland is particularly informative. Sweden and Finland are both Nordic Arctic states that are geographically proximate to Russia, sharing a maritime and land border with Russia respectively. However, although Sweden and Finland are Arctic states with territory above the Arctic Circle, they do not border the Arctic Ocean, meaning they

cannot make claims over Arctic sea-bed resources. Thus, if these states chose to invest in boosting their Arctic military activity after the shock, this would present strong evidence that fears of a potential Russian territorial invasion, rather than securing resources, were driving these states' behavior. However, unlike Norway, these states did not boost their Arctic military activity immediately after the shock.

In fact, both Finland and Sweden have larger populations than Norway above the Arctic Circle but maintain a smaller Arctic military presence ("Chapter Five: Geopolitical Impacts of the Changing Arctic" 2013). Only seven years after the shock, in 2014, the year that Russia invaded Crimea, did Sweden and Finland begin to make greater investments in defending themselves against a territorial invasion from Russia. In fact, Finland was forced to rearm, given that, in 2012, before Crimea, it drastically cut down the size of its army from 350,000 to 230,000 (Forsell and Rosendahl 2017). Figure 1 demonstrates that Norway increased its military spending much more post-shock than Sweden, Denmark and Finland, despite the fact that they are all small Nordic states geographically proximate to Russia.

Figure 1: Nordic State Military Expenditure (1996-2016) [4]



Second, if Norway was only concerned about its territorial borders then why did it allocate scarce funds for its power projection capabilities to secure offshore resource claims? Moreover, why did it focus its war game exercises on defending these claims instead of focusing exclusively on territorial invasion? If Norway was principally concerned about territorial invasion, then we should observe greater investment in land forces than in maritime power projection assets. But, we observe the opposite. This is because following the shock, Norwegian defense officials were more worried about a potential conflict over resources than the possibility of territorial invasion. For example, in 2008, Norwegian Chief of Defense Sverre Diesen asserted that competition over maritime resources, rather than Russian territorial invasion, was the most likely cause of future conflict in the region(Lunde

Saxi 2010, 69). Thus, it appears Norway's concerns over its maritime disputes with Russia, and not its shared border, were the principal factors driving its Arctic foreign-policy investments.

Third, and relatedly, one might wonder if the difference between the size of potential resources at stake, and the degree of contestation with other states, explains the difference in policy between Norway and Denmark. Several pieces of evidence help to alleviate this concern. First, Norway and Denmark have similar sized Arctic EEZ's, and estimates suggest that they possess similar reserves of oil and gas (See Table 2 below). Additionally, a greater percentage of Denmark's total Arctic EEZ claims are disputed: 16.1% compared to only 10.1% for Norway. Second, both Norway and Denmark have overlapping claims with Russia (recall that both Denmark and Russia claim the North Pole) and Russia has increased the frequency with which it projects power into disputed areas within both the Norwegian and Danish defense zones (Sergunin and Konyshev 2015).

Thus, both states faced challenges to their territorial claims from a state that was willing to back its claims with military force. While it is certainly the case that Russia has projected power with greater frequency and intensity to the territory under dispute with Norway, the fact that Russia still has disputes with Norway is because Oslo chose to make claims over Svalbard's EEZ that exclude Russia. Recall that Norway not only claimed an EEZ and an Extended Continental Shelf, but also made claims beyond what is dictated by international law through its exclusive claim to develop the resources in the Fishery Protection Zone around Svalbard. In contrast, Denmark has not made any claims beyond what it is unambiguously allowed under international law. Thus, Denmark and Norway have similar sized EEZs, and similar amounts of resources at stake. However, they have taken different approaches regarding both the composition of claims, and the degree to which they can back their claims with military force.

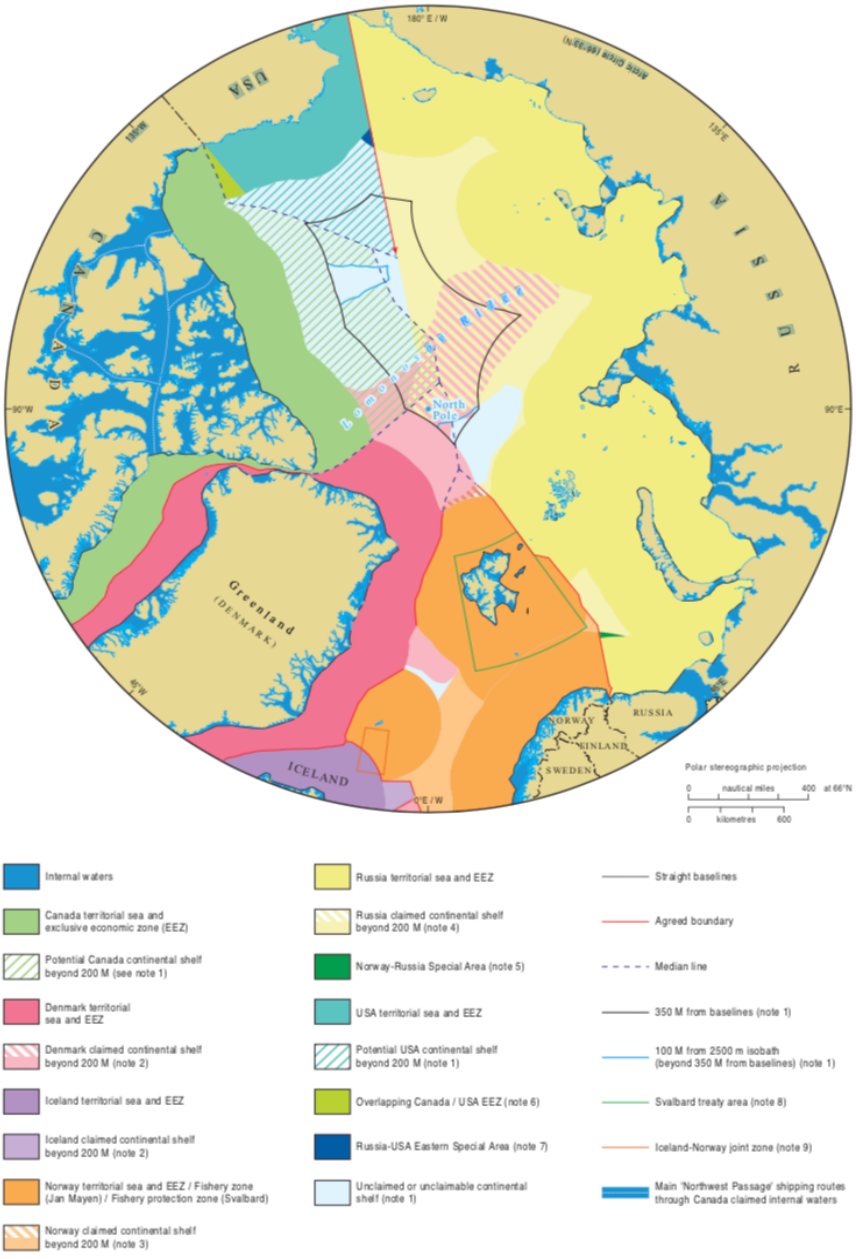
Table 2: EEZ Area and Resources Norway vs. Denmark

	Total Potential EEZ Area (km^2)(Praprotnik 2013, 43–44)	**% of EEZ area that is disputed, potentially claimable area, or treaty area**(Praprotnik 2013, 43–44)	**Distribution of Estimated Oil and Natural Gas Resources (Total Estimated Resources in Oil Equivalent [billion barrels])**(Keil 2013)	**Percentage of share of total Arctic Gas and Oil**(Keil 2013)
Denmark	1,695,011	16.1%	44.49	11%
Norway	1,920,762	10.9%	47.46	12%

F. Arctic Maps

Figure 2 (below) shows all current overlapping claims between the five Arctic states.

Figure 2: Map of States' Arctic Claims and Overlapping Claims.[5]



G. Note on Codebooks for Arctic Military Activity Events, Bases and Ice Breakers

The first dataset, entitled *Arctic Military Action Events Dataset*, includes all publicly reported events that involved state owned or controlled forces being deployed to the Arctic. I include all state forces, both military and non-military, for two reasons. First, any state-owned unit deployed to the Arctic signals a state's willingness to invest in maintaining a regional presence. Additionally, these forces can aid the state's power projection by enhancing situational awareness or providing necessary logistical support (such as icebreakers clearing sea-lanes). Second, the distinction between military and non-military is often blurred. For example, while some states have no Coast Guard and delegate the operation of all ships to their Navy, others have what are effectively warships operated by a Coast Guard. To obtain the most accurate account of a states' power projection capabilities, I code all reported deployments of state forces to the Arctic and distinguish between whether the forces involved are military or non-military. I count and code all recorded events during a five-year period from January 1, 2005 to December 31, 2009. This allows me to assess the change in each state's Arctic military activity in the two and a half years immediately before and after the shock. The periods surrounding the shock are most informative for measuring changes in the willingness of states to deploy forces to the Arctic. Additionally, collecting data on military activity events over a longer period is cost prohibitive.

I compare the number of Arctic military deployments, or military activity events, before and after the shock. I examine three types of events. The first, "Within Borders" involves the deployment of forces within the borders of the state. This includes any event in which a state's forces – military, non-military, or paramilitary (including Coast Guard or Canadian Arctic Rangers) -- are deployed above the Arctic Circle. The second type of event, power projection deployment

beyond borders, or "Power Projection," involves the deployment of state forces beyond the state's borders. For example, if Canadian Rangers engaged in exercises on Canadian soil, then this would count as "Within Borders", not "Power Projection", because they did not deploy beyond the state's borders**.** In contrast, if Canada deployed a warship to the Arctic this would be coded as power projection as it extends beyond Canada's borders. The third type of event, "Disputed Areas or Other State's Borders", involves incidents in which states projected power to a claimed or disputed area, or to the border of a state with which it had a dispute. For illustration, this type of event would be coded "yes" if Canada deployed a ship to a disputed area such as the North Pole **(**which it shares disputes over ownership with Russia) or to the borders of Russia.[6] The purpose of these categories are to allow us to assess not just the change in each state's Arctic military activity, but whether there is a change in their willingness to project power beyond their borders and engage in gunboat diplomacy to back their resource claims.

The second and third data sets are the *Icebreaker and Ice Hardened Warships Dataset* and *Arctic Bases Dataset*. These data sets are used to operationalize the change in each state's level of investment in their Arctic Force Structure. Recall that while countries can immediately deploy forces to the Arctic, building ships and bases takes years. For this reason, these two data sets extend over a long period from January 1, 1997 to December 31, 2017. The pre-shock period runs from January 1, 1997 to June 30, 2007, and the post-shock period runs from July 1, 2007 to December 31, 2017. This provides us with approximately 10 years before and after the shock. Extending the data back further in time before the shock helps prevent ships or bases ordered before the shock being incorrectly counted as part of the state's post-shock response. Extending the data forward in time after the shock allows us to assess whether states actually followed through on their commitments to build new forces. Additional details on the coding procedures used to code the data for the *Arctic Military Activity Events Dataset* can found in the online supplementary materials. The complete dataset and

codebooks for *Arctic Bases Dataset* and *Arctic Icebreakers and Ice-Hardened Warships Dataset* can be found at https://doi.org/10.7910/DVN/GWAWJD.

H. Counter-Arguments: Five Conventional Wisdoms

Several prominent counter-arguments to my theory exist. However, as I demonstrate below, none can explain the foreign policy choices of the five cases presented above.

International Legal Status Quo

First, it might be that those states with large shares of the resources within their EEZ, who stood to benefit under international law, were reluctant to respond to the shock by projecting power, whereas those states that received less resources were more willing to pursue gunboat diplomacy as an extra-legal option. However, a closer look reveals that, even if we only include hydrocarbons that were within Russia's EEZ and ECS and not claimed by another state, Russia received 53.3% of the total share of Arctic Ocean offshore hydrocarbons (Praprotnik 2013). Given that Russia would benefit more than any other state from the status quo distribution of resources under international law, why did it choose to back its claims by projecting military force?

One might still argue that states' responses were driven by those that stood to benefit the most. If this were the case, then Canada should have invested the most in projecting power, given Ottawa would increase its relative stock of Arctic resources by nearly 19% if its potential claims were realized, while Russia's would increase by only 5.3% (Praprotnik 2013). The fact that Russia has made more expansive claims than any other Arctic state and that it has backed these claims by projecting military force despite possessing such a large share of Arctic resources represents especially strong evidence for my theory and casts doubt on alternative explanations.

History, Geography and Status-Seeking

It is undeniable that Russia cares deeply about asserting its great power status and that its geography and historical factors have given it a higher level of interest in the Arctic than other states. These slow-moving factors might explain why Russia had a higher level of interest and military presence than other states before the shock. However, they cannot explain the rapid *change* in Russia's Arctic military activity, force structure and presence immediately after the shock. If Russia is only interested in asserting its status and not exploiting the resources, then why did it not project more power into the Arctic before the resources were exposed? Alternative explanations have no answer. Furthermore, Russia returned to the Arctic in summer of 2007, long before its assertive foreign policy adventures in Georgia in 2008, Crimea in 2014 or Syria in 2015.

Responding to the Newly Exposed Northern Flank

Though the shock dismisses constant or slow-moving factors, one might remain concerned about factors that co-varied with the shock. Specifically, the melting ice not only exposed resources, but also sea-lanes, exposing countries' northern flanks. This is particularly important for Russia, given that the Northern Fleet, along with its submarine-based nuclear deterrent, is based in the Arctic. While these factors are no doubt important and likely explain at least some states' responses to the shock, there are several countervailing factors that suggest this was not the primary factor driving events. Ten years after the-shock, Arctic sea-lanes are not viable, and are unlikely to be for decades. Similarly, countries have realized that concerns over exposing a northern flank are overblown, given that any northern amphibious invasion would first have to navigate dangerous ice-choked waters. As Canada's Chief of Defense Staff, General Natynczyk, quipped in 2009, "If someone were to invade the Canadian Arctic, my first task would be to rescue them," (Exner-Pirot

2015).This explains why Arctic nations, such as Canada, Denmark and the US, are not racing to defend their coastline.

Russian Defense of its Nuclear Deterrent

The desire to protect its undersea nuclear deterrent may explain why Moscow has invested so heavily in the Northern Fleet and in upgrading the Arctic bases near its headquarters in Murmansk. However, if protecting submarines is Russia's primary motivation, then it is less clear why Russia has invested in bases far from Murmansk along the Northern Sea Route. Moreover, why did Moscow project power with greater frequency to claimed and disputed areas after the shock and why has it adopted a far more assertive force posture with states with which it has maritime resources disputes, like Norway? Why have Russian officials consistently made statements in both speeches and strategic documents linking the importance of securing Arctic resources with commitments to increase Russia's Arctic military presence? These outcomes are puzzling if Russia only cares about protecting its nuclear deterrent, but can be explained by and are consistent with my theory and its predictions.

Democratic Defensiveness Against an Assertive Russia

Finally, a skeptic might argue that Norway is responding to Russia and is more concerned with defense than asserting rights to resources. Norwegian policy is certainly driven in part by its concerns regarding Russia. However, Norway is not only interested in defending its territory, but also its off-shore resource claims. If Norway was only concerned about Russia, it could have relinquished its expansive claims over the sea-bed resources in the area around Svalbard and accommodated Russia. Instead, Norway refused to succumb and invested in its capabilities to project force to areas under dispute. This may explain why Norway has increased its military spending more after the shock than

Sweden, Denmark and Finland, despite the fact they are also small Nordic states that are geographically proximate to Russia.[7]

Moreover, strategic interaction with Russia cannot explain why Norwegian officials made the Arctic Norway's top foreign policy priority and explicitly linked the region's energy resources to Norway's prosperity. Unlike the other Arctic democracies, Norway has backed its claims with costly investments in improving its Arctic military capabilities and presence, despite being less powerful. Unlike its production-oriented counterparts, Norway has also chosen to project power to areas under dispute and maintain an Arctic military presence beyond its territorial borders and waters. The fact that Norway has invested so much in its Arctic military presence, surpassing its more powerful democratic counterparts, exposes the limits of theories founded on domestic political institutions and lends support to my explanation of variation in states' willingness to seek rents.

In summary, as is common with studies of a small number of cases, there are certain individual outcomes that are over-determined; in that both my theory and its competitors arrive at similar predictions. However, none of these five conventional wisdoms can provide explanations for all of the variations in the type or timing on the policy responses for each of the five Arctic cases.

I. Regressions with Alternative Dependent Variables

Table 3: Replication of main analysis with new bases as the dependent variable.

	Dependent variable:				
	Bases New Investment				
	(1)	(2)	(3)	(4)	(5)
Difference in differences	0.258***	0.087*	0.086*	0.083*	0.085*

	(0.068)	(0.048)	(0.048)	(0.047)	(0.047)
Resource-dependent	-0.008	-0.012**	-0.011**	-0.004	-0.005
	(0.008)	(0.005)	(0.005)	(0.007)	(0.006)
Post-shock	0.016	0.019	0.017	-0.001	0.009
	(0.016)	(0.029)	(0.028)	(0.018)	(0.026)
Quarterly GDP		-0.001			
		(0.001)			
ln(Quarterly GDP)			-0.063		-0.075
			(0.080)		(0.085)
Quarterly GDP (% change)				-0.015	-0.016
				(0.014)	(0.014)
ln(Military expenditure)		-0.003	-0.002	-0.0005	-0.001
		(0.005)	(0.005)	(0.004)	(0.005)
Constant	0.008	0.130	0.322	0.027	0.372
	(0.008)	(0.159)	(0.423)	(0.060)	(0.442)
Observations	420	296	296	295	295
R2	0.12	0.047	0.047	0.056	0.058

Note: Results from OLS regressions with quarterly count of new investments in military bases as the outcome. Units are country-quarters, spanning the years 1997 to 2017. Robust standard errors clustered by country in parentheses. Russia and Norway are coded as resource-dependent. The post-shock period begins in June 2007. Models 2-5 drop pre-2002 observations for Russia due to missing quarterly GDP data.

*p<0.1; **p<0.05; ***p<0.01

Table 4: *Replication of main analysis with new ice-hardened ships as the dependent variable.*

	Dependent variable:				
	New Icebreakers				
	(1)	(2)	(3)	(4)	(5)
Difference in differences	0.056	0.004	0.006	0.012	0.004
	(0.061)	(0.080)	(0.079)	(0.076)	(0.079)
Resource-dependent	0.063**	0.092**	0.091**	0.095**	0.099**
	(0.029)	(0.042)	(0.042)	(0.041)	(0.043)
Post-shock	0.016	-0.014	-0.011	0.012	-0.021
	(0.016)	(0.032)	(0.031)	(0.025)	(0.030)
Quarterly GDP		0.004			

		(0.002)			
ln(Quarterly GDP)			0.268		0.248
			(0.171)		(0.173)
Quarterly GDP (% change)				-0.023	-0.022
				(0.017)	(0.017)
ln(Military expenditure)		-0.003	-0.004	-0.005	-0.002
		(0.006)	(0.006)	(0.006)	(0.006)
Constant	0.008	-0.223	-1.110	0.110	-1.027
	(0.008)	(0.237)	(0.789)	(0.090)	(0.798)
Observations	420	296	296	295	295
R2	0.037	0.056	0.055	0.057	0.063

Note: Results from OLS regressions with quarterly count of new icebreakers as the outcome. Units are country-quarters, spanning the years 1997 to 2017. Robust standard errors clustered by country in parentheses. Russia and Norway are coded as resource-dependent. The post-shock period begins in June 2007. Models 2-5 drop pre-2002 observations for Russia due to missing quarterly GDP data.

$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Table 5: Replication of main analysis with new icebreaker tonnage as the dependent variable.

	Dependent variable:				
	Icebreaker Tonnage				
	(1)	(2)	(3)	(4)	(5)
Difference in differences	386.532	33.921	50.265	92.504	39.487
	(460.722)	(648.367)	(644.521)	(610.086)	(644.114)
Resource-dependent	316.290	625.882	618.079	619.280	648.420
	(343.780)	(532.955)	(528.485)	(480.830)	(512.045)
Post-shock	-91.294	-385.860	-355.174	-165.106	-379.486
	(134.417)	(312.134)	(291.441)	(169.600)	(262.666)
Quarterly GDP		23.035			
		(26.881)			
ln(Quarterly GDP)			1,693.778		1,597.606
			(2,092.658)		(2,135.204)
Quarterly GDP (% change)				-68.086	-60.512
				(100.050)	(105.391)
ln(Military expenditure)		101.615	99.089	84.668	103.455
		(79.137)	(77.673)	(63.628)	(74.905)
Constant	132.246	-3,453.580	-8,979.338	-1,251.549	-8,588.037
	(132.352)	(3,204.712)	(10,070.400)	(1,011.723)	(10,238.600)
Observations	420	296	296	295	295
R2	0.018	0.025	0.024	0.022	0.025

Note: Results from OLS regressions with new icebreaker tonnage as the outcome. Units are country-quarters, spanning the years 1997 to 2017. Robust standard errors clustered by country in parentheses. Russia and Norway are coded as resource-dependent. The post-shock period begins in June 2007. Models 2-5 drop pre-2002 observations for Russia due to missing quarterly GDP data. $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

J. Why a state's choice to invest in enhancing their military presence signals the strength of their interest and how this can enhance their capacity to coercive bargain over the control of resources.

"Regional deployments enhance states' ability to credibly signal their resolve in two ways: tying hands and sinking costs (Slantchev 2005, 533). As Slantchev writes, "Military moves, such as arms buildups, troop mobilizations, and deployments to the potential zone of operations, can alter incentives in a crisis by changing one's expected payoff from the use of force. These are tacit bargaining moves that can restructure the strategic context thereby creating and possibly signaling one's commitments while under-mining those of the opponent." (Slantchev 2005, 533).

Building regionally specific power projection capabilities and deploying military forces **sinks costs**—demonstrating resolve to fight over geographically specific issues. A dollar sunk into an Arctic base cannot be invested elsewhere. Icebreakers and ice-hardened ships are useful for projecting power to the Arctic but much less useful elsewhere. A dollar spent on training troops to operate in the Arctic is a dollar not spent on training them to operate in the desert or tropics. Forces cannot be in two places at once and thus deploying forces to the Arctic means not deploying them elsewhere. As I mentioned in the manuscript, according to an independent report by the NRC in 2011, "U.S. capabilities had degraded so significantly that the U.S. had lost its ability to conduct High Arctic warfare (National Research Council 2011, 19)".

Even if military forces do not enhance the probability of a military victory, they can still signal resolve by acting as a tripwire. As Reiter and Poast write, "A tripwire force is defined as a body of troops that is not large enough to shift the local balance of forces in order to stop or significantly slow down an attack. Such a force makes a threat to intervene more credible because the early and unavoidable deaths of friendly troops in combat would force defender intervention (Reiter and Poast 2021, 36)." For example, were Russia's icebreakers and ice-hardened surface ships to engage in a fait accompli by taking control over Svalbard's resource-rich waters, these forces could quickly be destroyed by American submarines if Washington sought to reverse such a fait accompli but doing so would increase the risk of escalating a conflict with a nuclear-armed Russia.

Similarly, Norway deploys Aegis frigates to these same resource-rich waters around Svalbard. These deployments make it harder for Russia to impose a fait accompli. This is because Russia would first have to engage the Norwegian ships and risk sinking them. The U.S. and NATO might be able to argue that a Russian fait accompli that takes control of Svalbard waters and that kills no Norwegian sailors does not constitute an Article 5 violation. It is precisely such conflicts that Norway is concerned about because it would not necessarily trigger Article 5 and NATO intervention given that these are not technically part of Norwegian territory or even Norway's EEZ. However, if Russia sunk a Norwegian frigate and in doing so killed over 100 Norwegian sailors, it would be much harder for the U.S. and NATO to argue that the action did not constitute an attack on Norway and therefore an Article 5 violation. In short, investing in power projection capabilities allows Norway to deploy "floating trip wires" that increase the likelihood that Russia will be successfully deterred from attempting such a fait accompli because Moscow knows that it would be harder to do so without triggering a NATO intervention.

However, tripwires are just one way in which investing in regional military deployments can help tie hands and signal resolve. More recent research suggests that military deployments will be most credible when a state goes beyond just investing in regional tripwire forces and makes more costly investments in deploying military forces that are capable of shifting the local balance of military power (Reiter and Poast 2021). As Slantchev writes, "military actions which states take during a crisis——mobilizing troops, dispatching forces——entail costs that are paid regardless of the outcome, and in this sense are **sunk**; however, they also improve one's expected value of war relative to peace, and in this sense they can tie one's hands" (Slantchev 2005, 534). These actions tie hands and thus an actor's ability to credibly signal their resolve via two mechanisms.

First, they reduce the cost of conflict because some of the costs have already been paid. For example, Russia could threaten to engage in a fait accompli by using icebreakers and ice-hardened ships to occupy the resource-rich waters around Svalbard and begin drilling if Norway does not acquiesce to its claim to be able to develop the resources there. Russia's threat to do so is a lot more credible if it has already paid the cost of building these ships and training its force to operate in the Arctic than if it has not already paid these costs.

Second, investing in these forces helps change the local balance of forces and thus enhances the probability that Russia can take what it wants by force and hold on to it, should bargaining fail. For example, Arctic power projection capabilities would enhance Russia's ability to engage in such a fait accompli and its capacity to physically stop any Norwegian forces that sought to reassert control over this water or prevent Russian ships from drilling. In short, local Russian military superiority vis-a-vis Norway would make it impossible for Norway to successfully retake these waters by force. They also make it far more costly for the United States were it to attempt to do so on behalf of its NATO ally. For example, Russian deployment of S-400 Surface to Air Missiles (an advanced anti-aircraft and anti-missile weapon system) at its Arctic bases significantly raises the cost of any American military intervention in the Arctic. All else equal, the higher the expected cost of intervention, the more likely the United States would be to take the position that such a fait accompli by Russia does not constitute a violation of Norway's territory integrity, in order to avoid having to pay these costs.

In short, Russia's investment in Arctic power projection capabilities shifts the local balance of forces in its favor, and in doing so, increases the probability that it can successfully engage in a fait accompli, while making threats to do so more credible. These deployments are a signal, and enhance the credibility of a state's deterrent and compellent threats.

K. Addressing Counter-Arguments Relating to the United States

"One might reasonably ask, why can't the U.S. use its forces outside the Arctic to threaten Russia and get control over more Arctic resources?" In other words, if the U.S. wanted to threaten to fight a war over Arctic resources, this war would not have to be confined to the Arctic, so why is the United States' lack of investment in projecting power to the Arctic revealing as to the strength of its preference to secure control over Arctic resources? In short, it might be the case that the United States has just as strong an interest in securing control over additional resources as Russia, but we might incorrectly

infer that it has a weaker preference because it does not need to respond to the shock by investing in projecting power to the Arctic because its global power projection capabilities already sufficiently secure control over those resources.

If this is the case, then we should observe two key sets of outcomes. First, the United States should behave like Russia with regards to its claims over resources and stated interests. It should make expansive claims over the Arctic that go beyond what it can claim using the principles of international law. U.S. officials should publicly and privately state that the U.S. has a strong interest in militarily securing control over Arctic resources. U.S. strategic documents should prioritize the Arctic and strongly emphasize the importance of securing control over Arctic resources as Russian documents do.

Second, if the U.S. believes its global power projection capabilities are sufficient to deter and defend against threats to its interests abroad, then it should be unnecessary for the U.S. to pay the costs associated with investing in power projection regionally. If we observe that the United States does not need to project power regionally to deter and defend against threats to its regional specific interests, then this would be evidence that the U.S. does not need to project power to the Arctic to secure control over resources there.

If instead we do not observe the U.S. making expansive extra-legal claims over Arctic resources, and we do not observe U.S. officials or strategic documents emphasizing the importance of militarily securing control over Arctic resources, this would be informative as to the strength of U.S. interests. More specifically, it would be evidence that the United States does not have as strong an interest as Russia in militarily securing control over these resources. Furthermore, if we do observe the U.S. prioritizing investing in projecting power to other regions but not the Arctic then that would be evidence of two things. One is that the U.S. expects its dominant global power projection capabilities alone are insufficient to credibly deter, defend, and advance its regional interests. Two is that even when there is a shock that rapidly exposes resources that the U.S. could have sought to gain control over, the U.S. did not have a strong enough interest in doing so to prioritize substantially increasing its investment in projecting power to the Arctic.

In sum, if we observe the United States making expansive claims over resources and its officials and strategic documents explicitly prioritizing militarily securing control over Arctic resources as Russian documents do, then this would be evidence that the U.S. does have as strong an interest as Russia. However, if we observe that the U.S. does none of these things, then this would be evidence that the U.S. does not have as strong an interest as Russia in securing control over Arctic resources.

The case evidence clearly reveals that in contrast to Russia:

- The U.S. does not make any expansive claims over additional resources, and none of its claims went beyond what it can claim using the principles of international law.
- U.S. officials did not make explicit statements about the importance of militarily securing control over Arctic resources.
- U.S. strategic documents did not prioritize the Arctic or strongly emphasize the importance of securing control over Arctic resources.

As I write in the paper, this is why Arctic experts have referred to the United States as the "reluctant Arctic power."

This American (lack of) response to the shock provides important evidence that the U.S. does not have as strong an interest in securing control over Arctic resources as those nations that **did** respond to the shock by making much larger investments and prioritizing the Arctic in their strategic documents, public statements, force posture, and training exercises.

On the second issue, the evidence clearly demonstrates that the United States:

- Prioritizes investing in projecting power to specific regions to further its interests, rather than only investing in global power projection capabilities and keeping these forces at home.
- The U.S. does so to credibly signal its resolve to fight over these issues if necessary.
- The U.S. did not respond to the shock that exposed resources by prioritizing investing in projecting military power to the Arctic nearly as much as other nations such as Russia or even tiny Norway (relative to their respective budget constraints).

In short, the U.S. clearly does prioritize investing in projecting power regionally over other issues, just not Arctic resources. The lack of U.S. interest in Arctic resources becomes more apparent when we contrast this with how the United States behaves in other regions where it needs to signal its interest in keeping global sea-lanes open in places such as the Middle East or South China Sea. The United States is not able to simply sit back and rely on the fact that it has superior global power projection capabilities. If it did, it would not be able credibly signal that it is willing to use force to deter states like China and Iran from taking control over sea-lanes in the South China Sea and Straits of Hormuz.

Region-specific deployments such as FONOPS in the South China Sea and Straits of Hormuz signal that U.S. threats are credible by "sinking costs," "tying hands," and enhancing the US ability to "change facts on the water" by securing control over these sea-lanes by force if necessary. Were the U.S. to instead invest in global power projection capabilities that were stationed at home and refrain from deploying abroad except after the outbreak of war, then China and Iran might doubt whether U.S. threats were credible, and there would be a major delay before the U.S. could deploy enough forces to "change facts on the water" if China or Iran were to seize control over these sea-lanes.

In short, when coercively bargaining over geographically/regionally specific issues such as control over or access to sea-lanes or sea-bed resources, it is not necessarily the case that simply investing in global power projection capabilities is the best strategy for enhancing one's bargaining leverage. Instead, states are generally forced to project power regionally to credibly signal that they are willing to fight over the geographic issue in question.

While the U.S. could likely credibly signal that it would defend its own offshore resources in the EEZ off the coast of Alaska without projecting force to the Arctic, it might have trouble convincing Russia or other Arctic nations that a threat to use force to secure control over additional Arctic resources beyond its EEZ is indeed credible and not just a bluff. If the United States did in fact have a strong interest in securing control over additional resources, it would need to be able to credibly signal that it would be willing to impose and endure high costs to acquire these resources. Thus, the lack of U.S. response to the shock that exposed natural resources by projecting force reveals something about the strength of its preference to secure control over additional Arctic resources."

Did the fracking revolution make the U.S. less willing to respond the shock?

One might be reasonably concerned that the shale gas revolution made the US less willing to invest in securing control over Arctic resources because it believed that it would soon be energy independent. For this to be the case, it would have had to be widely understood at the time that fracking would make the U.S. energy independent. However, according to Daniel Yergin, in 2007 – the year in which the Arctic shock occurred – few understood how much fracking would change American domestic energy production (Yergin 2011, 331). Instead most believe that the U.S. would face a sharp **decline** in domestic energy production. Recall that in 2007 energy prices had been rapidly increasing for years and many were still concerned that the world had reached peak oil. Yergin's conclusion is supported by data which shows that U.S. oil and gas reserves were not increasing prior to 2007. In fact, U.S. oil reserves actually were slightly lower in 2008 than they were in previous years (see Figure 1 below). It was not until several years after the shock that U.S. oil and gas reserves began to dramatically increase (See Figure 1 and 2 below). Moreover, as of 2020, the latest year for which data is available, the U.S. reserves-to-production ratio for oil is 11.4 implying that the U.S. can only maintain existing levels of oil production for 11.4 years and gas for 13.8 years (bp Statistical Review of World Energy 2021, 16, 34). For comparison, Russia's reserves-to-production ratio suggests that it can maintain existing production for oil for 27.6 years and gas for 58.6 years (bp Statistical Review of World Energy 2020, 16, 34). Thus, it is unlikely that the fracking revolution can explain the lack of U.S. response in the years immediately following the shock."

Figure 1 Oil Reserves Estimate Based on BP Data

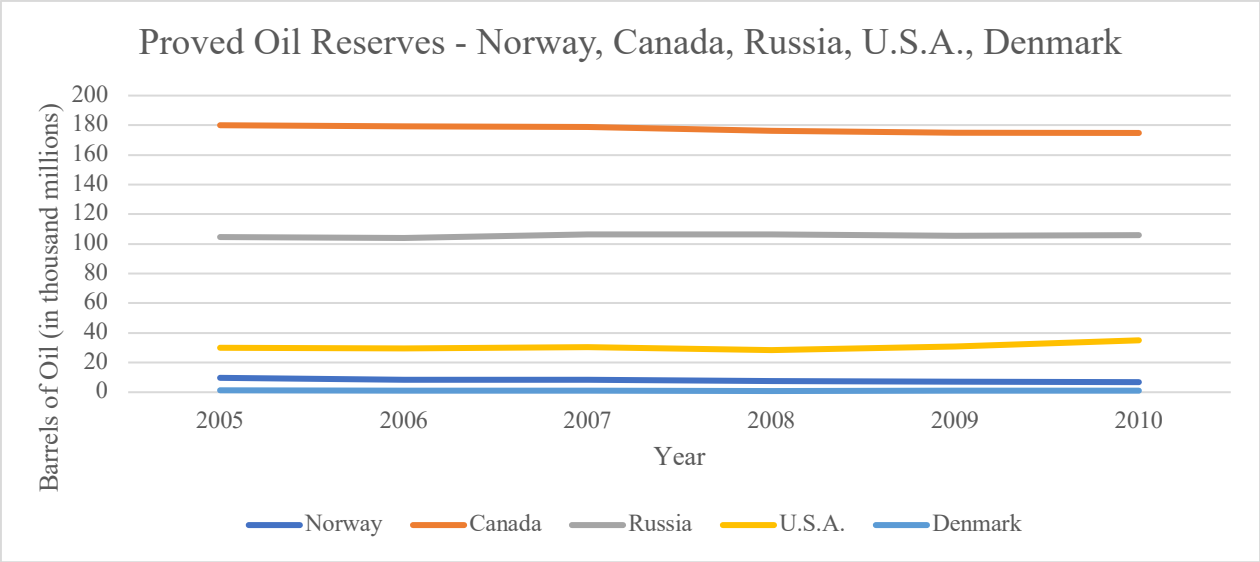
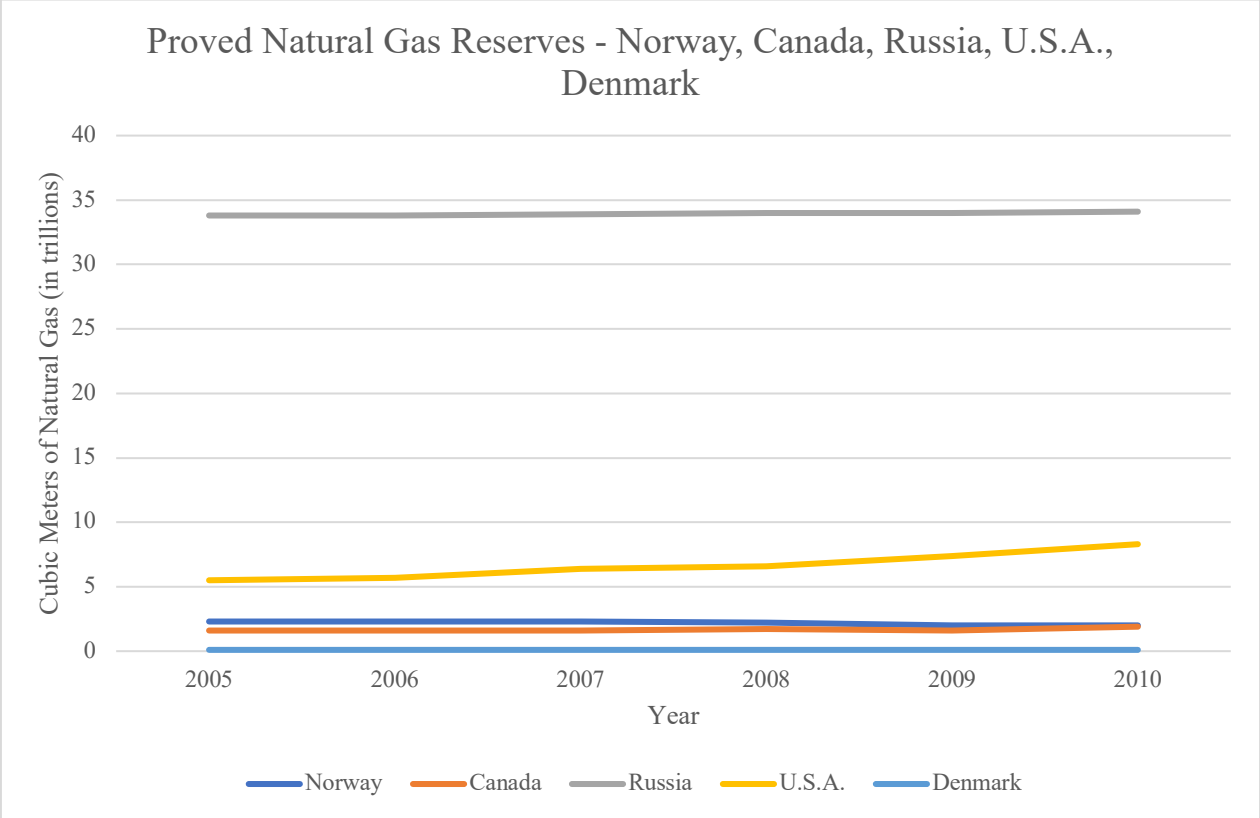


Figure 2 Gas Reserves Estimates based on BP Data



Did fracking make the U.S. resource-dependence and therefore more willing to respond the shock?

Fracking never made the U.S. economically dependent on natural resource rents. While U.S. did eventually become one of the world's largest oil and gas producers, the profits extractable from selling this natural resource never because large shares of the U.S. economy. Resource rents have averaging less than 1% of US GDP over the last decade (The World Bank 2018). Thus, my theory would predict that fracking would not make the U.S. more willing to respond to the shock my projecting military force to secure control over additional resources.

Notes

[1] ("Oil and Violence: The Foreign Policy of Resource-Rich States" 2013; Graham and Tucker 2017)
[2] Calculated based on Fuel exports % of merchandise exports from the World Bank. [(Fuel Export % * total merchandise exports in US$)/GDP 2005]. World Bank staff estimates through the WITS platform from the Comtrade database maintained by the United Nations Statistics Division (http://data.worldbank.org/indicator/TX.VAL.FUEL.ZS.UN)
[3] (Pettersen 2012)
[4] All data from: (The World Bank, n.d.)
[5] Map courtesy of IRBU Research Center: (IBRU, Durham University n.d.)
[6] For more on these distinctions, consult the Arctic Military Activity Events Codebook.
[7] For a comparison of Nordic states' defense spending over time, see Online Appendix Section F.

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