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> *As the noose tightens on a state's economy, the victim may pursue a highly risky course of action—such as Germany's decision to resume unrestricted submarine warfare or Japan's decision to attack Pearl Harbor—that it otherwise may not have hazarded. . . . [H]istorical experience suggests that embargoes may include actions or reactions that are neither orderly nor predictable and that they are not simple, safe, and controllable substitutes for war.*
>
> ROBERT A. DOUGHTY AND HAROLD E. RAUGH JR., "EMBARGOES IN HISTORICAL PERSPECTIVE"

On their own, energy embargoes are not a stand-in for strategy, nor are they an effective substitute for war.[1] With a long-term trend of rising U.S.-China tensions and China's growing dependence on imported crude oil to underpin its economic growth, distant energy blockades have received significant attention as potential tools for deterring, coercing, or terminating conflict with China.[2] Significant discussion of the energy blockade issue over the past decade likely was stimulated by a 2008 analysis by Gabriel B. Collins and William S. Murray ("No Oil for the Lamps of China?").[3] "No Oil" argued that, at a fundamental level, a maritime oil blockade would create significant political, economic, and diplomatic collateral consequences, and thus would be unfit as a stand-alone campaign strategy in a conflict with China.

Subsequent analyses typically either focused primarily on addressing predominantly tactical and operational issues or, in some cases, argued that the concerns raised in "No Oil" would be deemed secondary during a military conflict between China and the United States.[4] Yet the political, economic, and financial aspects of sustaining a unilateral—or perhaps bilateral, if not

Gabriel Collins is the Baker Botts Fellow in Energy & Environmental Regulatory Affairs at the Baker Institute Center for Energy Studies at Rice University in Houston, Texas. He previously was a researcher in the Naval War College's China Maritime Studies Institute, a private-sector commodity analyst, and an associate attorney at BakerHostetler LLP. He cofounded the China SignPost analysis portal.

Naval War College Review, Spring 2018, Vol. 71, No. 2

Naval War College Review, Vol. 71 [2018], No. 2, Art. 6

alliance-based—oil blockade against China mean that even a militarily successful blockader could find its political, economic, and diplomatic position rendered untenable well before a blockade could exert its full effects.[5] Neutral countries as well as U.S. allies would pressure Beijing and Washington strongly to end the conflict quickly, even in a distant-blockade scenario that focused on oil alone.[6] The pressure likely would be exponentially stronger in scenarios in which Chinese maritime trade was interdicted more broadly, which likely would be the actual case. Under either scenario, as the blockade wore on the U.S. position outside the military domain would weaken progressively—most likely at a rate that exceeded the speed at which the blockade was pushing China toward termination of the conflict. This article aims to fill a critical gap by examining in greater detail the nonmilitary means that China likely would employ in response to a maritime oil blockade and these approaches' strategic effects.

While the U.S. military almost certainly can execute the blockade mission against the People's Republic of China (PRC), adverse political and economic dynamics likely would turn tactical success into a strategic outcome that, at best, would be muddled. Energy and resource blockades clearly would be a critical complement to a comprehensive, long-term war effort, and significant conceptual and planning work must be dedicated to the subject. But taking a tool that is fundamentally about slowly grinding an adversary down and trying to convert it into a substitute for head-on military conflict would be a risky strategy. It could make regional allies and China question U.S. resolve; it could allow service leaders and civilian politicians to "punt" on important procurement commitments that are necessary to ensure credible combat capabilities in the face of China's rising antiaccess/area-denial (A2/AD) capabilities; and it could lull the American public into thinking that there are relatively low-cost ways to resolve a military conflict with China victoriously—a combination that would be extremely unlikely in practice.

Great-power wars typically are won on the political and economic fronts, where the country with the greatest reservoir of political will and the largest economic and industrial heft prevails.[7] Yet the political will in the United States and other countries to accept the adverse impacts that globally disruptive physical trade warfare would generate should not be taken for granted. Disruptions would emanate both from the U.S.-led action and, very likely, from the Chinese retaliatory reactions. The political and social stamina necessary to endure an oil blockade's global economic consequences, potentially for a multiyear period, likely would be among the most critical factors in determining whether a tactical military success could be translated into a strategic victory that would help the United States maintain its preeminent position in maritime East Asia. In grappling with this issue, this analysis draws on a broad range of data and historical examples to illustrate the profound strategic risks and adverse consequences for the United States that likely would follow from imposing a maritime oil blockade on China.

Some of the analysts who responded to Collins and Murray's 2008 work expressed remarkably glib opinions on the economic consequences of a U.S.-China conflict involving maritime blockades of energy supplies, other key raw materials, and export goods. One analyst essentially dismissed the grave economic consequences of attacking a critical node of the global economy and the attendant —and unpredictable—diplomatic and political pressures this would create, noting that destructive economic shock waves are "a given in any war between the United States and China."[8] Another posited that the world trade system could be rebuilt in a manner that excludes China, asserting that "[t]he U.S. geographic position and maritime nature of global trade [mean] the rest of the world economy could rebuild around the perimeter."[9]

Such views risk creating a dangerous sense of strategic complacency. China's economy is not the equivalent of a discrete brick that could be pulled out of the global trading architecture and simply replaced or rebuilt around quickly. Rather, the trade flows that are viewed as strategic vulnerabilities also reflect complicated international supply chains and manufacturing ecosystems that took decades to develop—and to which China is central and critical.

To put the matter into historical context, China today plays a significantly more important role in the global economy than Germany did on the eve of World War I. Imperial Germany accounted for slightly under 15 percent of global manufacturing production in 1913, while China now accounts for more than 25 percent of global manufacturing value added, within a much larger and more deeply interconnected global economy.[10] Rewiring global industrial chains to offset meaningfully the loss of full Chinese participation would take years at best, and might not even be possible. A prolonged global economic output loss of a magnitude at least equal to that of the 2008–2009 Great Recession—if not the Great Depression itself—would become conceivable under such circumstances.

Arguably, strategic thought on the option of blockading oil shipments to China has been distorted by prior U.S. economic-warfare campaigns against smaller countries. Such embargoes—particularly against Iran—damaged the target country sufficiently that Washington could declare "victory," but avoided imposing systemic global costs high enough to alienate key U.S. allies and supporters. Economic warfare against Iran is also a low-cost venture in the sense that—setting aside pinprick retaliation through its Middle Eastern proxies such as Hezbollah or Shia militias or isolated cyber attacks—Iran has relatively few attractive retaliatory options for inflicting serious strategic pressure on the United States. China, in contrast, would have a range of credible military and nonmilitary options for retaliating against a U.S. energy blockade.

Oil-based economic warfare against China would present challenges different from and much more complex than those pertaining to the economic and trade-warfare campaigns the United States has waged over the past several decades. First, the community of trading nations—many of which chafed under the U.S. embargo against Iran—likely would be far less willing to tolerate actions against China that would harm their own economies deeply, with the pain of such harm increasing the longer the blockade continued. Reactions from countries fed up with U.S. action against China could unfold in numerous ways, including denying overflight rights and port and airfield access, severing trade relationships with U.S. companies, and refusing to cooperate with potential U.S. sanctions against China.

Second, China's economic weight means that, unlike a country such as Iran, Iraq, Libya, North Korea, Sudan, or Syria, it cannot be cut off from the global economy with relatively little systemic consequence. An enduring lesson of past U.S. military actions abroad is that we are at our most powerful when we act with a critical mass of like-minded nations supporting us and facilitating the translation of national wealth into combat power. Unless China conducted a Pearl Harbor–style first strike, the United States likely would find it very difficult to line up sufficient international support for—or at least extended tolerance of—an economically destructive maritime oil blockade against China that likely would need to last for twelve months or longer to have full strategic effect. The global economic injury incurred simply would far outweigh the upside of supporting a prolonged campaign whose genesis most likely would come from a highly local miscalculation in a place such as the East or South China Sea, where the conflict is bilateral but the consequences would reverberate globally.

Third, China has multiple supply-side and demand-side options for buying itself strategic space and time to cope with a cutoff of seaborne oil and refined-products imports. Its crude-oil inventories now likely exceed six hundred million barrels, equal to roughly a hundred days' worth of seaborne crude-oil imports.[11] Despite China's growing absolute and relative dependency on imported crude oil, it also remains one of the world's largest producers, pumping more than 3.5 million barrels per day (bpd) from its own fields. With Kazakh and Russian assistance, it also likely could surge secure overland crude-oil imports by several hundred thousand barrels per day on relatively short notice. These additional supplies from Kazakhstan and Russia would not be sufficient to offset fully a loss of maritime supplies, but could help stretch the life of existing crude stockpiles. China also can ration demand and use domestically produced fuel substitutes such as coal-based methanol to extend gasoline supplies and reduce crude-oil demand. This article will explore each of these potential responses in depth.

Fourth, past history in the Asia-Pacific region suggests that a successful U.S. embargo of oil shipments to a strong military power may escalate conflict in unpredictable ways. The U.S. decision to cut off oil shipments to Japan in the summer of 1941 helped trigger Japan's invasion of the oil-rich Dutch East Indies, and arguably precipitated the attack on Pearl Harbor. It is dangerous to assume that economic pressure would be more likely to push China's leadership toward capitulation than escalation. Nationalism is a potent force in today's China, and if an outside power attempted to blockade China's seaborne oil supplies, the Chinese public would likely call for a strong military response and other escalatory measures. Furthermore, many of the potential flash points at which a military confrontation could be precipitated between the United States and China—arising from various territorial and resource disputes in the East and South China Seas—involve matters that are disproportionally important to China and positions for which Beijing enjoys strong domestic support. Even objectively inflammatory measures, such as turning reefs into military outposts, are applauded widely by the Chinese body politic, and coercive measures by Washington in response to such actions would allow Beijing to portray itself as a victim of foreign aggression against China's assertion of its perceived interests. Framing the narrative in this way could help maintain domestic political cohesion and brace Chinese society for a potentially prolonged and economically damaging conflict.

The disproportionate importance of fundamentally local conflicts also strongly suggests that, rather than creating off-ramps for escalation control and conflict termination, an approach fundamentally based on a distant oil blockade instead might lead Chinese leaders to escalate and put the United States in a position from which it must either concede to China's actions or amplify its military and political response into a higher-intensity conflict.

Fifth, the effects of suddenly removing more than five million barrels per day of demand from the global oil market and cutting off Chinese access to other seaborne resource imports likely would send commodity prices into a tailspin and cause severe economic disruptions to commodity exporters in the Middle East and other regions. Economic damage of sufficient scale could translate rapidly into social and political upheaval in an already-volatile region—where, it bears noting, it ultimately is U.S. military power that underpins the regional security architecture.

China's global economic heft, other countries' unhappiness with being subjected to the collateral consequences of a U.S.-China conflict, and the risk of serious problems for key commodity exporters likely would put the United States in a race against time to force Chinese capitulation before limited reserves of external political support were depleted.[12] Assuming the United States sought substantive Chinese capitulation, such time pressure would undermine a central motivation for using a distant oil blockade: escalation control through the ability to impose economic pain in a calibrated manner.

The often-underappreciated adverse consequences do not mean that a distant energy blockade lacks strategic viability. Rather, they suggest that policy makers considering maritime embargoes or so-called offshore control should recognize that, while the United States might have the tactical capability to seal off China's maritime oil arteries, blockades alone are a limited means to a limited end. As has been argued previously, "effective blockades typically take years to achieve their goals and even then succeed only when they are a part of a comprehensive military action that usually includes invasion or massive aerial bombardment."[13] Blockade advocates must consider the strategy's inherent limitations, as well as the full range of potential adverse consequences for American strategic objectives. Otherwise, they risk setting the United States up for a Pyrrhic victory—or worse.

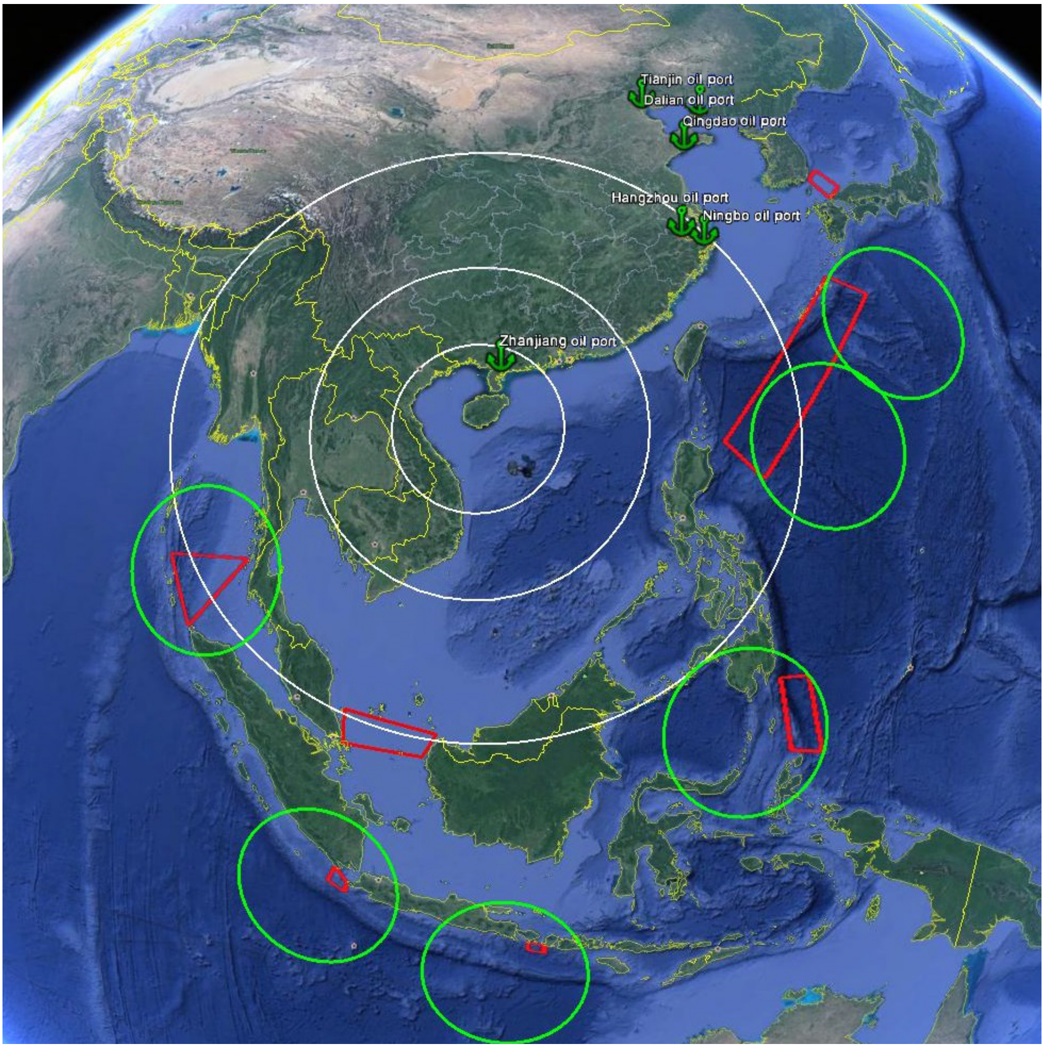
U.S. ABILITY TO INTERDICT CHINA'S SEABORNE OIL TRADE

China's reliance on seaborne oil supplies has risen steadily over the past decade and could rise further as domestic production declines.[14] The country's oil-demand growth rate has slowed dramatically, registering only a 2.5 percent increase in 2016. Nonetheless, demand growth now occurs atop a large base (nearly twelve million barrels per day), so even a 2 percent demand growth rate still would mean consumption of oil products expanding by 240 thousand barrels per day (kbd). Furthermore, the current oil price downturn has pressured China's domestic oil output, which declined by 7 percent year over year in 2016 and is poised for further declines in 2017, barring a major recovery in oil prices.[15]

Moreover, the imported oil passes overwhelmingly through the Strait of Malacca and a handful of other passages that the U.S. Navy could seal off effectively (see figure 1).[16] Under normal peacetime conditions, the Malacca Strait is the dominant waterway for transit of oil shipments; it carried an estimated 16.0 million bpd of crude oil and petroleum products in 2016, the most recent year for which official Energy Information Administration data are available.[17] The largest tankers use the deeper Lombok Strait, since their draft plus the underhull clearance required for safe passage exceeds the twenty-five-meter depth the Malacca offers.[18]

Additionally, a distant blockade would be imposed far from the Chinese coast, reducing the threat to U.S. forces from Chinese A2/AD systems. The most

FIGURE 1
KEY PASSAGES FOR SEABORNE CRUDE OIL HEADED TO CHINA



Source: Google Earth, author's analysis.

important Asian inbound oil tanker routes are the Strait of Malacca and Lombok Strait for crudes originating in Africa and the Middle East, and the western Pacific passage between the Philippines and Japan for cargoes coming from North and South America.

A distant blockade also would need to interdict the Myanmar–China oil pipeline, which eventually could move as much as 440 kbd of crude oil from Kyaukpyu in coastal Myanmar to Yunnan Province in southwest China.[19] Preventing tankers from off-loading at the Kyaukpyu terminal would require few, if any, naval platforms to remain on-site. The area could be declared an exclusion zone

Naval War College Review, Vol. 71 [2018], No. 2, Art. 6

for the duration of a conflict, and if the Myanmar authorities failed to comply the facility could be disabled via air strikes, aerial mining, or other kinetic action.[20] In short, U.S. forces likely would be able to neutralize rapidly China's overland routes for seaborne oil imports to avoid the Strait of Malacca and other choke points farther east and prevent them from diverting forces needed to seal other maritime ingress routes.

Differentiating among Targets in a Crowded Maritime Landscape

A large portion of China's inbound oil trade would be readily targetable because it is carried on PRC-flagged vessels owned by PRC-domiciled shipping companies or their subsidiaries.[21] Vessels operated by or for China's large, state-owned oil-trading companies, such as UNIPEC—which has ranked consistently as one of the world's largest supertanker charterers over the past several years—also would be readily identifiable.[22] Moreover, because a PRC entity would be the clear financial beneficiary of trade conducted with such vessels regardless of the stated cargo destination, they almost certainly would be seized or turned away if they entered a blockade zone.

Yet even after sifting out the "obviously PRC" target set, naval planners would face the challenging question of how to permit oil to continue flowing to regional U.S. allies "behind the blockade" while also preventing leakage of oil to the PRC. Oil cargoes can be traded while still at sea in a tanker, creating an opportunity for potential blockade-runners to obscure the cargo's ultimate destination.[23] This is a strategically important consideration, because smart blockaders typically aim to minimize disruption to shipping between neutral countries so as to maximize political support for—or, at a minimum, tolerance of—the blockade.

A specially tailored version of the "navicert" system that Britain used during World Wars I and II offers a possible solution.[24] In the system's original form, a shipper applied to the British government for approval to ship goods to a particular country. Then, after investigating the cargo, its destination, insurers, and parties that stood to benefit financially from the shipment, British authorities granted an approved shipment a navicert, which functioned as a "commercial passport" that allowed the vessel to pass through the Royal Navy (RN) blockade.[25] A vessel without a navicert was treated as a blockade-runner and was subject to seizure. Today, a vessel also might be required to place a U.S. government–controlled tracking beacon on board as a precondition for being granted a navicert in such a system.[26]

In the case of a hypothetical distant oil blockade, secure digital navicerts could be issued for carriage of oil and refined products into Asian ports east and north of Singapore. To tighten the blockade, the United States could combine navicerts and "forcible rationing."[27] In essence, forcible rationing entails allotting a fixed quantity of crude oil (and possibly refined products) to neutral markets behind the blockade cordon. The quota would be based on the neutral countries' actual demands, to create a situation in which a neutral country's reexports to China would create shortages and hardship in that market, thus setting up a self-enforcing compliance mechanism that creates disincentives to transship crude oil or refined products or both onward to China in violation of a blockade. If consumers in a specific neutral market were found to be reducing their fuel use and shipping the remainder onward to China in response to high-price offers from Chinese traders desperate for fuel, quotas could be adjusted downward accordingly.

There are approximately thirty large (i.e., 100 kbd or larger distillation capacity) oil refineries in East Asia outside of China that lie behind a likely distant-blockade perimeter, most of which are in Japan and South Korea (see figure 2). U.S. regulators could attach destination clauses to navicerts that prevented the resale of crude once tankers passed the distant-blockade force and could enforce these by requiring certified shippers to report vessel locations in real time and surveilling activity at oil wharves at regional refineries and storage depots. Given that Japan, Singapore, South Korea, and Taiwan likely would have interests broadly aligned with those of the United States during a conflict with the PRC, the United States also could station expert observers at each large regional refinery to track distribution of crude oil and petroleum products to ensure that supplies were not diverted to China.[28] Refineries in Indonesia and Malaysia could prove more complex, perhaps requiring additional tracking and verification measures, such as aerial surveillance of ship traffic to and from the facilities.

These plants' combined daily crude-processing capacity is approximately 6.8 million bpd. Since most oil would be arriving over long-haul routes in large tankers, this would keep inbound ship volumes manageable: three to four very large crude carriers per day, or approximately ten smaller Aframax vessels, if shipments were moved that way. The certified-shipper system could be replicated for vessels carrying refined products such as diesel, gasoline, and jet fuel.[29]

Handling Noncompliant Vessels

If a vessel were to violate the terms of the navicert, tamper with the permit or the tracking systems, or otherwise engage in behavior suggestive of an intent to violate the blockade, consequences could come in two fundamental forms. First, military forces in the blockade cordon could employ disabling fire. As Sean Mirski points out, several high-profile sinkings or disablings likely would have a strong deterrent effect on future prospective blockade-runners.[30]

The second, preferable method would occur at the "back end" of the navicert regime. Namely, geographic factors and draft restrictions constrain the passage of large tankers between China and large overseas oil suppliers, limiting them to no

FIGURE 2
KEY NON-PRC EAST ASIAN OIL REFINERIES

Facility	Country	Capacity (kbd)
JX Nippon Oil & Energy (Mizushima)	Japan	380
JX Nippon Oil & Energy (Negishi)	Japan	270
TonenGeneral (Kawasaki)	Japan	258
Showa Yokkaichi (Yokkaichi)	Japan	255
Kashima (Kashima)	Japan	253
Cosmo (Chiba)	Japan	220
Idemitsu (Chiba)	Japan	200
Idemitsu (Aichi)	Japan	175
Idemitsu (Hokkaido)	Japan	160
TonenGeneral (Sakai)	Japan	156
Kyokuto (Chiba)	Japan	152
JX Nippon Oil & Energy (Sendai)	Japan	145
Fuji (Sodegaura)	Japan	143
JX Nippon Oil & Energy (Oita)	Japan	136
Cosmo (Yokkaichi)	Japan	132
TonenGeneral (Wakayama)	Japan	132
JX Nippon Oil & Energy (Marifu)	Japan	127
Seibu (Yamaguchi)	Japan	120
Taiyo (Shikoku)	Japan	118
Osaka International Refining Company (Osaka)	Japan	115
Cosmo (Sakai)	Japan	100
Nansei (Nishihara)	Japan	100
Toa (Keihin)	Japan	70
Japan subtotal		3,917
SK Energy (Ulsan)	South Korea	817
GS Caltex (Yosu)	South Korea	750
S-Oil (Onsan)	South Korea	565
SK Energy (Inchon)	South Korea	275
Hyundai (Daesan)	South Korea	275
South Korea subtotal		2,682
Petron (Bataan)	Philippines	180
Philippines subtotal		180
Grand total		6,779

Note: kbd = thousand barrels per day.

Sources: "Location of Refineries and Crude Distillation Capacity in Japan (as of June 2015)," *PAJ,* www.paj.gr.jp/; "About Bataan Refinery," *Petron,* www.petron.com/; "Overview of SK Energy's Petroleum Business," *SK Energy,* eng.skenergy.com/; "Refining Facilities," *GS Caltex,* www.gscaltex.com/; "Oil Refining Business," *S-Oil,* www.s-oil.com/; "Overview," *Hyundai Oilbank,* www.oilbank.co.kr/; "Overview," *SK Incheon Petroleum,* eng.skincheonpetrochem.com/.

more than six straits and passes between islands in the so-called first island chain (the Pacific Ocean between Japan and the Philippines). Generally, after such ships off-load crude oil in China they eventually have to pass back through the distant blockade stations if they are to obtain additional crude oil. Any outbound ship that (1) lacked a navicert, or (2) could not provide beacon tracking data that corroborated its compliance with the issued navicert, or (3) had attempted to off-load crude at sea to a China-bound vessel would be presumed to have run the blockade and could be seized or sunk. Conducting outbound screening activities would have the advantage of allowing naval forces to operate beyond the most dense—and thus most dangerous—coverage of China's A2/AD systems.

CHINA'S NONMILITARY RESPONSES: BUYING TIME

One of this article's primary contributions is its examination of China's nonmilitary options for responding to a loss of seaborne oil supplies. China has various options for offsetting a loss of seaborne crude oil and refined-product supplies. The potential responses span a range of time and cost dimensions.

China's initial nonmilitary responses to a distant oil-and-refined-products blockade likely would emphasize two core elements: (1) minimizing domestic oil demand to extend the life of commercial and strategic crude-oil stocks, and (2) maximizing nonmaritime liquid-fuel supplies by working to augment overland imports of crude oil and refined products, as well as blending domestically produced "extenders" such as coal-derived methanol into the gasoline and diesel-fuel pools to reduce the demand for crude oil. The intent would be to maintain the ability to fuel the military and to support as much civilian economic activity as possible, with the ultimate goal of holding out long enough for the U.S. political will to sustain the conflict to wane, potentially opening the door for a peace settlement more favorable to Chinese interests.

Demand-Side Options

Conservation through rationing would be among the lowest-cost and fastest responses to a seaborne energy embargo. The experience of the United States during World War II offers perhaps the most applicable case study for assessing potential parameters for rationing in China. The America of that era was—just as contemporary China is—a world-class industrial power that was heavily mechanized, and for which petroleum was an irreplaceable strategic economic input.[31] Between 1941 and 1944, the United States used a mix of voluntary and compulsory measures to decrease private and commercial highway gasoline consumption (i.e., transportation-driven gasoline demand) by 32 percent.[32] As transportation expert Bradley Flamm points out, the U.S. achievement was especially noteworthy because it occurred "at a time when population, employment, and income growth would normally have led to large increases in auto ownership and gasoline consumption."[33]

China remains in a period of similarly dynamic growth in personal car ownership. Yet there are important differences that credibly suggest that China could reduce motor-fuel demand more rapidly than the United States did during World War II, and perhaps circumscribe demand even more severely if circumstances warranted. First, by 1940 the United States already had more than two hundred private cars per thousand persons—approximately twice the current ownership rate in China.[34] Second, many Chinese still use public transit as their primary mode of transportation to work and for daily activities, so a move to curtail auto use likely would spark less resistance than it did in the United States, where the government faced stiff pushback from many car owners who chafed at gasoline-supply restrictions. Third, Chinese car owners in key markets, including Beijing, already regularly face serious restrictions on their driving—for instance, via administrative decrees that only cars with even- or odd-numbered license plates can be used on certain days.[35]

So what would it mean in concrete terms if China responded to a seaborne oil and products embargo by imposing rationing that reduced gasoline demand by a third relative to preblockade levels? The International Energy Agency forecast that China's gasoline demand in 2017 would be approximately 3 million bpd.[36] Thus, a 33 percent reduction in gasoline use—a million barrels per day—would decrease China's total estimated oil products demand by more than 8 percent.

Oil demand likely would decline further as economic activity slowed because of the blockade and as civilian consumption of diesel and middle-distillate fuels (which are critical to air and naval operations) fell. "Involuntary" rationing likely would accelerate as export-oriented factories shut down and trucking activity fell. This article's analysis suggests that the average heavy truck in China consumes approximately 144 barrels of diesel fuel per year.[37] Under such conditions, idling 5 percent of the Chinese heavy-truck fleet—a plausible and conservative projection for the likely effects of an oil blockade—would remove a diesel-demand volume equivalent to the entire daily consumption of the Shanghai municipality—approximately 112 kbd.

Rationing also would facilitate the redirection of fuels to the Chinese military and critical internal-transport activities. Even during the peak of U.S. military operations in Iraq and Afghanistan and "normal" training activities and force movements, the Defense Department's daily average fuel use was nearly four hundred thousand barrels per day—an amount equal to slightly more than 10 percent of China's *domestic* crude-oil output.[38] Even if some fuel use was not included in this figure—for instance, that by transport aircraft and ships transiting multiple countries to support operations—it still strongly suggests that China's domestic crude supplies alone would be more than sufficient to fuel the country's military operations for a very long period, particularly since the PLA does not face the "tyranny of distance" and the fuel-use intensity it causes to nearly the degree that forward-based U.S. forces would. Furthermore, China's rapidly growing domestic air-travel market likely would cease to operate during a conflict, owing both to reduced travel activity and to the need to reroute domestic kerosene consumption—now nearing seven hundred thousand barrels per day—to support military activities.

Finally, the domestic rail system, which moved 13 percent of the country's freight volume in 2015 (as opposed to the 32 percent of freight volume that moved by highway), also likely would receive priority fuel allocations. Rail is a high-volume coal mover in China, and would become more important if a blockading power threatened the coastwise coal shipping that currently moves several hundred million tons of the fuel per year from northern to southern Chinese ports. Railroads are highly fuel efficient. Indeed, based on the estimates in the previous paragraph and fuel-efficiency data from the Union Pacific (UP) and BNSF railroads, shutting down 5 percent of China's heavy-truck fleet potentially would free up middle-distillate fuel sufficient to move roughly 1.5 trillion ton-miles of goods.[39] This volume would be equivalent to 13 percent of all freight goods transported in China during 2015, according to data from the National Bureau of Statistics.[40]

Supply-Side Options

Rationing and other conservation activities would set the stage for China's core supply-side response to a disruption in the supply of oil and refined products caused by a blockade: tapping strategic and commercial stockpiles. As the country drew down crude-oil and petroleum-products inventories, it also would redouble efforts to procure additional supplies via pipeline, rail, and truck from Kazakhstan and Russia.[41] These two overland supplier countries are China's "strategic depth," from an oil-security perspective. They have significant supplies of crude and the ability to increase flows to China fairly rapidly, and likely would have abundant diplomatic and geostrategic reasons in the event of a maritime oil blockade to scale up overland oil supplies to China, quietly but significantly. Once scale-up occurred and infrastructure kinks were ironed out, these increased supplies—one could call them the "Oil Silk Road"—likely could be sustained for years and could undermine a blockade meaningfully by extending the time an adversary would have to sustain it.

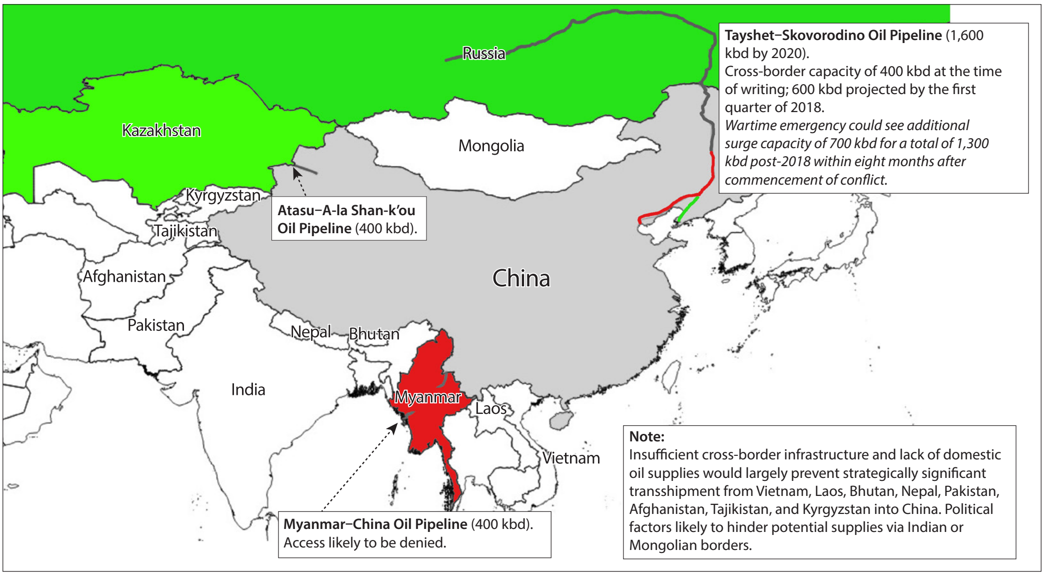
The Atasu–A-la Shan-k'ou (Alashankou) pipeline that brings Kazakh and some Russian crude into Xinjiang currently has a capacity of twenty million tons per year—approximately four hundred thousand barrels per day.[42] Since early 2014, the line has operated below capacity, and as of October 2017 it delivered only about fifty thousand barrels per day, suggesting that the line currently has approximately 350 kbd of "headroom" if supplies needed to be surged in the event of a seaborne energy embargo.[43]

From Russia, the first Skovorodino–Daqing crude-oil pipeline entered service in 2010 and now can deliver a maximum supply of four hundred thousand barrels per day.[44] Transneft and the China National Petroleum Corporation (CNPC) are now in the final stages of building a parallel pipeline from Skovorodino to Daqing that would expand the system capacity to six hundred thousand barrels per day; it is slated to enter service in 2018.[45] In April 2017, CNPC also put the 440 kbd–capacity Myanmar–China oil pipeline into operation, but this system should not be considered a "secure" source of supply the way Kazakh and Russian pipelines are, because, as discussed above, it is highly vulnerable to naval interdiction, especially if a conflict escalated.[46]

In the event of a blockade, Chinese traders also likely would move rapidly to secure supplies via rail. Prior to the construction of the Skovorodino–Daqing pipeline spur, Russian producers delivered as much as 228 kbd of crude by rail into China.[47] The ultimate surge capacity during a crisis would depend primarily on three factors: (1) congestion on key Siberian rail routes between the west Siberian oil fields and the Chinese and Kazakh borders, (2) the availability of tank cars on each side of the border, and (3) the speed with which Russian and Chinese rail operators could calibrate their train cycle times to maximize rolling stock use. GlobalTrans, one of Russia's primary freight-rail operators, reported at the end of 2016 that the country had a total of 260,000 operational tank cars.[48] To put that number in perspective, the United States had 371,000 operational tank cars at the end of 2014, at which point railroads were moving more than 950 kbd of crude within U.S. borders.[49]

From mid-2012 to spring 2013, U.S. railroads more than doubled their crude-oil haulage volume as coastal refiners demanded crudes from burgeoning shale plays.[50] The scale-up rate and total haul volume were facilitated by the high efficiency of the U.S. freight rail network and the fact that even the distant Bakken oil fields in western North Dakota were never more than about 2,400 km from end-user markets. In contrast, a crude measurement on Google Earth suggests that the rail distance from Russia's core oil fields in Khanty-Mansi Autonomous Okrug to the main ingress point for rail-borne crude at Manzhouli, Inner Mongolia, is nearly four thousand kilometers each way. Given these numbers, even a full mobilization of Russian crude by rail hauling apparatus likely would not be able to deliver more than perhaps four hundred thousand barrels per day sustainably, with an additional one hundred thousand barrels per day coming from Kazakhstan (see figure 3). These volumes would be helpful—but they are not blockade breakers by any means.

FIGURE 3
CHINA'S OVERLAND OIL SUPPLY OPTIONS



Note: kbd = thousand barrels per day.

Source: Google Earth, author's analysis.

Expanding Pipeline Capacity from Russia. Transneft's eastern Siberia–Pacific Ocean (ESPO) pipeline currently can transport fifty-eight million tons (roughly 1 million bpd) of crude oil per year from Tayshet to Skovorodino, which is the start point of the southbound pipeline system into the Daqing area.[51] The pipeline spur into China currently can transport approximately four hundred thousand barrels of crude per day and is expected to be capable of moving six hundred thousand barrels per day once a parallel pipeline whose construction was completed in November 2017 enters service in early 2018.[52]

Those numbers suggest that if the first stage of the ESPO from Tayshet to Skovorodino were to run at full capacity under current parameters, there would be an additional four hundred thousand barrels of oil available per day once the pipelines into China were running at full utilization. Transneft plans to expand the ESPO's capacity to eighty million tons per year (1.6 million bpd) by 2020.[53] Taking this full-capacity number and subtracting the anticipated amount slated to head into China (six hundred thousand barrels per day) suggests that as much as one million barrels per day could be available if an exigent situation led Russian firms to breach contracts for seaborne supplies through the port of Kozmino and instead make oil available to supply China. The big question is how so much oil could be moved in a timely manner. As outlined above, rail and truck will play a key role initially. However, another option exists that has not received much, if any, consideration to date: building additional southbound pipeline capacity.

China was able to build the initial Russia–China pipeline at an average rate of approximately 1.6 km per day, and has built crude-oil pipelines in western China at rates approaching 2.25 km per day.[54] The Jinzhou–Zhengzhou oil-products line was welded at an average rate of 3.6 km per day.[55] In a time of national emergency, pipelines could be built much more quickly, as builders likely would marshal a much larger share of their equipment and manpower for a select few "national priority" projects than would be the case under normal conditions.

Perhaps the closest historical analogy comes from the American construction of the "Big Inch" oil pipeline during World War II. The Big Inch enabled the secure overland movement of crude oil from Texas oil fields to East Coast refineries. Oil formerly had been moved from the Gulf of Mexico in coastwise tankers, but German submarine attacks jeopardized this maritime supply line and forced the United States to find alternative routes. At 1,254 miles (two thousand kilometers) long, the Big Inch covered roughly twice the distance a line from the Russian border to Daqing would, and construction crews managed to complete it in just 350 days—an average construction rate of nearly six kilometers per day.[56] Therefore, it is not inconceivable that a thousand-kilometer pipeline from Russia capable of moving several—perhaps as many as seven to eight—hundred thousand barrels of crude oil per day into the Daqing area could be built within six months.[57]

If rationing, demand substitution, and overland supply measures were combined with a pipeline that could be brought on line within six months of the conflict's commencement, the effects on China's ability to withstand a maritime oil blockade could be profound. Because Transneft's eastbound pipelines are now linked to fields in eastern Siberia and Russia's core west Siberian producing areas, crude supplies could be sustained for a long period and the infrastructure would be located far inland, where it could be struck only at significant risk to the attacker's forces and with a high risk of escalation.

Use of "Fuel Extenders." Chinese fuel providers could blend methanol produced from abundant domestic coal reserves into the country's gasoline and diesel fuel supplies as a way to replace some degree of seaborne crude-oil imports lost to a blockade. The focus is on methanol as a fuel extender because, unlike ethanol produced from corn and staple grains, methanol production does not consume essential human food supplies.

The fuel extenders would provide China with multiple strategic advantages. Methanol can be produced from the country's abundant domestic coal supplies. Argus, a petroleum market data provider, estimates that by 2018 China will be able to produce approximately 120 million tons per year of methanol (equivalent to 2.6 million bpd), 80 percent of which is slated to come from coal feedstock and would be invulnerable to a maritime blockade, at least from a feedstock perspective.[58] However, China would need to be self-sufficient in the catalysts used to make methanol from coal; some of China's largest coal-to-methanol plants currently source their catalysts from a key foreign-domiciled manufacturer that very likely would face significant pressure to curb Chinese customers' access to catalysts during any conflict between China and the United States.[59] It is currently unclear to what extent the Chinese coal-to-methanol industry depends on foreign-sourced catalysts.

Modern fuel-injected gasoline engines generally can tolerate a blend of 15 percent methanol and 85 percent gasoline, also known as M15.[60] At least sixteen Chinese provinces—including some of the country's largest gasoline markets—have promulgated local methanol-gasoline standards, and the country overall already blends approximately five hundred thousand barrels per day of methanol into its gasoline and motor-fuel pools, displacing the equivalent of 250 kbd of crude oil.[61] At the end of 2015, China had an estimated 55 million tons per year (around 1,190 kbd) of domestic methanol-production capacity, according to market data provider Platts.[62] China's methanol-production capacity increased by 7.16 million tons per annum (tpa) in 2016, and is slated to rise by a further 7 million tpa in 2017, bringing the total nameplate capacity to nearly 1,500 kbd.[63] Argus estimates that, counting captive supply for methanol-to-olefins plants, China's total methanol-production capacity could be as much as 120 million tpa by 2020—roughly 2.6 million bpd.[64] It is thus highly plausible that by early 2019 China could have 2 million bpd of domestic methanol-production capacity.

Much of China's domestic methanol supply currently is used to produce olefins—a feedstock for petrochemical and polymer production. It is very likely that during a blockade contingency the Chinese government would prioritize liquid-fuel availability over the manufacturing of polymers and petrochemicals, a significant portion of which go to export markets. Of a domestic methanol supply exceeding 2.5 million bpd, a substantial portion of the stream likely would be diverted into the gasoline/motor-fuel supply, to reduce the call on crude oil. (Here it should be noted that a gallon of methanol yields approximately 49 percent as much energy as a gallon of gasoline.)[65]

If Chinese policy makers chose to replace 15 percent of the refined blendstocks from crude oil in the country's total gasoline pool with coal-derived methanol, this would suggest a requirement for approximately six hundred thousand barrels per day of methanol.[66] The country's estimated 2018 domestic coal-based methanol-production capacity of roughly two million barrels per day would be able to accommodate this number, and in doing so would displace the energy equivalent of nearly three hundred thousand barrels per day of crude oil–derived products demand.[67]

Naval War College Review, Vol. 71 [2018], No. 2, Art. 6

Tests by researchers in Australia and Iran have shown that a lightly modified common diesel engine could run successfully on a blend of diesel fuel and methanol. The team tried mixes incorporating 10 percent, 20 percent, and 30 percent methanol by volume and found that a 10 percent methanol / 90 percent diesel blend generally performed best in terms of delivering a usable torque curve, adequate power, and reasonably efficient fuel consumption.[68] However, the blend ratio likely would be pushed higher to maximize the reduction in crude-oil usage; therefore, this analysis uses 15 percent as the methanol-blend figure. With 2.25 barrels of methanol as the energy equivalent of one barrel of diesel fuel, 725 kbd of methanol theoretically could meet 15 percent of China's diesel-fuel demand volume (3.3 million bpd × 5 percent demand reduction × 15 percent of supply × 2.25 = 724 kbd of methanol) and displace 320 kbd of crude oil–derived products consumption. Large-scale adoption of fuel extenders likely would create additional engine performance and maintenance issues above what Chinese drivers experience today, but a blockade-driven crisis scenario likely would make vehicle users willing to accept and adapt to such disruptions.

COMBINED MEASURES WOULD HELP CHINA MAXIMIZE PRESSURE ON THE BLOCKADER

Each additional month that China successfully endured a seaborne energy blockade would mean increased pressure on a blockading power to terminate the conflict. This analysis contemplates a scenario of conflict post-2018. The base scenario's assumptions are as follows:

1. On the first day, China holds combined commercial and strategic crude-oil stocks of seven hundred million barrels in storage tanks and underground caverns.[69]
2. The country's refinery runs of crude oil are 12.5 million bpd.
3. Rationing rapidly reduces demand for oil products by 35 percent relative to preconflict levels.
4. China imports a baseline volume of six hundred thousand barrels per day of crude from Russia and four hundred thousand barrels per day from Kazakhstan by pipeline.
5. The 440 kbd Myanmar–China pipeline is interdicted and unable to supply crude.
6. Russia and Kazakhstan surge railborne crude supplies by a combined total of four hundred thousand barrels per day.
7. In addition to pipeline and rail supplies, Russia and Kazkahstan provide 150 kbd of crude overland, by truck.

FIGURE 4
BASE ASSUMPTIONS FOR VARIOUS SCENARIOS

Beginning crude oil stocks, kbd	700,000
Baseline refinery runs, kbd	12,500
Refinery runs at 35% rationing, kbd	8,125
Refinery runs at 40% rationing, kbd	7,500
Refinery runs at 45% rationing, kbd	6,875
Methanol and fuel extenders, kbd	615
Domestic production, kbd	3,600
Pipeline supplies from Russia and Kazakhstan, kbd	1,000
Rail- and truck-borne supplies from Russia and Kazakhstan, kbd	550
Emergency supplementary pipeline from Russia, kbd	700

Note: kbd = thousand barrels per day.

8. Methanol blended into gasoline, vegetable oils blended into the diesel-fuel supply, and other fuel extenders reduce crude-oil demand by 615 kbd.

Under the baseline scenario, China's crude-oil stockpile would last for approximately ten months. If Chinese policy makers could reduce demand for oil products by 40 percent through rationing, import an additional one hundred thousand barrels per day of crude from Russia and Kazakhstan by rail and truck, and bring new pipelines capable of moving four hundred thousand barrels per day of Russian crude from Skovorodino within eight months of blockade imposition, the country's stockpile "holdout time" would rise to seventeen months. For reference, it is unlikely that China's direct military fuel needs would exceed five hundred thousand barrels per day even during an intense conflict.

Building a new pipeline from the Russian border capable of importing an additional six hundred thousand barrels per day of crude would increase the holdout time to twenty months in the 40 percent–rationing case. In a more extreme response scenario—maintaining all the above conditions but reducing crude-oil refinery runs by 45 percent from preconflict levels—the holdout time would be extended to more than four years. In the most optimistic response scenario—achieving 45 percent rationing reduction in oil-products demand and building additional pipeline capacity of eight hundred thousand barrels per day from eastern Siberia into northeast China—China would have nearly eight years before crude stockpiles ran out.

It is likely that even a conflict response that began with rationing less than 35 percent relative to preconflict oil consumption soon would experience substantial involuntary reductions as economic activity slowed. As China's gross domestic product and economic activity declined, the country likely would end up with ample domestic and overland liquid-fuel supplies to maintain basic activities, as discussed earlier. In addition, a multiyear-blockade scenario also likely would trigger even deeper structural adaptations. These likely would include greater use of public transport; greater use of railroads and internal waterways to move cargo instead of trucking it; cessation of most domestic passenger flights; and

Naval War College Review, Vol. 71 [2018], No. 2, Art. 6

FIGURE 5
CHINA'S CRUDE-OIL "HOLDOUT" TIMES UNDER VARIOUS SCENARIOS

Scenarios		Implied Months Stocks Would Last
No Emergency Pipeline from Russia		
Initial crude-oil stockpile drawdown rate without seaborne imports and no rationing, kbd	–6,735	3
Draw rate with 35% demand rationing, kbd	–2,360	10
Draw rate with 40% demand rationing, kbd	–1,735	13
Draw rate with 45% demand rationing, kbd	–1,110	21
Emergency Pipeline from Russia Enters Service on Eighth Month of Blockade		
Drawdown rate with no seaborne crude imports once supplementary emergency pipeline built (no rationing), kbd	–6,035	3
Draw rate with 35% demand rationing, kbd	–1,660	12
Draw rate with 40% demand rationing, kbd	–1,035	21
Draw rate with 45% demand rationing, kbd	–410	62

Note: kbd = thousand barrels per day.

significant expansion of coal-to-liquids production capacity, which currently is considered too environmentally damaging and economically uncompetitive to justify funding. Here it bears noting that if all currently approved coal-to-liquids projects in China came on line, their total capacity would be 13.8 million tons per year, equivalent to nearly three hundred thousand barrels per day of diesel fuel.[70]

While these scenario estimates are relatively simplistic, they suggest that rationing would be the highest-impact response strategy for Chinese policy makers facing a blockade of seaborne crude-oil imports. Building additional pipelines to move additional Russian oil into northeast China and blending methanol and other fuel extenders into the gasoline and diesel pools would be the next most impactful responses.

The scenarios also highlight the reality that, within historically realistic response parameters, China very feasibly could adapt to conflict conditions and withstand a blockade for a longer period than an outside power realistically could sustain the operation. At the most fundamental level, a blockader would find itself increasingly isolated on the world stage, which would complicate its ability politically, economically, and militarily to continue its campaign.

In addition, unlike imperial Japan in World War II, whose military was crippled by a seaborne oil blockade because the country had no meaningful domestic oil production, China's domestic production and overland imports supply many times the daily oil requirements of even the most intense conceivable conflict scenarios.[71] Therefore the People's Liberation Army Air Force and Navy would not be constrained by fuel shortages, enabling them to project power against a blockader and to maintain territorial gains and presence within the first island chain in a manner that likely would force the United States ultimately either to escalate by engaging in direct military conflict closer to China or to forgo military action in China's near neighborhood, effectively making China the new military hegemon in much of East and Southeast Asia.

CRITICAL STRATEGIC CHALLENGES TO A DISTANT OIL BLOCKADE

Risk of Systemic Global Disruptions

The commodity flow disruptions and price volatility that would accompany a distant blockade of China likely would be phenomenal. Sealing off the country's maritime inbound oil arteries by itself rapidly would eliminate approximately 10 percent of global oil demand, cratering prices in the process and setting the stage for multiple negative secondary effects in the Persian Gulf region and others dependent on oil-export revenues. The effects would worsen as a blockade ground on, disrupting regional and global supply chains and almost certainly prompting demand rationing within China itself. A reduction in global crude-oil demand on the order of eight to ten million barrels per day within months of a blockade being imposed is not inconceivable. To put that figure in perspective, the global surplus during the deepest phase of the 2014–16 global oil price crash was only about two million barrels per day, and prices still fell below thirty dollars per barrel at one point—likely less than half the price that Russia, Saudi Arabia, Iran, and other major exporters need to balance their budgets and maintain long-term financial and political stability.[72]

To try to achieve a timely rebalancing of the global oil market under such conditions, the Organization of the Petroleum Exporting Countries (OPEC) would be forced to make dramatic cuts in production volumes. During the 2008–2009 oil price collapse, OPEC moved decisively to reduce production, and by the end of 2008 had agreed to cuts that reduced total daily global oil supplies by nearly 5 percent (more than four million barrels per day).[73] The results were substantial: oil prices that bottomed in February 2009 nearly doubled by the end of that year.[74] But a blockade scenario likely would entail production cuts of twice this size; in other words, equivalent to approximately a quarter of the cartel's collective daily output. Cuts also would occur in an environment in which it would be uncertain when demand from OPEC Gulf producers' cornerstone East Asian customers, foremost among them China, might recover.

China has been the key source of demand-side support for global oil prices over much of the past decade, accounting for roughly 43 percent of global incremental oil-demand growth between 2009 and 2015.[75] On the secondary, but directly linked, level, commodity demand in China, which would suffer badly

Naval War College Review, Vol. 71 [2018], No. 2, Art. 6

FIGURE 6
CHINA'S SHARE OF GLOBAL DEMAND FOR SELECT STRATEGIC, HIGHLY TRADED COMMODITIES IN 2015

Commodity	2015 Share of Global Consumption	Estimated Annual Global Export Market Size (2015), Billion USD	Three Largest Exporter Countries
Crude oil	13%	739	Saudi Arabia, Russia, Canada
Steel	43%	277	Australia, Brazil, South Africa[a]
Natural gas	6%	244	Russia, Qatar, Norway
Copper	49%	155	Chile, Zambia, Russia
Soybean[b]	30%	78	Brazil, USA, Argentina
Aluminum	53%	50	Russia, Canada, UAE
Wheat	16%	42	Canada, USA, Australia
Corn	22%	30	USA, Brazil, Argentina
Zinc	47%	20	Australia, Peru, South Korea
Nickel	53%	18	Russia, Australia, Canada
Lead	35%	16	Australia, Mexico, Peru
Total value		1,669	

Notes:
UAE = United Arab Emirates; USD = U.S. dollars.
Lead and zinc data include raw metal and ores and concentrates.
a. Iron ore raw material exporters.
b. Soybeans and soybean meal.

Sources: Bloomberg (steel price), industry associations, International Trade Administration (steel), Observatory of Economic Complexity (trade value), U.S. Department of Agriculture.

under a blockade, has had a multiplier effect on global raw-material demand and prices. Consider the oil market, for instance. The five regional groupings that account for the majority of commodity exports to China (the Middle East and North Africa, Latin America, Southeast Asia, the former Soviet Union, and sub-Saharan Africa) accounted for roughly 10.5 million barrels per day of oil-products demand increase between 2000 and 2015—1.6 times the amount by which China's own oil-products demand grew during that time.[76] Much of this came as rising commodity prices stimulated by China's growth meant larger export revenues that catalyzed economic growth and greater local oil demand in key commodity-exporting countries.

The significant long-term reduction in revenue to major oil and commodity exporters as a result of decreasing oil-demand volumes and depressed prices could exert profound internal political effects and trigger new conflicts and inflame existing ones across the Middle East and parts of Africa. Sufficiently serious regional contingencies could divert U.S. military resources from the Asian theater, particularly if the United States found itself politically and diplomatically isolated on the world stage. This could undermine the sustainability of a distant energy blockade against China.

Distant Blockade Signals U.S. Weakness?

Relying on blockade, especially a distant blockade, as a primary means of prosecuting a conflict with China would risk signaling that the U.S. commitment to maintaining the Asian security architecture is, in fact, limited. Allies and the Chinese leadership alike likely would draw important conclusions from the message that U.S. actions transmitted. Regional partners might perceive a need to hedge their bets, while Beijing could conclude that if it held out long enough, Washington's position and its resolve to prosecute the conflict would weaken, increasing the likelihood of a resolution that favored Chinese interests.

China Would Retain Its Military Hardware—and Still Pose a Challenge

One of the distant blockade's chief points of attractiveness—its potential to reduce the belligerent parties' direct kinetic actions against each other—is also a potential weakness because it leaves a defeated country with much of its antebellum military capacity. As Evan Braden Montgomery of the Center for Strategic and Budgetary Assessments (CSBA) points out, a successful distant blockade that did not also include actions aimed at degrading China's military would leave the United States struggling to "confront the challenge of reaching a sustainable accord with a defeated, potentially revanchist, and still militarily powerful China."[77] In other words, victory today through a successful distant blockade might sow the seeds of a future conflict in which the blockaded party presumably would undertake great efforts to ensure it did not again suffer defeat by blockade.

Domestic Challenges from Powerful Commercial Interests

The broad deference the White House and powerful U.S. regulatory agencies such as the Departments of Justice and the Treasury showed to Wall Street during and after the great financial crisis of 2008 raises unsettling questions for planners contemplating the domestic political dimensions of an energy blockade against China. Would these same offices and agencies—many of which would be involved intimately in implementing a blockade—truly be willing to injure influential private economic interests by effectively throttling the world's second-largest economy?

Multiple historical examples demonstrate that conflicting internal political priorities can impair a blockade's strategic effectiveness severely. For instance, more than one year into its Beira patrol aimed at preventing oil shipments from reaching the rebellious colony of Rhodesia, Britain suffered major embarrassment when a tanker entered the port of Beira even though an RN frigate had ordered it to stop and even had fired warning shots.[78] In the context of a distant oil blockade against China, any hesitance to use force against noncompliant vessels likely would encourage open defiance rapidly and induce an onslaught of Chinese-flagged ships trying to run the cordon. Instead, well-publicized use of disabling fire against noncompliant vessels in the early stages of a blockade would offer the best deterrent and substantially increase the blockade's effectiveness and strategic value. But planners should not assume that civilian elected officials would be willing to allow the U.S. Navy broad tactical latitude to sink or disable vessels attempting to defy a blockade, particularly if these officials' willingness to go "all in" on an oil blockade was attenuated by their desire to protect the commercial interests of their private patrons.

This is especially true in the case of a "partial war," among the most likely scenarios for a Sino-American kinetic conflict. In such a confrontation between nuclear powers, the overriding objective is to control escalation carefully rather than to pursue total military dominance.[79] When civilian policy makers prioritize restraint over military effectiveness, it risks opening space for commercial interests to try to maintain to the maximum practicable extent their antebellum commercial relationships. Internal political division invites attempts to circumvent an embargo. Nowhere would this be more apparent than in enforcement actions against confirmed—or, in particular, suspected—blockade-runners. Internal disunity likely would create conflicting or unclear rules of engagement and hamstring on-scene commanders who must make important tactical decisions with substantial strategic consequences.

Perhaps the most prominent instance of domestic political discord undermining a blockade or economic-warfare campaign comes from Britain's experience against Germany at the outset of World War I, between 1914 and 1916. Britain's Admiralty enthusiastically promoted a full-bore assault on maritime trade bound for Germany, including that transiting through neutral ports, but it was stifled by a range of powerful diplomatic and commercial interests on the home front in Britain. As Nicholas A. Lambert noted in his groundbreaking historical account *Planning Armageddon,* the enduring lesson of Britain's initial failure in its economic-warfare and blockade campaign against Germany was that, in the context of deeper global trade and financial linkages, "effective implementation of sea power was no longer simply a function of naval power but required the state to subordinate what might be termed the informal elements of maritime power (shipping, financial services, and communications). But in seeking control over the infrastructure of the global trading system, the British state created enormous resistance by effectively compelling its nationals to act against their profit-maximizing instincts."[80]

Britain ultimately did blockade Germany successfully, but getting to the point of an effective cordon took the better part of two years. If the time required for

Britain to impose an effective blockade against Germany transpired in a U.S-China conflict scenario, Washington's battle already might be lost. Under such a scenario, China would have shown the ability to execute an aggressive action and consolidate its gains while the United States dithered, then responded only belatedly because the core issues at stake mattered much more to China.

When assessing a potential military approach, one must appreciate its strengths, weaknesses, and inherent limits. An oil blockade is not itself a strategy; rather, it is an action appropriately subsumed into a larger economic, diplomatic, and military campaign. It is also an action that in physical, trade-warfare terms would be akin to a nuclear strike on the global economy. An open military conflict between the United States and China would be a globally cataclysmic event on many levels. Furthermore, physically interdicting one of the largest channels in the global oil trade—and with it, major parts of the Chinese economy—very likely would open a Pandora's box of unforeseen secondary and tertiary adverse consequences whose effects could be worse than even the most pessimistic analyses might suggest.

For this reason, properly understanding the issue and constructing and maintaining an effective and sustainable security architecture designed to prevent such a conflict from ever coming to pass should be core U.S. national security priorities. In this respect, continued advocacy on behalf of a blockade-centric approach (i.e., offshore control) risks undermining U.S. strategic credibility in East Asia. Favoring a blockade-based deterrence policy goes in exactly the opposite direction by communicating that the U.S. political and military communities lack the will to engage in the intense conflict that may in fact be necessary to repel territorial seizures and other actions aimed at undermining U.S. security guarantees and Washington's standing in the eyes of its allies and others across Asia.

Treating a distant blockade as the centerpiece of Washington's China-facing military stance also risks warping domestic procurement debates, with potentially grave long-term strategic consequences. If a critical mass of Congress comes to believe that the Navy simply can close off China's maritime oil arteries, members may become more reluctant to appropriate the hundreds of billions of dollars needed in coming decades to fund the personnel costs and hardware acquisitions needed to support and sustain a robust U.S. forward presence in Asia.

History strongly suggests that even if a potential foe appears vulnerable to over-the-horizon pressure on its seaborne commerce, a blockade never should be substituted for war or a campaign strategy. As U.S. policy makers contemplate options for potential conflict with China, they forget this lesson at their peril.

NOTES

The opinions in this article are the author's alone and do not reflect any views or positions of the Baker Institute for Public Policy or Rice University.

1. The epigraph comes from Robert A. Doughty [Col., USA] and Harold E. Raugh Jr. [Maj., USA], "Embargoes in Historical Perspective," *Parameters* 21, no. 1 (Spring 1991), p. 29.
2. For a deterrence view, see Sean Mirski, "Stranglehold: The Context, Conduct and Consequences of an American Naval Blockade of China," *Journal of Strategic Studies* 36, no. 3 (February 2013), available at carnegieendowment.org/. For a war-termination view, see T. X. Hammes, "Offshore Control: A Proposed Strategy for an Unlikely Conflict," *Strategic Forum,* no. 278 (June 2012), available at www.dtic.mil/.
3. Gabriel B. Collins and William S. Murray, "No Oil for the Lamps of China?," *Naval War College Review* 61, no. 2 (Spring 2008), p. 88, available at www.usnwc.edu/. In that analysis, and in this article, the idea of an "oil blockade" encompasses both crude oil and refined products.
4. Sean Mirski advanced a detailed road map of ideas for filling tactical gaps pointed out by Collins and Murray. Douglas Peifer offers a shorter and more conclusory set of arguments. Douglas C. Peifer, "China, the German Analogy, and the New AirSea Operational Concept," *Orbis* 55, no. 1 (Winter 2011), pp. 114–31.
5. The author acknowledges that a physical oil blockade likely would be implemented in conjunction with financial coercion. Such financial measures would leverage the United States' massive wealth; the U.S. dollar's status as the de facto global reserve currency; and U.S. dominance of the global trading apparatus, including banking infrastructure, settlement and clearance systems, and communications networks. This analysis refrains from in-depth discussion of financial warfare for two primary reasons: (1) the scope and length of the study, and (2) because using financial weaponry against China would risk triggering unintended strategic consequences that, in many instances, likely would parallel fundamentally the blowback that a maritime oil blockade would unleash. Iran—the most recent victim of a U.S.-led financial-warfare campaign—is a marginal player in the global economy, but China would pose a very different set of challenges owing to its global systemic importance.
6. This analysis purposely avoids the topic of a grain blockade. The reason is simple: a successful distant petroleum blockade in theory can help accomplish a "mission kill" by sapping an adversary's national power and, if combined with strikes on oil-refining assets, can ground air forces and halt fossil fuel–powered shipping but does not starve a civilian population physically. Interdicting staple food supplies risks forcing a populace and its leaders into what is literally a survival situation, with all the attendant escalatory consequences that flow from such a state of affairs. The analysis uses the term *petroleum* because to succeed, such a blockade would need to interdict both crude oil and potential imports of refined products such as diesel fuel, gasoline, and jet fuel.
7. See, for instance, Daniel Moran, "Stability Operations: The View from Afloat," a chapter in *Naval Peacekeeping and Humanitarian Operations: Stability from the Sea,* ed. James J. Wirtz and Jeffrey A. Larsen (London: Routledge, 2009).
8. Peifer, "China, the German Analogy, and the New AirSea Operational Concept," p. 127.
9. Hammes, "Offshore Control," p. 12.
10. World Trade Organization, *World Trade Report 2013: Factors Shaping the Future of World Trade* (Geneva: 2013), p. 50, available at www.wto.org/; Marc Levinson, *U.S. Manufacturing in International Perspective,* CRS Report R42135 (Washington, DC: Congressional Research Service, January 18, 2017), available at digitalcommons.ilr.cornell.edu/.
11. "Satellite Data Show China May Have Stored More Crude Than Estimated," *Bloomberg News,* September 29, 2016, www.bloomberg.com/.
12. *Capitulation* could encompass a range of possible outcomes. In a territorial dispute, it is difficult to envision a scenario in which Beijing would cede occupied territory willingly.

13. Collins and Murray, "No Oil for the Lamps of China?," p. 92.
14. See, for instance, Eric Ng, "Woe to Oil: Why China's 2017 Output Will Extend Record Decline," *South China Morning Post,* January 16, 2017, www.scmp.com/, and Gabe Collins, "China Peak Oil: 2015 Is the Year," *The Diplomat,* July 7, 2015, thediplomat.com/.
15. Damon Evans, "Price Spikes Feared as Asian Oil Production Drops," *Nikkei Asian Review,* March 29, 2017, asia.nikkei.com/.
16. The force requirements for sustaining a distant blockade covering multiple choke points could pose significant opportunity costs, particularly if a conflict expands and additional platforms are needed for force-on-force engagements away from the distant-blockade area. Even if crews are rotated on and off forward-deployed ships to reduce steaming time between the vessels' home ports and the blockade zone, ships still need periodic maintenance and replenishment. Data from the CSBA suggest that in a high-OPTEMPO scenario, forward-deployed ships could be deployed for six months out of a given twelve-month period, meaning that at least two ships would be needed for each vessel slot in a blockade force. Bryan Clark et al., *Restoring American Seapower: A New Fleet Architecture for the United States Navy* (Washington, DC: CSBA, 2017), p. 104, available at csbaonline .org/.
17. "World Oil Transit Chokepoints," *EIA,* July 25, 2017, www.eia.gov/.
18. "Panama Canal Expansion Will Allow Transit of Larger Ships with Greater Volumes," *EIA,* September 17, 2014, www.eia.gov/.
19. Yimou Lee, Chen Aizhu, and Shwe Yee Saw Myint, "RPT—Beset by Delays, Myanmar–China Oil Pipeline Nears Start-Up," *Reuters,* March 21, 2017, af.reuters.com/.
20. For a more detailed discussion of the vulnerability of the Myanmar–China pipeline and the oft-discussed proposed pipeline from Gwadar, Pakistan, to China, see Andrew S. Erickson and Gabriel B. Collins, "China's Oil Security Pipe Dream: The Reality, and Strategic Consequences, of Seaborne Imports," *Naval War College Review* 63, no. 2 (Spring 2010), pp. 89–111, available at www.usnwc .edu/.
21. Andrew Erickson and Gabriel Collins, "Beijing's Energy Security Strategy: The Significance of a Chinese State-Owned Tanker Fleet," *Orbis* 51, no. 4 (December 2007), pp. 665–84.
22. See, for instance, "Tankers: China's UNIPEC Top Dirty Tanker Charterer in 2016—Shipbroker," *S&P Global Platts,* January 11, 2017, www.platts.com/.
23. Collins and Murray, "No Oil for the Lamps of China?," pp. 79–95.
24. The first public discussion of navicerts in a China blockade context of which the author is aware comes from Mirski, "Stranglehold."
25. Malcolm Moos, "The Navicert in World War II," *American Journal of International Law* 38, no. 1 (January 1944), pp. 115–19.
26. Mirski, "Stranglehold."
27. For a detailed discussion of "forcible rationing," its administrative benefits, and an internal debate in Britain on the issue during World War I, see Nicholas A. Lambert, *Planning Armageddon: British Economic Warfare and the First World War* (Cambridge, MA: Harvard Univ. Press, 2012), pp. 468–69.
28. For a historical example, consider the Allies' stationing of expert observers at petroleum installations in Spain during World War II to try to prevent oil products from being diverted to Nazi Germany. Leonard Caruana and Hugh Rockoff, "An Elephant in the Garden: The Allies, Spain, and Oil in World War II," *European Review of Economic History* 11, no. 2 (August 2007), pp. 159–87.
29. The navicert framework suggested purposely excludes Rosneft's Komsomolsk refinery and the company's proposed facility near Vladivostok, for two reasons. First, these plants are intended to use Russian crude oil, not imports. Second, any "imports" ostensibly bound for these plants (1) would allow diversion of additional Russian oil supplies to northern China, or (2) themselves would be diverted into the Chinese market, or (3) both.
30. Mirski, "Stranglehold."
31. There is the vital caveat that U.S. oil-product rationing in that conflict was necessitated by the need to redirect resources to war production at home and military campaigns and was not an act of survival precipitated by an

external power physically severing American petroleum supply lines.

32. Bradley Flamm, "Putting the Brakes on 'Non-essential' Travel: 1940s Wartime Mobility, Prosperity, and the U.S. Office of Defense," *Journal of Transport History* 27, no. 1 (March 2006), p. 87.

33. Ibid.

34. Regarding vehicle numbers, see "State Motor Vehicle Registrations, by Years, 1900–1995," *Federal Highway Administration,* www.fhwa.dot.gov./; for the U.S. population in 1940, see "A Look at the 1940 Census," *United States Census Bureau,* www.census.gov/; for Chinese automobile fleet and population data, see *National Bureau of Statistics of China,* data.stats.gov.cn/.

35. Wealthier drivers can evade such restrictions by owning multiple vehicles and license plates, but even with such adaptations the idea that the government can restrict car usage arbitrarily is already much more deeply ingrained in driver psyches than it was in the United States even as early as 1941.

36. "Oil Market Report," *International Energy Agency,* March 15, 2017, www.iea.org/.

37. Gabriel Collins and Andrew Erickson, "Where China's Diesel Fuel Exports Are Coming from and Where They Are Going," *China SignPost,* November 14, 2016, www.chinasignpost.com/.

38. Sohbet Karbuz, "US Military Energy Consumption—Facts and Figures," *Sohbet Karbuz* (blog), May 20, 2007, karbuz.blogspot.com/.

39. UP data for 2015 show 927.677 billion gross ton-miles / 1,064 million gallons (gal) of fuel consumed = 872 gross ton-miles per gallon; and (112 kbd of fuel [5 percent of estimated diesel consumption by heavy trucks in China] × 365 days per year × 42 gal per barrel [bbl] = 1,716 million gal of fuel) × 872 gross ton-miles per gallon = ~1.5 trillion gross ton-miles. UP data sourced from the 2015 *Annual Report Pursuant to Section 13 or 15(d) of the Securities Exchange Act of 1934—Union Pacific Corporation,* available at www.up.com/.

40. "National Data (Transport → Freight Ton-Kilometers)," *National Bureau of Statistics of China,* data.stats.gov.cn/.

41. Truck-based overland oil shipment is much more expensive per unit than moving crude or products by pipeline, but hard-pressed regimes have used the technique to move significant volumes of petroleum goods. For instance, Clinton administration officials estimated that in the late 1990s Iraqi interests were smuggling fifty to sixty thousand barrels per day of crude oil and refined products by truck from northern Iraq into Turkey. James Risen, "Iraq Is Smuggling Oil to the Turks under Gaze of U.S.," *New York Times,* June 19, 1998, www.nytimes.com/.

42. "About the Company," *KCP,* www.kcp.kz/.

43. Data for the quantity of oil China imports from Kazakhstan come from China General Administration of Customs, cited by *Bloomberg,* www.bloomberg.com/.

44. "Сковородино–граница КНР" [Skovorodino–Chinese Border Pipeline], *Transneft—Realized Projects,* www.transneft.ru/.

45. "Расширение пропускной способности нефтепровода «Сковородино–Мохэ»" [Capacity Expansion of Skovorodino–Mohe Pipeline], *Transneft—Current Projects,* www.transneft.ru/.

46. "Myanmar–China Crude Pipeline Officially Put into Operation," *CNPC,* April 11, 2017, www.cnpc.com.cn/.

47. Андрей Зуев [Andrei Zuev], "Труба на смену рельсам" [Switching Rails for Pipeline], *Central Dispatching Agency of Russian Fuel and Energy Complex (CDU-TEK),* www.cdu.ru/.

48. Valery Shpakov and Alexander Shenets, "Full Year 2016 Results," *Globaltrans,* April 3, 2017, www.globaltrans.com/.

49. "Movements of Crude Oil and Selected Proucts by Rail," *EIA,* www.eia.gov/; Robert E. Pickel Jr., "North American Car Fleet: Trends" (presentation to the North East Association of Rail Shippers, Philadelphia, PA, October 16, 2015), available at www.nears.org/.

50. "Movements of Crude Oil and Selected Products by Rail."

51. "Расширение трубопроводной системы «Восточная Сибирь–Тихий океан» на участке Тайшет–Сковородино до 58 млн. тонн нефти в год" [Expansion of Eastern Siberia–Pacific Ocean Pipeline System Aims for a Capacity of 58 Million Tonnes per Year], *Transneft,* www.transneft.ru/.

52. "Сковородино–граница КНР" [Skovorodino–Chinese Border Pipeline], *Transneft—Recently Completed Projects,* www.transneft.ru/; "Second China–Russia Crude Oil Pipeline Project Completed," *Asia Times,* November 14, 2017, www.atimes.com/.
53. "Расширение трубопроводной системы «Восточная Сибирь–Тихий океан» Реконструкция магистральных нефтепроводов Западной Сибири" [Expansion of Eastern Siberia–Pacific Ocean Pipeline System and Modernization of Oil Trunk Pipelines in Western Siberia], *Transneft,* www.transneft.ru/about/.
54. From the author's database of Chinese pipeline-construction projects, available on request.
55. Ibid.
56. "Big Inch Pipelines of WWII," *American Oil & Gas Historical Society,* aoghs.org/.
57. 1,000 km / 6 km/d.
58. For Chinese methanol production and feedstock-type data, see Anu Agarwal, "Developments in China's Methanol Market and Implications for Global Supply," *Argus,* May 8, 2015, www.argusmedia.com/. There are approximately 333 gallons of methanol per metric ton, meaning that one ton of methanol is volumetrically equivalent to 7.92 barrels. "Methanol FAQs," *SCC,* www.southernchemical.com/.
59. See, for instance, "Shenhua Baotou Coal Chemical Company Announces the Acceptance of the World's Largest Methanol Plant," *Johnson Matthey,* June 16, 2012, www.jmprotech.com/.
60. Methanol Institute, *Methanol Use in Gasoline: Blending, Storage and Handling of Gasoline Containing Methanol* (Singapore: June 2016), available at www.methanol.org/.
61. "Methanex Investor Presentation," *Methanex,* March–April 2017, www.methanex.com/; "China's Use of Methanol in Liquid Fuels Has Grown Rapidly since 2000," *EIA,* February 23, 2017, www.eia.gov/.
62. Anton Ferkov, *China's CTO/MTO Boom* (London: S&P Global Platts, January 2016), available at www.platts.com/.
63. CCF Group, "China's Methanol Availability in 2016 and Forecast in 2017," *IGP Methanol,* January 18, 2017, igpmethanol.com/.
64. Agarwal, "Developments in China's Methanol Market and Implications for Global Supply."
65. Ibid.
66. "Fuel Properties Comparison," *Alternative Fuels Data Center,* October 29, 2014, www.afdc.energy.gov/. Calculation: 3,000 kbd of gasoline demand × 65 percent [reflects 35 percent demand reduction from rationing] × 15 percent of total remaining gasoline pool × 2 bbl of methanol per bbl of gasoline = 585 kbd of methanol.
67. China already blends more than 400 kbd of methanol and methanol derivatives into its gasoline supply. See, for instance, "China's Use of Methanol in Liquid Fuels Has Grown Rapidly since 2000." The proportion of methanol likely would rise under wartime conditions, but not without challenges. For example, methanol can cause serious corrosion of certain polymers and metals, such as aluminum, that are used in many engine and fuel supply–system components in cars, but can be offset by remedial additives. "Methanol as a Gasoline Blending Component," ACEA Position Paper, *European Automobile Manufacturers Association,* October 2015, available at www.acea.be/.
68. T. F. Yusaf et al., "The Effect of Methanol-Diesel Blended Ratio on CI Engine Performance," *International Journal of Automotive and Mechanical Engineering* 8, no. 1 (December 2013), pp. 1385–95.
69. The estimate of seven hundred million barrels ultimately may prove conservative. It is drawn from an estimate of six hundred million barrels of crude in storage in China's aboveground tanks at the end of 2014 and underground storage caverns at Huangdao, Jinzhou, Zhanjiang, Huizhou, and one other location that are slated to hold 130 million barrels of crude by 2020. "Satellite Data Show China May Have Stored More Crude Than Estimated," *Bloomberg News,* September 29, 2016, www.bloomberg.com/; Meng Meng and Chen Aizhu, "China Goes Underground to Expand Its Strategic Oil Reserves," *Reuters,* January 6, 2016, www.reuters.com/.
70. Lu Wang and Michelle Leung, "China Coal to Liquids' Outlook Dimmed," *Bloomberg Intelligence,* October 19, 2016, www.bloomberg.com/. Diesel fuel conversion factor of 7.5 bbl per ton obtained from "Conversion Calculator," *CME Group,* www.cmegroup.com/.

71. Consider that in fiscal year 2004 the U.S. military used approximately 395,000 bpd of oil to fight wars simultaneously in Iraq and Afghanistan; sustain multiple global deployments; and conduct intensive ground, air, and naval training exercises.

72. For global oil supply and demand data, see "Annual Statistical Supplement," 2016 ed., *International Energy Agency,* www.iea.org/.

73. "151st (Extraordinary) Meeting of the OPEC Conference," *Organization of the Petroleum Exporting Countries,* December 17, 2008, www.opec.org/; "Oil Market Report," *IEA,* October 2008, www.iea.org/.

74. For oil price data, see "NYMEX Futures Prices," *EIA,* www.eia.gov/.

75. Gabriel Collins, *China's Evolving Oil Demand: Slowing Overall Growth, Gasoline Replacing Diesel as Demand Driver, Refined Product Exports Rising Substantially,* Baker Institute for Public Policy Working Paper (Houston, TX: Rice University—Baker Institute, 2016), available at www.scholarship.rice.edu/.

76. Ibid.

77. Evan Braden Montgomery, "Reconsidering a Naval Blockade of China: A Response to Mirski," *Journal of Strategic Studies* 36, no. 4 (2013), pp. 615–23.

78. Richard Mobley, "The Beira Patrol: Britain's Broken Blockade against Rhodesia," *Naval War College Review* 55, no. 1 (Winter 2002), pp. 63–84.

79. In the case of a total war—such as the British campaign against Germany between 1916 and 1918 or the U.S. blockade of Japan in World War II—private financial interests clearly are subordinated to the national interest and national strategic goals.

80. Lambert, *Planning Armageddon,* p. 500.