

U.S. Nuclear Primacy and the Future of the Chinese Deterrent

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Since the end of the Cold War, and particularly since the September 11 attacks, public discussions about nuclear weapons have focused on the dangers of terrorism, “loose nukes,” and the consequences of nuclear proliferation. These are critical issues and deserve close attention. Yet, insufficient attention has been given to important developments at the global strategic nuclear level. This is unfortunate because the shifting nuclear balance among the major powers of the world could have a dramatic impact on international security in the 21st century.

The last great change in the strategic nuclear balance of power occurred nearly half a century ago with the onset of nuclear stalemate between the superpowers.¹ That stalemate, characterized by the condition of mutual assured destruction (MAD), meant that neither the United States nor the Soviet Union had the capability to destroy the other’s retaliatory force, even by launching a surprise attack. Since the end of the Cold War, however, the

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strategic nuclear balance among the great powers has shifted dramatically. While Russia's nuclear arsenal has steeply declined and China's arsenal remained largely unchanged, the United States has steadily improved its nuclear counterforce capabilities. As a result, today we are witnessing the dawn of a new era of U.S. nuclear primacy.

Our research on U.S. nuclear primacy draws attention to this important development and calls for further discussion and debate about its implications for international relations.² For example, we see several ways in which U.S. nuclear primacy could significantly affect U.S.-China security relations. First, the continued growth of U.S. nuclear counterforce capabilities will put pressure on China to take steps to reduce the vulnerability of its own arsenal; for instance, by enlarging its long-range nuclear arsenal, expanding plans to deploy intercontinental-range mobile missiles, and perhaps even pre-delegating some launch decisions to subordinate commanders.³ Such steps would be costly for China, and might leave the United States worse off than before it acquired nuclear primacy.

Second, the emergence of U.S. nuclear primacy may lead to dangerous crisis instability and increase the odds of nuclear war. For example, if China does not redress its vulnerability in peacetime, leaders in Beijing may feel compelled to do so in the midst of a brewing crisis or conventional war. In such a case, Beijing may feel pressure to alert its small intercontinental ballistic missile (ICBM) force either to signal China's resolve or to (slightly) reduce the vulnerability of its arsenal. But a Chinese alert could backfire and trigger a preemptive nuclear attack on China's vulnerable missile force.

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Third, the growth of U.S. nuclear counterforce capabilities may give U.S. leaders valuable coercive leverage during future crises and wars, including conflicts with China. The United States strongly prefers that its future wars be waged exclusively with conventional weapons; in fact, one of the great quandaries currently confronting U.S. strategists is how to fight conventional wars against nuclear-armed adversaries without triggering escalation. Nuclear primacy may provide one solution: allowing Washington to credibly warn adversaries not to alert their nuclear forces or issue nuclear threats during a

conflict. In other words, U.S. nuclear primacy may allow the United States to force its enemies to keep their nuclear forces on the sideline and keep their conflicts with the United States at the conventional level.

In sum, America's growing nuclear counterforce capabilities are a double-edged sword for the United States – raising the danger of renewed arms races and crisis instability, but also conferring real benefits for the United States.

The Critics

Our critics raise myriad questions about our analysis.⁴ Bruce Blair, Chen Yali, and Li Bin are skeptical that we are witnessing the emergence of U.S. nuclear primacy. Furthermore, they are confident that China will feel little pressure to respond and strengthen Beijing's small nuclear arsenal, even as the United States continues to enhance its nuclear counterforce capabilities.

America's growing nuclear counterforce capabilities are a double-edged sword.

They are also sanguine about crisis stability, apparently because China is committed to a policy of “no first use” (NFU), meaning that it has deliberately chosen to absorb a nuclear first strike before retaliating with nuclear weapons. Therefore, escalatory dangers during a crisis will be greatly mitigated because

one side – China – will avoid taking any coercive or preemptive actions with its nuclear weapons. Finally, the critics argue that nuclear primacy will not grant the United States any real utility; U.S. coercive threats would lack credibility because a disarming strike would become impossible if China alerted its forces in the wake of an American threat. In sum, our critics claim that nuclear primacy is “irrelevant” and that deterrence will remain robust – even if the United States continues to hone its counterforce capabilities, and even if China's rise triggers increased hostility between Beijing and Washington.⁵

Before we address our critics' analyses, we clarify four potential points of confusion about our argument. First, we believe that America's drive for nuclear primacy is primarily driven by concerns about future relations with China, rather than Russia.⁶ We modeled a hypothetical U.S. first strike against Russia because doing so provided a much harder test of our thesis about the dramatic shift in the nuclear balance. (Russia has a far larger nuclear arsenal compared to China.) We would be greatly surprised if relations between Moscow and Washington deteriorated so completely in the coming decades that a nuclear war became, once again, a plausible concern for either country.

However, we lack such optimism about Sino-American relations.

Second, our analysis self-consciously understates many aspects of America's first-strike capability against Russia or China. For example, we omit consideration of any conventional military attacks that could support a U.S. nuclear counterforce strike. Our model also excludes attacks on nuclear command and control sites, which could prevent (or sufficiently delay⁷) an adversary's retaliation if a few nuclear targets survived a U.S. first strike. And finally, our analysis only considers the current capabilities of U.S. forces, even ignoring some significant upgrades that are already underway and which will soon give another boost to U.S. nuclear counterforce capabilities.⁸

Third, we have never claimed that the United States is pursuing a first strike strategy, as Blair and Chen assert in their article addressing our work.⁹ Rather we claim that the United States is pursuing a first-strike capability. The distinction is crucial. The United States plans to win its future wars without resorting to nuclear weapons. Nevertheless, the U.S. military continues to enhance its nuclear counterforce capabilities with two plausible purposes: strengthening U.S. coercive leverage in high-stakes crises against nuclear-armed adversaries, and giving U.S. leaders nuclear options in case nuclear attack by an enemy appears imminent. But nowhere do we state – or believe – that the United States is seeking a nuclear first-strike strategy – i.e., a military doctrine that relies on nuclear first strikes to win the nation's wars.

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Finally, the importance of the shift in the nuclear balance does not hinge on the U.S. willingness to launch a nuclear attack on Russia or China, let alone on an assumption that a nuclear strike against one of those countries is guaranteed to succeed. Chinese and Russian military planners pay close attention to changes in the U.S. arsenal and are likely to adjust their force levels, deployment patterns, and alert status accordingly. Just as American planners put greater stock in actual Chinese military capabilities than in China's stated intentions, we assume that Chinese and Russian leaders pay more attention to changes in American military capabilities rather than the declarations from Washington about America's goals and intentions. Therefore, even if the United States would never launch a preemptive nuclear strike, the pursuit

of nuclear primacy should be expected to trigger a response among U.S. adversaries.

Below we address our critics' arguments about the effects of nuclear primacy. We first focus on issues that bear directly on China's security and U.S.-China relations. We then address several technical critiques of our model and assumptions about U.S. nuclear primacy.

Implications of U.S. Nuclear Primacy for Chinese Security

We contend that America's growing counterforce capabilities will have three significant implications for China: it may pressure China to reduce the vulnerability of its nuclear forces, it could promote dangerous escalatory dynamics if the United States and China became engaged in a major crisis or conventional war (e.g., over Taiwan), and it might give Washington valuable coercive leverage over Beijing in a high-stakes military crisis. Our critics dispute each of these claims. We describe and address their criticisms in turn.

China's Reaction to its Vulnerability

Several of our critics claim that leaders in Beijing are unconcerned about the growth of America's nuclear counterforce capabilities. For example, Blair and Chen claim that Chinese strategists believe in the theory of existential deterrence – the notion that deterring a first strike merely requires that there is “some conceivable prospect” that a small portion of China's retaliatory force will survive the attack and retaliate.¹⁰ This theory of deterrence differs from other formulations on two dimensions: it assumes that robust deterrence merely requires the possibility of retaliation (rather than the assurance of retaliation), and that robust deterrence merely requires that a small nuclear retaliatory force survive a first strike (rather than a massive retaliatory force).¹¹ According to Blair and Chen, China's leaders trust that a small and vulnerable retaliatory force will have sufficient deterrent effect, so China will not build up its arsenal in response to U.S. nuclear primacy. To support their view, Blair and Chen note that China maintained a small deterrent arsenal throughout the Cold War, even as the superpowers scrambled to out-do each other with new counterforce weapon systems.

We believe that Blair and Chen are overly confident that China will sit idly by while the United States hones its counterforce capabilities. We note that two articles recently published in this journal – by Shen Dingli and Sun Xiangli – suggest that Blair and Chen have misinterpreted Chinese thinking

about nuclear deterrence. The articles suggest that although China's leaders believe that a small number of surviving Chinese warheads would be sufficient for inflicting unacceptable damage on an adversary, Chinese planners do care about ensuring that at least a portion of their small retaliatory force will survive a first strike. In other words, Beijing is not satisfied with merely having "some conceivable prospect" of retaliation.

Specifically, Shen and Sun explain that although Beijing has never tried to numerically match its adversaries' nuclear arsenals, Chinese nuclear strategy has always required that its retaliatory force be survivable. Shen explains why the Chinese nuclear arsenal is relatively small, writing that China is uninterested in nuclear warfighting capabilities and "only needs to assure a credible nuclear retaliation so as to deter a first nuclear attack."¹² Sun is more explicit. She notes that "the effectiveness of nuclear deterrence is determined not by the comparative quantity...of the weapons but rather by their capability for retaliation."¹³ According to Sun, the key requirements for China's nuclear deterrent are the ability "to survive an enemy's first strike" and thereby maintain "a basic retaliatory capability."¹⁴

Sun goes further and explicitly argues that China evaluates its deterrent requirements by assessing the threats to its nuclear forces. China's limited nuclear arsenal "does not mean the number of weapons that make up a limited nuclear force is immutably fixed. ... [I]he required size for such a capability is a dynamic quantity relating to the nuclear arsenal's survivability."¹⁵ If Sun is correct, then the ongoing U.S. efforts to increase U.S. counterforce capabilities will force China to rethink the size of its nuclear arsenal and its low peacetime level of readiness.

It is true that China maintained a small nuclear arsenal during the Cold War but there are good reasons to wonder whether

China's Cold War nuclear posture is a reliable guide to its future nuclear arsenal. For one thing, China was much poorer during the Cold War than it is today, so even a modest nuclear buildup would have required much more painful tradeoffs in the form of reduced spending on conventional military forces or reductions in non-military expenditures. More important, the most significant military threat facing China during much of the Cold War was

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from the Soviet Union, not the United States. Soviet nuclear forces were substantially less accurate (and hence less effective for disarming attacks) than U.S. forces during the Cold War, and both were substantially less lethal than the current American arsenal.

Most important, China's reaction to U.S. nuclear primacy will be conditioned by the broader strategic context: China's role in the world. During the Cold War, China was initially a junior member of the Soviet alliance system; later it disentangled itself from the Cold War confrontation, establishing only loose

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political ties to the United States. Today, in contrast, China is poised to become a "great power" and perhaps a strategic competitor to the United States. If China's role in world politics expands, its relations with the United States will likely sour, and its requirements for nuclear deterrence will likely expand as well. Assuming that China's defense policies in the coming decades will

mirror its policies in the Cold War is like assuming America's security policies in the mid-20th century would resemble its policies in the 19th century – that is, before America's rise to true great power status.

In sum, we do not claim to know for certain how China will react to growing U.S. counterforce capabilities; after all, other Chinese strategists may disagree with Shen and Sun and instead claim that Chinese leaders place less emphasis on force survivability. Our point is simply that U.S. counterforce developments pressure China to reduce the vulnerability of its arsenal, and the pressure will increase if the United States and China become real rivals. The implication is that the United States should only pursue nuclear primacy if it recognizes and accepts the risk of a Chinese buildup – including an expanded arsenal, a larger force of mobile long-range missiles than would otherwise be built, and perhaps arrangements including decentralized and pre-delegated launch authority. Continuing to hone U.S. counterforce capabilities under the assumption that leaders in Beijing will do nothing in response is reckless.

Dangerous Crisis Dynamics and China's Commitment to NFU

A second line of criticism holds that our worries about crisis instability are unnecessary. Critics claim that Beijing will not take actions during crises, such as alerting its nuclear forces, which could trigger a preemptive U.S. attack.

Worries about crisis instability – and a nuclear war that neither side intends – can be set aside because of China’s commitment to the principal of NFU and its concomitant willingness to leave its nuclear forces un-alerted and in a non-threatening posture during crises.

China’s official NFU pledge is sweeping, promising that “[a]t no time or under no circumstances would China first use nuclear weapons.”¹⁶ This pledge is taken seriously by many knowledgeable observers of China, including Sun, Shen, and Li. Blair and Chen are adamant about China’s sincerity about NFU, noting that “China never wavered from its no-first-use (NFU) doctrine,” that Beijing’s “NFU commitment remains solid,” and that “NFU will not be dislodged any time soon, if ever. It is a virtual canon of Chinese nuclear orthodoxy.”¹⁷

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However, it is difficult to reconcile this confidence in China’s commitment to NFU with the apparently widespread view in China that Beijing might initiate nuclear war against the United States rather than lose a conventional conflict over Taiwan. The statements along these lines by Maj. Gen. Zhu Chenghu, dean of China’s National Defense University, have been widely reported. In a previous article, Blair wrote that Zhu’s belief, “that China would resort to all military means necessary, including nuclear weapons, in order to preserve China’s territorial integrity (of which Taiwan is a part) seems non-controversial from a Chinese perspective.” Blair continues and observes that “Zhu’s view is consistent with China’s policy in saying that China would risk everything under the circumstances” of a failed conventional (non-nuclear) war over Taiwan.¹⁸

Zhu and Blair are not alone in believing that China might threaten or use nuclear weapons first in a conventional war over Taiwan. Referring to Taiwan, Shen notes that “China’s...core national interest is national unification” and that “[i]t is logical to conclude that China will use any means to defend its core interest – nuclear weaponry certainly being one such means.”¹⁹ Chen apparently agrees. In her article with Blair, they write: “The Taiwan issue...arouses such fervent emotions throughout [China] that irrational behavior in its use of nuclear weapons cannot be ruled out.”²⁰

If China may be willing to threaten or initiate nuclear war against the

United States during a war over Taiwan, then why should we be sanguine about crisis stability? Why wouldn't the United States be tempted to preempt China's forces in such a scenario, if a Chinese alert (for example, mating the DF-5A warheads to missiles) may actually indicate that China is about to launch an attack on the United States? Contrary to the claims of our critics, the dangers of crisis instability – and a nuclear war that neither the United States nor China want – may in fact be grave.

Nuclear Primacy and Coercive Leverage

Li denies that U.S. nuclear primacy will give the United States greater coercive leverage or more military options over China – whether during peacetime, a crisis, or even a conventional war. As Li notes, in order to coerce China to change its behavior (for example, to compel China to cease attacks on Taiwan), the United States would need to signal Beijing that China's actions risk a nuclear response from the United States. (Coercion requires warning about the ramifications of non-compliance, even if such warning is conveyed discreetly or implicitly.) The problem for the United States, according to Li, is that if confronted by such a warning, China can “raise its nuclear alert accordingly and thereby increase the survivability of its nuclear forces.” Specifically, Li says “China may relocate its cave-based ICBMs” if the United States signals that a nuclear attack is possible. Li's point is that the very act of issuing a coercive threat will permit a Chinese alert, which will greatly reduce the likelihood of a successful U.S. disarming strike.²¹

The available information on the Chinese nuclear arsenal suggests that Li is mistaken. Although Li suggests that China could relocate its “cave-based” missiles in response to a U.S. threat, the only Chinese nuclear missiles hidden in caves are apparently DF-4s – and those missiles lack the range to strike the United States. China's only nuclear weapons capable of reaching the United States are its DF-5A missiles, which are based in silos. The DF-5A missiles are maintained at low levels of readiness; their nuclear warheads are kept separately in storage and the missiles themselves are un-fueled.²² China could respond to U.S. coercive threats by mating warheads to missiles, but even that step would not meaningfully reduce their vulnerability to attack. China lacks not only a national early-warning system to provide indication of an incoming attack, but also a launch-on-warning doctrine that would allow its forces to escape destruction if it believed an attack was coming.

In sum, the Chinese long-range arsenal appears to be vulnerable to a

disarming attack, regardless of whether those forces are “alerted” or not. Therefore, Li is wrong to discount the possibility of U.S. nuclear coercion during a crisis or war on these grounds.

Ironically, one of the clearest explanations for how the United States may use nuclear primacy in a crisis or war with China appears in an earlier article by Blair. His recent article with Chen labels our suggestion that the United States might use nuclear threats “the zenith of provocation” and “unthinkable.”²³ However, in the autumn 2005 issue of *China Security*, Blair describes exactly the crisis dynamics we envision leading to U.S. nuclear threats and perhaps even a preemptive nuclear attack. He notes that if China were to alert its strategic nuclear forces during a war with the United States over Taiwan, “the United States would likely act to beat China to the punch.” He continues, “Given constant U.S. surveillance of Chinese nuclear launch sites, any major Chinese preparations to fire preemptorily would be detected and countered by a rapid U.S. preemptive strike against the sites by U.S. conventional or nuclear forces... The United States could easily detect and react inside of the lengthy launch cycle time of Chinese forces.”²⁴

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Blair’s words mirror our argument and suggest the two ways that nuclear primacy may benefit the United States. First, if the Chinese were to threaten nuclear escalation in the context of a Taiwan war, the U.S. could strike first and likely destroy the Chinese force on the ground – “beat China to the punch,” as Blair puts it. Second, China’s knowledge of its vulnerability to nuclear preemption might prevent China from alerting its nuclear force – or even attacking Taiwan – in the first place.

To be clear, we do not claim that U.S. nuclear primacy will prevent China from fighting a war if Taiwan were to declare independence. The high intensity of Chinese views about Taiwan suggests that Beijing might fight for Taiwan, regardless of the risks of doing so. Rather, we argue that U.S. nuclear primacy may play an important coercive role in such a war – as Blair’s analysis, quoted above, also implies. Specifically, U.S. nuclear primacy could be used to warn China against issuing nuclear threats or alerting its nuclear forces, and hence contain the fighting at the conventional level. In the coming years, in fact, the greatest payoff to Washington from U.S. nuclear primacy might be

that it allows the United States to fight and win conventional wars against nuclear-armed adversaries: coercing adversaries to keep their nuclear arsenals out of the strategic equation.

Alleged Flaws in our Model of U.S. Nuclear Primacy

We support our findings about the emergence of U.S. nuclear primacy by modeling a surprise U.S. nuclear attack against Russia. Our model uses unclassified data on U.S. weapons systems, the numbers and types of Russian targets, and standard formulas for estimating the likely results of a given set of attacks on a given set of targets.²⁵ Scholars and analysts have carried out similar analyses since the dawn of the nuclear age. By our calculations, no Russian strategic missiles, bomber bases, or submarines would survive a U.S. first strike if the attack caught the Russian forces in their normal peacetime routines. Given the far smaller and more vulnerable Chinese nuclear arsenal, we concluded that a similar U.S. first strike against China would be much easier.

Our critics raise several important challenges to our model, but their critiques miss the mark. We address their key concerns below.

U.S. Missile Accuracy

Blair and Chen argue that our assessment of U.S. nuclear primacy rests on unwarranted confidence in U.S. missile accuracy. They note that we consider the possibility that U.S. weapons may perform below expectations – i.e., as much as 20 percent below expectations – but they claim that we ignore the possibility that actual U.S. missile performance may be even lower: perhaps 40-50 percent below our expectations. They thus charge that we “do not adequately inform the reader that the probabilities of destroying Russian hard targets such as missile silos would plummet if U.S. missiles missed their targets by a considerably greater distance than assumed by their model.”²⁶

This criticism is factually incorrect. We published much more sensitivity analysis than Blair and Chen acknowledge on both of the key variables that drive the results of the model: the accuracy of U.S. delivery vehicles and the reliability of U.S. weapon systems. Contrary to Blair and Chen’s claims, we show that the results of our model do not change even when we allow the accuracy and reliability of U.S. weapons to fall below expectations by 40 or 50 percent.²⁷

Why are our results so robust? During the past 15 years, the United States

has done so much to upgrade its first strike capabilities – most notably by deploying Trident II D-5 missiles throughout the entire ballistic missile submarine (SSBN) fleet, placing high-yield W88 warheads on many of those missiles, and deploying stealthy B-2 bombers – that today a first strike could succeed even if the performance of key U.S. weapon systems fell far short of their expected accuracy, reliability, or both.

Furthermore, the United States continues to work to increase the lethality of its nuclear forces, thereby reducing even more the significance of any actual deviations from expected levels of accuracy. For example, the U.S. Navy recently experimented with using Global Positioning System (GPS) signals to provide terminal guidance for Trident II reentry vehicles (which would dramatically improve the warhead's accuracy) and it is enhancing its Trident II W76 warheads with a new fuze to permit ground-bursts (which will greatly enhance the warhead's lethality against hardened targets).²⁸ Achieving GPS-like accuracy with submarine-launched ground-burst warheads would mark a tremendous leap in U.S. counterforce capabilities, providing gains in performance that could substitute for potential inaccuracy in other weapon systems. The point is that our analysis is not sensitive to plausible levels of uncertainty about U.S. accuracy, and will become even less sensitive in the future as U.S. weapons grow even more capable.

U.S. Ability to Generate a First Strike Force

Blair and Chen question whether the United States could secretly bring its strategic nuclear forces to combat-ready status without alerting Russia and China. Although nearly all of the U.S. ICBM force is ready to fire during peacetime conditions, Blair and Chen claim that the process of readying U.S. bombers and submarines would be “noisy” – i.e., detectable by Russia and China. The bomber force in particular, they argue, would require approximately 72 hours of visible preparations prior to a nuclear operation.

This criticism is unpersuasive for three reasons. First, the U.S. attack we model uses only those submarines that are at sea conducting routine activities at the time of the strike; no submarines are flushed out of port prior to the attack, because doing so would, in fact, warn U.S. adversaries. Our estimate of the number of U.S. submarines typically at sea is conservative. We assumed that the United States typically has eight of its 14 ballistic missile subs at sea: four on “hard alert” and four additional subs exercising or traveling to or from deployments. After we published our analysis, newly available infor-

mation reveals that the United States has actually maintained on average 62 percent of its ballistic missile submarine fleet at sea in recent years; in fact, at one point during the 1990s the United States briefly had 78 percent of its SSBN fleet underway.²⁹ Therefore, without any manipulation of normal U.S. submarine deployment routines, the United States could have eight or nine SSBNs at sea. By slightly manipulating the deployment schedules (e.g., delaying the return of just one submarine to port) the United States should be able to get 10 submarines into firing position without sending any visible signals to adversaries.

Second, regarding the U.S. bomber force, Blair and Chen provide no evidence for their claim that it would require three days of visible activity for the United States to ready its bombers for a nuclear mission.³⁰ As they note, the United States stores nuclear gravity bombs and cruise missiles on its

The United States continues to work to increase the lethality of its nuclear forces.

bomber bases with the aircraft. Although it is theoretically possible that the United States has configured its bombers in such a way that preparation for nuclear delivery would be visible and time consuming, we see no reason to assume this is the case. It is important to remember that the total number of aircraft involved in the attack

we model is modest: 42 B-52s and 16 B-2s, plus (roughly) an equal number of tankers. Prepping this force would be a smaller and less visible task than launching a typical Cold War-era strike, which would have involved hundreds of bombers and their support planes.

Most importantly, even if Blair and Chen are correct that preparing a large bomber strike would require several days of “noisy” activity, the United States could substantially reduce the number of bombers (and hence tankers) involved in the attack with no significant change in outcome. In fact, the United States could conduct an attack on the Russian arsenal with only half of the bomber force we used in the model: that is, with only 21 B-52s and nine B-2s, which is 38 percent of the entire force. If even that modest number of aircraft could not be readied quickly and quietly, the targets assigned to some of those bombers could be covered if nine or 10 submarines were available instead of eight, which the discussion immediately above suggests is entirely plausible.

Finally, none of these issues should obscure an important point: the problem of alerting U.S. forces for a large-scale attack is only relevant in the context of a strike on Russia. A disarming attack on China would not even require the full arsenal from a single U.S. ballistic missile submarine; in fact, just three B-2s could do the job.³¹

Russian “Launch on Warning”

In our analysis we demonstrate that the United States appears able to strike Russian or Chinese nuclear forces before they have a chance to launch and escape destruction. Our claim is not surprising with regard to China. China has no comprehensive early warning system to detect an incoming nuclear attack, and Beijing’s long-range nuclear forces are not configured to launch quickly in any case. More surprising is that Russia – which has relied on a hair-trigger “launch on warning” doctrine for many years – would be unable to fire its missiles before incoming U.S. warheads arrived and detonated. Russia’s early warning problems stem from three factors: (1) Russia’s satellites cannot detect the launch of submarine-fired missiles; (2) its ground-based radar network has a hole pointing toward the Pacific ocean, through which the United States could launch a submarine attack; and (3) the United States has stealthy bombers plus approximately 400 stealthy nuclear-armed cruise missiles, which could also evade Russia’s early warning network.

Blair and Chen acknowledge that there is a hole in the Russian early warning network but claim that we exaggerate the relevance of this gap. They make two points: First, they dismiss the importance of the Russian radar hole, arguing that it contributes little to Russia’s already precarious ability to launch on warning. Even if the hole did not exist and Russia was able to quickly detect an incoming U.S. attack, Russian leaders would have difficulty completing their own launch sequence before fast-arriving U.S. submarine-launched missiles began detonating on Russian silos. Second, Blair and Chen then reverse course and observe that incoming warheads from U.S. submarines would only outrace the Russian launch sequence by a few moments – a window of Russian vulnerability that is too narrow for the United States to exploit with any confidence.³²

This line of argument is deeply flawed because it concedes the existence of the radar hole, but then ignores its implications. They assert that the hole is essentially redundant, because even without the hole, U.S. sub-launched missiles could hit their targets too quickly for Russia to respond. But then they

undermine their point about redundancy by illustrating why the radar hole is critically important: without the hole, incoming sub-launched warheads would barely beat the completion of the Russian launch sequence. With the hole, U.S. submarines can “sneak in” hundreds of warheads before Russian leaders are even aware the race to launch has begun. In short, if U.S. missiles exploit the Russian radar hole, Russian leaders will not be in a tight race to launch before the incoming warheads arrive. Instead, Russian commanders will not even get off the starting mark until the U.S. warheads are only a few (less than five) minutes from their targets – far too late to launch on warning.

Moreover, if a U.S. submarine-launched missile attack was supported by hundreds of stealthy nuclear-armed cruise missiles plus hundreds of nuclear bombs delivered from stealthy B-2 bombers, the United States could conceivably detonate many hundred warheads in Russia with no warning at all.

Finally, Blair and Chen claim that even if there is a hole in Russia’s early warning network, a major U.S. first strike would be detected early because the

United States would attack Russia from all sides.³³ This assumption, however, is unreasonable. If the Russian warning network has glaring vulnerabilities, U.S. planners would strive to exploit them fully. We refer readers to the chilling memos, now declassified, which describe analyses conducted in 1961 for senior Kennedy administration officials, and which were briefed to the president at the height of the Berlin crisis. The memos describe ideas for modifying U.S. nuclear

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attack plans to maximize the chance for success in a surprise strike against an un-alerted Soviet strategic force. In these analyses, a small U.S. bomber force (about 40 planes) was to exploit known holes and vulnerabilities in Soviet warning radars to sneak through and destroy Moscow’s missiles and bombers before they could launch.³⁴ There is no reason to believe that U.S. planners have grown less creative or would forego the opportunity to exploit holes in the Russian early warning system in a nuclear war.

In sum, in the event of a U.S. first strike, China would have no reasonable hope of launching its missiles before they were destroyed because China has never built such a capability. But even Russia – with its satellites, radars, and a

launch on warning doctrine – would need to absorb a U.S. first strike before retaliating (if any retaliatory forces survived such an attack). As our model demonstrates, this leaves the Russian arsenal very vulnerable.

The Problem of Imperfect Intelligence

Li suggests that our analysis of U.S. nuclear primacy fails to acknowledge the problems of imperfect intelligence. Li asks: How do we know if the United States has really identified the entirety of the Chinese long-range nuclear arsenal? He acknowledges that the United States could destroy all of the Chinese missiles it has located, but emphasizes that military planners and political leaders can never be certain that they have accounted for every weapon. Thus, our conclusion that the United States can destroy the Russian or Chinese arsenal in a first strike is unwarranted, and responsible leaders would shrink back from issuing nuclear threats or launching attacks because they would recognize the speculative nature of their target intelligence.

The problem of fallible intelligence does not negate either the fact or the significance of U.S. nuclear primacy for at least four reasons. First, U.S. leaders have historically been willing to initiate nuclear war against a nuclear-armed adversary with a vulnerable arsenal, even though U.S. leaders understood that their intelligence was not perfect. For example, during the previous period of U.S. nuclear primacy (in the 1950s), U.S. strategy called for initiating nuclear war against the entire “Sino-Soviet Pact” if the Soviets invaded Western Europe – even though there was no guarantee that U.S. intelligence had located every Soviet nuclear weapon, or that the attack would destroy them all.³⁵ In short, U.S. leaders believed that the United States could probably destroy the entire Soviet long-range nuclear force with a first strike, and that was good enough for the U.S. government. The United States kept this strategy right until the Soviets developed a survivable arsenal, which ended the first period of U.S. nuclear primacy.

Second, military planners employ a standard targeting strategy for dealing with intelligence uncertainty: when in doubt, assume that possible targets are real targets. For example, rather than risk leaving a real Chinese DF-5A missile untargeted, U.S. warplans likely target every identified DF-5A silo plus many possible silos – some of which may be decoys and some of which may simply be suspicious topographical features. This sort of “overkill” targeting is a luxury available to a country with a huge numerical advantage in nuclear forces, and the United States has such an advantage against China.

Third, in the midst of a high-stakes military confrontation – for example, if China began alerting its nuclear forces during a conventional war with the United States – the United States might strike first even if leaders in Washington doubted they could destroy every single long-range Chinese weapon. In the immediate aftermath of a limited U.S. counterforce attack – one that targeted only China’s DF-5A silos, but avoided direct attacks on Chinese leadership and population targets – U.S. leaders would likely hasten to explain that any Chinese nuclear retaliation against U.S. forces, American allies, or the U.S. homeland would trigger a second and far more extensive American strike.

Finally, even if U.S. awareness of fallible intelligence reduces the likelihood of a U.S. preemptive strike during a crisis or war, Chinese leaders do not know the state of U.S. intelligence about their weapons, or the level of U.S. confidence in that intelligence. Regardless of America’s actual willingness to conduct a preemptive attack on an alerting Chinese missile force, current U.S. counterforce capabilities create strong incentives for Chinese leaders to reduce the vulnerability of the Chinese arsenal.

Identifying the Onset of Nuclear Primacy

Blair and Chen argue that if nuclear primacy triggers the consequences we describe, it would have already done so. They claim that “the tectonic moment actually occurred 15 years ago when the Soviet Union collapsed and sapped its nuclear strength in the process.” They highlight 1991 as the key date because “that is when Russia drastically curtailed submarine and mobile land missile patrols, and when Russian missile silos became acutely vulnerable to a first strike by U.S. Peacekeeper (MX) missiles and soon after by Trident D-5 submarine missiles armed with W-88 warheads.” They note that the past 15 years have not witnessed Russian and Chinese efforts to reduce their vulnerability, the rise of crisis instability, or the exercise of U.S. nuclear coercion so, they conclude, our “theory is not valid.”³⁶

The claim that U.S. nuclear primacy had emerged by 1991 is simply wrong. The profound shift in the strategic nuclear balance occurred in the decade and a half since the end of the Cold War due to the combined effects of U.S. nuclear modernization and the deterioration of the Russian arsenal.

First, America’s efforts to expand its nuclear counterforce capabilities were only beginning to bear fruit in 1991. The most lethal first strike weapons in the U.S. nuclear arsenal are the Trident II D-5 missile, the W88 warhead, the

B-2 bomber, and the stealthy AGM-129 cruise missile. These weapons are critical for a U.S. first strike because they possess an unprecedented combination of minimal warning, high accuracy, and large warhead yield. For example, the AGM-129 has a relatively small yield (up to 150 kilotons) but pinpoint accuracy, and its stealthy characteristics would provide virtually no warning of attack. The B-2 bomber can deliver very high yield weapons (up to 1.2 megatons) with no warning, albeit at lower accuracy. The Trident II D-5 is fast-arriving (especially if it slips through the Russian radar hole) and highly accurate. If it is armed with the high-yield W88 warhead, it may be the most lethal weapon of the group. These four weapons systems are the foundation of America's current nuclear first strike capability.

The critical point is that of these four weapons, only the cruise missiles were well integrated into the U.S. nuclear arsenal by 1991. The first B-2 bomber became available for nuclear missions in late 1993, but it took the rest of the decade for the rest of the force to be deployed. The twenty-first (and last) B-2 did not become operational until 2000.³⁷ Similarly, although the entire arsenal of W88 warheads had been manufactured by 1989, the missiles that would carry them (the Trident II) were deployed gradually throughout the 1990s. The first submarine began to carry Trident II missiles in 1990, but it took eight years to get 10 Trident II subs into the force. Throughout the 1990s the majority of U.S. SSBNs carried the far less accurate Trident I missile and the far less lethal W76 warhead. In fact, America's nuclear first strike force is still emerging: the last two submarines are currently being converted to Trident II missiles; when they return to service in 2008, the whole process of equipping U.S. submarines with Trident II D-5s will have taken nearly 20 years.³⁸ Nuclear primacy did not emerge overnight; it continues to be a gradual process.³⁹

Countries violate taboos and many of their most deeply held values when confronting dire threats.

Second, Blair and Chen fail to acknowledge the extent to which the Russian deterrent arsenal has deteriorated – in both quantity and quality – since 1991.⁴⁰ For example, they contend that 1991 was the year when Russia “drastically curtailed” its strategic submarine deterrent patrols and the early 1990s was a period when it was “struggling to keep a single submarine on patrol at any given time.”⁴¹ In fact, the Russian navy continued to generate enough SSBN

deterrent patrols in the early 1990s to significantly complicate U.S. nuclear attack plans. In 1991, for example, Russian submarines conducted more than 30 deterrent patrols, more than enough to keep several subs at sea at all times and render a successful U.S. first strike improbable. Three years later this number had dropped to approximately 20 patrols, and it then dropped again to about 10 patrols per year by 1998. The point is that the collapse of the Russian submarine-based deterrent was a gradual process. In fact, the force could not be considered totally ineffective as a deterrent until about 2001, when Russian subs only sortied twice. (Russia conducted no SSBN patrols in 2002.)⁴² Additionally, aside from the sheer numbers, the quality of Russia's nuclear deterrent force has also deteriorated significantly from 1991 to the present. To give but one example, the longer Russian crews go without significant patrol experience, the more they are losing the skills needed to evade U.S. efforts to track them.

Finally, Blair and Chen's criticism about the timing of the emergence of U.S. nuclear primacy misses a broader point. The significance of nuclear primacy depends on the nature of the strategic relationship between two countries at any given time. The United States did not have hostile relations with Russia or China in the 1990s, and still does not today. But trouble may be brewing for U.S.-Sino relations as Chinese power grows. The real test for our concerns about nuclear primacy will occur in the next 15 years. We believe that as U.S. counterforce capabilities continue to grow, and especially if Sino-American relations sour, nuclear primacy will loom larger.

The Nuclear Taboo

A final flaw in our model, as alleged by our critics, is that the nuclear taboo renders the entire scenario of a nuclear first strike attack implausible and irrelevant. Nuclear weapons have become so abhorrent that their use by U.S. leaders is unthinkable. As Li writes, nuclear weapons are merely "a paper tiger," and U.S. counterforce improvements are "just a whitening of the paper tiger's teeth."⁴³ According to Blair and Chen, Chinese leaders completely discount the utility of nuclear force and believe that the United States shares its view in spite of the lip service American leaders pay to the importance of nuclear weapons.⁴⁴ All of this merely reinforces the point that China has no reason to build up its nuclear arsenal in response to U.S. nuclear primacy.

There are several reasons to doubt that leaders in Beijing will entrust their national security to the restraining power of the nuclear taboo. First, it is hard

to believe that Chinese leaders base their defense plans on the assumption that the United States is too moral to be ruthless in war. The paramount goal of national survival greatly overshadows leaders' confidence in the normative prohibitions constraining their adversaries. Second, the seminal studies of the nuclear taboo merely claim to establish that the nuclear taboo exists and has constrained state behavior, but do not attempt to measure the power of that constraint.⁴⁵ Does the taboo reduce the probability of U.S. nuclear use relative to what it would be without the taboo by 20 percent? Or by 80 percent (or more)? Absent that critical data, there is no rational justification for leaders in Beijing or elsewhere to base their countries' security on the nuclear taboo.

Third, taboos can change or disappear. One scholar recently listed a set of trends that "could unravel" the nuclear taboo.⁴⁶ What is striking is that every one of these trends is either happening or being considered today.⁴⁷ There is no guarantee that the nuclear taboo will disappear, but why would Chinese leaders stake their national security on a malleable norm of unknown power and longevity?


Fourth, countries (and individuals) violate taboos and many of their most deeply held values when confronting dire threats. For example, in 1937 and 1938 the United States led the world in condemning Japan's campaign of indiscriminate bombing raids on Chinese cities. The U.S. Department of State used the strongest possible language in railing against Japan's "slaughter of civilian populations" in China, calling Tokyo's tactics "barbarous," "inhuman," "contrary to the principles of law and humanity," and "crimes against humanity."⁴⁸ Of course, American leaders felt quite differently about the ethics of counter-civilian bombing after the United States had entered the war. The United States conducted indiscriminate terror bombing raids against Germany, and later adopted a strategy meant to inflict maximum pain on the Japanese people: it firebombed Tokyo (killing about 100,000 civilians in a single night) and over 60 other Japanese cities, and then dropped atomic bombs on Hiroshima and Nagasaki. All told, the incendiary and nuclear bombing campaign against Japan killed several hundred thousand Japanese civilians.

Our point is that the history of war is replete with episodes of countries doing things to their enemy during wartime that they would have found absolutely abhorrent before the conflict. Even in the 21st century this dynamic is still evident. Americans are not as worried about al-Qaida today as they were

afraid of Germany and Japan in the 1940s, but a muted version of the same dynamic – the willingness to violate taboos when scared – can be seen in the U.S. response to the September 11 terrorist attacks. For several years after the attack, the United States violated existing taboos against torture, kidnapping, and operating extra-judicial secret prisons. Only now are these practices being reined in. If the United States will violate taboos when Americans feel angry and scared, why would Chinese leaders assume that the nuclear taboo will protect their country during a serious military crisis?

The history of the nuclear age supports our position. The nuclear taboo did not allow the superpowers to stop worrying about a nuclear attack during the Cold War. Scholars claim that the taboo became institutionalized within the U.S. government from the 1960s to the 1980s. But this period directly coincides with a major nuclear arms race, one in which both the United States and the Soviet Union deployed enormous nuclear arsenals and paid great attention to their survivability. There is no evidence that either superpower was willing to forgo building survivable deterrent forces and rely on the nuclear taboo instead. We see no reason to expect China to behave differently today.

Conclusion

We hoped that our work on U.S. nuclear primacy would trigger a much-needed debate among scholars, analysts, and policymakers about the implications of America's emerging nuclear primacy and the wisdom of current U.S. policies designed to achieve such primacy. Thus, we welcome the critical articles recently published in this journal and are grateful for the opportunity to rebut those criticisms. The results of an extended debate on U.S. nuclear primacy will reveal a great deal about the nature of great power relations in the 21st century: most importantly, about the intensity of great power rivalries among nuclear-armed states, especially the United States and China, and the likely role of nuclear weapons in future crises and war. 

Notes

¹ We date the onset of nuclear stalemate to the early 1960s. Since that time, shifts in the nuclear balance have been minor because neither nuclear-armed superpower had a reasonable chance of destroying its adversary's retaliatory capability.

² Keir A. Lieber and Daryl G. Press, "The End of MAD? The Nuclear Dimension of U.S. Primacy," *International Security*, Vol. 30, No. 4 (Spring 2006), pp. 7-44; Keir A. Lieber and Daryl G. Press, "The Rise of American Nuclear Primacy," *Foreign Affairs*, Vol. 85, No. 2 (March/April 2006), pp. 42-54. For previous debates about our analysis see also Jeffrey S. Lantis, Tom Sauer, James J. Wirtz, Keir A. Lieber, and Daryl G. Press, "The Short Shadow of U.S. Nuclear Primacy?" *International Security*, Vol. 31, No. 3 (Winter 2006/07), pp. 174-93; Peter C. Flory, Keith Payne, Pavel Podvig, Alexei Arbatov, Keir A. Lieber, and Daryl G. Press, "Nuclear Exchange: Does Washington Really Have (or Want) Nuclear Primacy?" *Foreign Affairs*, Vol. 85, No. 5 (September/October 2006), pp. 149-157.

³ We believe that China will feel greater pressure than Russia because as China's power grows, the likelihood of serious Sino-American conflict seems greater than Russo-American conflict. Additionally, the Chinese nuclear force is so much more vulnerable even than Russia's that they will face great pressure to establish at least a minimal level of force survivability.

⁴ We focus here principally on the critiques raised in Bruce G. Blair and Chen Yali, "The Fallacy of Nuclear Primacy," *China Security (Autumn 2006)*, pp. 51-77; and Li Bin, "Paper Tiger with Whitened Teeth," *China Security (Autumn 2006)*, pp. 78-89. Also see Ivan Safranchuk, "Beyond MAD," *China Security (Autumn 2006)*, pp. 90-98.

⁵ Blair and Chen, "The Fallacy of Nuclear Primacy," p. 74; Bin, "Paper Tiger with Whitened Teeth," p. 88.

⁶ Other observers have noted that U.S. conventional force modernization programs appear driven by a potential rivalry with China. U.S. strategic nuclear modernization programs should be seen as part of the same long-range planning effort to deal with the uncertainties of Sino-American relations in coming decades. For example, as part of these efforts, in the 1990s the United States added China back into U.S. nuclear war plans (it had been removed from the U.S. SIOP in 1982). And over the past decade the United States has shifted the weight of its ballistic missile submarine force – the most lethal first strike weapon in the U.S. arsenal – from the Atlantic Ocean to the Pacific Ocean. Nine of 14 U.S. ballistic missile submarines are now slated for operations in the Pacific. See Hans M. Kristensen, Robert S. Norris, and Matthew G. McKinzie, *Chinese Nuclear Forces and U.S. Nuclear War Planning*, Washington, D.C.: Federation of American Scientists/Natural Resources Defense Council, November 2006, pp. 160-69.

⁷ If attacks on Russian command and control facilities delayed the launch of surviving Russia weapons by even an hour or two, a U.S. follow-on attack could be launched against those targets which might have survived the initial nuclear onslaught.

⁸ For example, we exclude the coming leap in lethality for the U.S. submarines as the first upgraded W76 warheads (W76-1) are deployed in the coming months. Nor do we incorporate the ongoing upgrades to the U.S. ICBM force, notably the deployment of Mk-21 reentry vehicles and W87 warheads (from retired Peacekeeper missiles) onto the Minuteman III force.

⁹ Blair and Chen, "The Fallacy of Nuclear Primacy," pp. 52, 56.

¹⁰ *Ibid.*, pp. 68, 73.

¹¹ To be clear, nuclear deterrence theories differ from each other on two critical dimensions: the

magnitude of retaliation that must be threatened to deter attack (e.g., 100 retaliatory warheads, or just one), and the probability that such retaliation will occur (e.g., assured retaliation, likely retaliation, or just possible retaliation).

¹² Shen Dingli, "Nuclear Deterrence in the 21st Century," *China Security (Autumn 2005)*, p. 12.

¹³ Sun Xiangli, "Analysis of China's Nuclear Strategy," *China Security, (Autumn 2005)*, p. 24.

¹⁴ Sun Xiangli, "Analysis of China's Nuclear Strategy," p. 24.

¹⁵ Ibid.

¹⁶ This quote, from China's official NFU declaration, appears in Shen Dingli, "Nuclear Deterrence in the 21st Century," p. 10.

¹⁷ Blair and Chen, "The Fallacy of Nuclear Primacy," pp. 68, 72.

¹⁸ Bruce G. Blair, "General Zhu and Chinese Nuclear Preemption," *China Security (Autumn 2005)*, p. 19.

¹⁹ Shen Dingli, "Nuclear Deterrence in the 21st Century," *China Security, (Autumn 2005)*, pp. 10, 13.

²⁰ Blair and Chen, "The Fallacy of Nuclear Primacy," pp. 71-72.

²¹ Li Bin, "Paper Tiger with Whitened Teeth," pp. 83-85.

²² Robert S. Norris and Hans M. Kristensen, "Chinese Nuclear Forces, 2006," *Bulletin of the Atomic Scientists*, Vol. 62, No. 3 (May/June 2006), pp. 60-63.

²³ Blair and Chen, "The Fallacy of Nuclear Primacy," p. 53.

²⁴ Blair, "General Zhu," p. 19.

²⁵ Details about the modeling can be found in Lieber and Press, "The End of MAD?" pp. 14-26 and 41-43.

²⁶ Blair and Chen, "Fallacy of Nuclear Primacy," p. 62.

²⁷ See Lieber and Press, "End of MAD?" p. 22-26, and especially Figures 1-3.

²⁸ Robert S. Norris and Hans M. Kristensen, "U.S. Nuclear Forces, 2007," *Bulletin of the Atomic Scientists*, Vol. 63, No. 1 (January/February 2007), pp. 79-82.

²⁹ Kristensen, Norris, and McKinzie, Chinese Nuclear Forces and U.S. Nuclear War Planning, pp. 167-168.

³⁰ To support their claim about the lengthy time required to prepare U.S. bombers for nuclear missions, Blair and Chen cite Bruce G. Blair, "De-alerting Strategic Nuclear Forces," in Harold A. Feiveson, ed., *The Nuclear Turning Point: A Blueprint for Deep Cuts and De-Alerting of Nuclear Weapons*, Brookings, 1999, pp. 117-18. However, those pages merely assert the same claim about the delay in alerting U.S. bombers without providing supporting evidence.

³¹ A single B-2 can carry 16 variable-yield nuclear gravity bombs. Set to their high-yield setting (greater than a megaton), these bombs would be highly lethal against China's ICBM force – consisting entirely of 20 silo-based DF-5 missiles.

³² Blair and Chen, "The Fallacy of Nuclear Primacy," pp. 58-59.

³³ Ibid., p. 59.

³⁴ William Burr, "First Strike Options and the Berlin Crisis, September 1961: New Documents from the Kennedy Administration," *National Security Archive Electronic Briefing Book*, No. 56 (Washington, D.C.: National Security Archive, 2001).

³⁵ An excellent description of U.S. warplans in the 1950s and 1960s is in Scott D. Sagan, *Moving Targets: Nuclear Strategy and National Security* Princeton, NJ: Princeton University, 1990, chap. 1. There was no element of bluffing in these plans; they were approved at the highest level of the U.S. government, and the president himself repeatedly declined to develop alternative approaches (i.e., he declined to consider non-nuclear approaches) for defending Western Europe. The only

plan on the shelf in the 1950s was to defend Western Europe by launching a massive nuclear strike against targets throughout the “Sino-Soviet Pact.”

³⁶ Blair and Chen, “The Fallacy of Nuclear Primacy,” pp. 66, 72-73.

³⁷ “B-2 Production,” see: <http://www.globalsecurity.org/wmd/systems/b-2-production.htm>.

³⁸ “Trident II D-5,” see: <http://www.globalsecurity.org/wmd/systems/d-5.htm>; “SSBN-726 Ohio-Class FBM Submarines,” see: <http://www.globalsecurity.org/wmd/systems/ssbn-726-unit.htm>; and Norris and Kristensen, “*U.S. Nuclear Forces*, 2007.”

³⁹ Blair and Chen are correct to point out that by 1991 the United States already possessed a potent first strike weapon: the highly accurate Peacekeeper missile. Furthermore, because of major problems with the Russian early-warning satellite network (distinct from the problems with their radar network), these Peacekeeper missiles could have struck with little warning and thus contributed significantly to a U.S. disarming attack. Nevertheless, a U.S. first strike could not succeed prior to the major changes that occurred in U.S. and Russian forces throughout the next fifteen years, such as (1) the deployment of the Trident II missiles throughout the U.S. submarine force, (2) the deployment of a substantial B-2 bomber force, and (3) the deterioration of the Russian submarine force (described below).

⁴⁰ See Lieber and Press, “The End of MAD?” pp. 12, 26-27.

⁴¹ Blair and Chen, “The Fallacy of Nuclear Primacy,” p. 66.

⁴² Hans M. Kristensen, “Russian Nuclear Submarine Patrols,” *Nuclear Information Project Nuclear Brief*, August 3, 2005, see: <http://www.nukestrat.com/russia/subpatrols.htm>.

⁴³ Li Bin, “Paper Tiger with Whitened Teeth,” p. 88.

⁴⁴ Blair and Chen, “The Fallacy of Nuclear Primacy,” p. 69.

⁴⁵ Nina Tannenwald, “The Nuclear Taboo: The United States and the Normative Basis of Nuclear Nonuse,” *International Organization*, Vol. 53, No. 3 (Summer 1999) pp. 433-468; Nina Tannenwald, “Stigmatizing the Bomb: Origins of the Nuclear Taboo,” *International Security*, Vol. 29, No. 4 (Spring 2005), pp. 5-49.

⁴⁶ Tannenwald, “Stigmatizing the Bomb,” pp. 43-45.

⁴⁷ For a list of the conditions and a discussion of this point, see Lieber and Press, “*The Short Shadow of U.S. Nuclear Primacy*,” pp. 174-193.

⁴⁸ John W. Dower, *War Without Mercy: Race and Power in the Pacific War* (New York: Pantheon, 1987), pp. 38-41.