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More than ten years ago Keir A. Lieber and Daryl G. Press forged a productive co-authorship and in "The End of MAD? The Nuclear Dimension of U.S. Primacy" questioned entrenched beliefs about the strategic nuclear balance supposedly existing between the United States and Russia. They then warned that "for the first time in decades, it [United States] could conceivably disarm the long-range nuclear arsenals of Russia or China with a nuclear first strike."[1] In "The New Era of Counterforce: Technological Challenge and the Future of Nuclear Deterrence," Lieber and Press return to the topic of the survivability of modern nuclear forces. To Lieber and Press, nuclear deterrence no longer appears. Their sobering analysis of the impacts of ongoing technological changes on the survivability of nuclear forces demonstrates an increased possibility of counterforce attacks.

Technological changes, from minor improvements to major breakthroughs like the development of intercontinental ballistic missiles (ICBMs), hardened missile silos, multiple independent reentry vehicle warheads (MIRVs), and submarine launched ballistic missiles (SLBMs), were major driving forces shaping American and Soviet nuclear postures and expected deterrence requirements for a better part of the Cold War. Both superpowers committed enormous resources to constantly improving their nuclear arsenals. As the superpowers' arsenals were growing in size to the tens of thousands, too many scholars and pundits started to take it for granted that sufficient capacities to deliver nuclear retaliation would be always available. By a fresh contribution discussing the impacts of technological development on the nuclear-armed state's capacity to

[1] Keir A. Lieber and Daryl G. Press, "The End of MAD?: The Nuclear Dimension of U.S. Primacy," *International Security* 30:4 (2006): 7-8.

fulfill the threat of nuclear retaliation, which is the cornerstone of nuclear deterrence, Lieber and Press bring a welcome advancement of the debate about nuclear deterrence in the twenty-first century. They argue that hardening, concealment, and redundancy – three legs that have historically helped ensure survivability of nuclear arsenals vis-à-vis any realistic attempts to destroy them in the first strike – are steadily being undermined.[2]

First, hardening seems an increasingly unviable strategy for protecting nuclear forces due to the increased accuracy of modern nuclear weapons' delivery systems. Even hardened structures like ICBM silos cannot typically survive a direct hit by a nuclear weapon. Reinforced structures can protect missiles, bombers, and command and control facilities from incoming weapons exploding close to the target, but not from those exploding very close to it. Lieber and Press illustrate the effects of improved accuracy with an example of the evolution of the U.S. nuclear arsenal from 1985 to 2017. Whereas roughly a quarter of the 1985 ICBMs and virtually all of the 1985 SLBMs would have missed small hardened targets like the enemy's ICBM silos, and exploded too far from the target to destroy it, there would be no missed targets today (19-21). Hence, usefulness of hardening for a nuclear force protection wanes against highly accurate weapons.

Lieber and Press further argue that increased accuracy of nuclear weapons eliminates the problem of 'fratricide' that prevents further immediate attacks on the same target.[3] Even today, some attacking weapons will likely fail, but no will miss. Since no targets will be missed in a modern nuclear first strike, there will also be no fratricide. Therefore, more than one attacking weapon can be assigned to any single target to compensate for a weapon that might fail in flight, and consequently all targets that can be located can also be destroyed (21-27).

Furthermore, the increased accuracy lets the attacker use lower-yield nuclear weapons. Accurate low yield weapons can be set to explode above the fallout threshold and still destroy a hardened target. Without nuclear fallout, the likely number of civilian causalities of a nuclear first strike drops radically (27-32). The cumulative effects of increased accuracy introduce a novel strategic situation when it is possible to destroy the enemy's hardened nuclear arsenal with few civilian casualties, a development that greatly enhances the attractiveness of the first strike, especially during a crisis.

The second common strategy to protect a nuclear arsenal, mobility and concealment, is undermined by improvements in remote sensing. Traditional sensor platforms like satellites and manned aircraft are improved and supplemented by new systems such as remotely piloted aircraft, underwater drones, autonomous sensors, and cyberspying. State-of-the-art sensors collect "a widening array of signals for analysis using a growing list of techniques" and, in contrast to the Cold-War generation of sensors, the twenty-first century monitoring is persistent and data are transmitted in the real time (33). The aggregate effects of this development put the survivability of systems like submarines and mobile missile launchers in jeopardy. These systems have always

[2] Lieber and Press do not address the problem of decreasing redundancy in detail, but rather refer to well-known trend of nuclear arsenals' reduction after the end of the Cold War.

[3] Nuclear fratricide means destruction or deflection of an incoming nuclear weapon by detonation of other nuclear weapon used in a same attack.

been relatively easy to destroy, but historically it had been nearly impossible to locate all of them. Lieber and Press argue that modern sensors make locating and destroying possible.

However persuasive Lieber and Press's analysis of the effects of the revolution in remote sensing is, it is not without some imperfections. For instance, the heavy secrecy that shrouds the real capabilities of modern nuclear submarines and their opponents' capabilities in anti-submarine warfare (ASW) precludes Lieber and Press from using current data to assess how vulnerable the submarines are. They must rely on the data about the vulnerability of Soviet Cold-War submarines to the United States' ASW capabilities to support their general argument about the vulnerability of this weapon's platform. Consequently, the article can show how vulnerable the submarines were and illustrate how vulnerable the submarines could be, but it remains uncertain how vulnerable they actually are. While logically sound, Lieber and Press's deductive argument about the vulnerability of modern submarines is inevitably not without some speculation.

It is also possible to argue that a reader can easily get a somewhat exaggerated impression about the degree of vulnerability of mobile missiles launchers to remote detection. Whereas Lieber and Press provide an impressive geospatial analysis of the possible remote-sensing coverage of North Korea's road network to show how vulnerable North Korea's mobile missiles are to detection and subsequent destruction, in a footnote they admit that such results cannot be directly applied to much bigger countries like Russia and China (fn. 98). Yet while the degree of vulnerability of submarines and mobile launchers to detection might have been slightly exaggerated, Lieber and Press certainly identify the trends that unequivocally undermine nuclear arsenals' survivability.

Furthermore, Lieber and Press rightly point out that the development of conventional arms, a trend out of the scope of their study, puts the survivability of nuclear forces in a further jeopardy. In fact, the increasing usefulness of conventional weapons in nuclear counterforce might be – at least in the long term – an even greater challenge to the survivability of nuclear arsenals than similar improvements in the accuracy of nuclear weapons. The historical data from past crises when a preventive strike against nuclear arsenal was contemplated show that would-be attackers tend to harbor strong preferences for conventional weapons to knock out the enemy's nuclear arsenal.[4] With the pinpoint accuracy of modern conventional weapons, even hardened targets such as ICBM silos can be knocked out in a conventional strike.[5]

Arguably, great powers will be able to maintain highly survivable nuclear postures as long as they remain ready to bear the costs. But smaller regional powers might be unable to compete in the possible arms races between increasingly effective first-strike forces and an increasingly difficult nuclear force protection. Then, as Lieber and Press insightfully point out, "in extreme circumstances—for example, if an adversary threatens escalation (or begins to escalate) during a conventional war—the temptation to launch a disarming strike may be powerful" (16).

How dangerous and how novel this strategic situation is remains an open question. Lieber and Press identify the trends undermining survivability of nuclear arsenals. Decreased survivability of nuclear forces might be

[4] Jan Ludvik, *Nuclear Asymmetry and Deterrence: Theory, Policy and History* (New York: Routledge, 2017), 167.

[5] Keir A. Lieber and Daryl G. Press, "The Nukes We Need: Preserving the American Deterrent," *Foreign Affairs* 88:6 (2009): 48.

quite a novel challenge for countries like the United States and Russia, whose second- strike forces have been largely considered invulnerable at least since the 1970s. Countries with sophisticated medium-sized nuclear arsenals like France and Britain will face an even greater challenge. Likely the most important question, however, is how the technological change influences already unstable relations between smaller nuclear powers that face much stronger, first strike capable enemies (North Korea is a prime example).

For small nuclear powers a dubious survivability is much less novel. Survivability of small nuclear arsenals has always been uncertain, and disarming attacks on the nuclear arsenals of small nuclear powers were contemplated by their stronger enemies. Yet none of the historical crises between a small nuclear power and a first strike-capable great power culminated in a disarming strike on the small nuclear power's nuclear weapons. Various factors, most prominently conventional deterrence, but also alliance dynamics, norms, and geography contributed to the absence of disarming strikes.[6] The importance of previously stabilizing factors will likely grow with the declining survivability of nuclear arsenals. It remains open to further inquiry how exactly technological changes analyzed by Leiber and Press impact these historical 'stabilizers'.

Lieber and Press's contribution to the debate about nuclear deterrence is an important one. It points to the trends that will likely shape the international security in years to come and shows what is possible with the state-of-the-art military technologies. Lieber and Press not only answer important questions, but also open equally important ones. Whether we are in the 'new era of counterforce' depends on how 'the technologically possible' matches 'the politically desirable.' This is a pertinent question that needs to be addressed by further research.

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[6] Lyle J. Goldstein, *Preventive Attack and Weapons of Mass Destruction* (Stanford: Stanford University Press, 2005); Ludvik, *Nuclear Asymmetry and Deterrence: Theory, Policy and History*.