Global Missile Defense Cooperation and China

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US-Russia ballistic missile defense (BMD) cooperation can improve strategic stability between both countries, but this cooperation would pose a potential threat to China’s strategic security, especially if it is a closed and deep cooperation. The United States and Russia should make their bilateral cooperation an open regime, and let China and other countries join, so that improvement of US-Russia strategic stability is not based on the sacrifice of strategic stability with China and other countries. China and the United States may also cooperate on BMD in areas of early warning and mutual launch notification. The security costs of these cooperative measures are very low, and the benefits would improve stability, confidence, and mutual trust. Finally, BMD cooperation between the United States and its East Asian allies (Japan and Taiwan) is threatening Sino-US strategic stability. The United States could improve Chinese confidence by increasing transparency about and limiting the performance of BMD systems. Keywords: ballistic missile defense, US-Russia relations, China, East Asian security.

At the summit of the North Atlantic Treaty Organization (NATO) held in Lisbon in November 2010, political leaders decided to expand the ballistic missile defense (BMD) system from its current design, which is intended to protect NATO troops, to that of protecting populations and territories. NATO leaders also decided to explore the possibilities of seeking cooperation with Russia. With regard to the means of cooperation, Russia suggested building a joint system, but the US position was that there should be two independent missile interceptor systems, so cooperation would probably be in the area of early warning (Collina 2011a). However, during a summit meeting in May 2011 and a meeting of defense ministers in June, the United States and Russia were unable to reach an agreement (Collina 2011b). BMD thus remains a serious issue in US-Russia relations.

This is not the first time that the United States and Russia have
talked about missile defense cooperation. In 2007, when Russia responded strongly to President George W. Bush’s proposal for a European BMD system, President Vladimir Putin proposed to share the Gabala radar stations in Azerbaijan with the United States in exchange for the latter’s commitment not to develop a BMD system in Europe (Fletcher 2007). Although the Barack Obama administration abandoned the Bush plan, Putin’s suggestion continues to serve as the starting point for US-Russia talks on BMD cooperation. China pays close attention to US-Russia BMD cooperation, but only recently has discussion begun about the impact of this cooperation on China’s security.

Cooperation among the United States and its Asian allies also worries China. US-Japan BMD cooperation includes the Patriot Advanced Capability-3 (PAC-3) system, the Aegis/SM-3 Block I mid-course BMD system, forward-based X-band radar (FBX), and joint development of SM-3 Block IIA interceptor missiles. US-Taiwan BMD cooperation includes the PAC-3 system and the PAVE PAWS early warning radar. The Chinese government has consistently opposed the US BMD system and related cooperation with its Asian allies. In its 2010 National Defense White Paper, the Chinese government asserts, “China holds that no state should deploy overseas missile defense systems that have strategic missile defense capabilities or potential, or engage in any such international collaboration” (Information Office of the State Council 2010).

Problematic Aspects of Cooperation on BMD

The above discussion illustrates two kinds of BMD cooperation. One is represented by US cooperation with its European and Asian allies. This kind of cooperation identifies certain countries as potential enemies and aims to respond to common threats, whether tactical, such as conventional ballistic missiles launched from China, or strategic, such as nuclear missiles launched from North Korea or Iran. The other kind is the proposed plan of US/NATO–Russia cooperation. This type does not target any specific state, as its primary objective is to build trust between both sides and to maintain strategic stability.

There is a potential contradiction between the two forms of BMD
cooperation. A joint BMD aimed at responding to common external threats might undermine strategic stability among the nuclear powers, while cooperation among nuclear powers to enhance strategic stability might reduce the operational capability of BMD. States need to balance these two purposes when they engage in BMD cooperation. In reality, BMD cooperation between allies is more likely to succeed, as both sides have a strong incentive to support it, while the desire for BMD cooperation among established nuclear powers is largely absent. Therefore, it is necessary for all sides to discuss how to prevent the ongoing BMD cooperation between the United States and its allies from undermining strategic stability among established nuclear powers. In addition, when nuclear powers negotiate BMD cooperation to enhance strategic stability, they have to ensure that such cooperation will not weaken the combat capability of their own BMD systems so as to sustain domestic support.

From the Russian perspective, a US-European BMD system aimed at Iran would undermine its capabilities for nuclear retaliation, thus endangering strategic stability between the United States and Russia. At least nominally, Russia is not considered a target of US-Europe BMD cooperation. The George W. Bush administration’s plan to deploy ten interceptor missiles in Poland and a fire control radar in the Czech Republic was strongly criticized by Russia. Later, the Obama administration revised the Bush plan by shifting its focus to the Aegis system with SM-3 series interceptors. The United States now plans to deploy SM-3 IA/B interceptors first—designed to intercept Iranian short- and medium-range ballistic missiles—and deploy SM-3 IIA/B interceptor missiles in the future. The latter is believed to be capable of intercepting intercontinental ballistic missiles (ICBMs). Although the US government did not acknowledge that this strategic shift was a concession to Russia, one can see that the changes to the plan are a reaction to Moscow’s concerns. Russian leaders apparently are satisfied with the short-term part of Obama’s plan but still express wariness about its future upgraded version. The proposed US/NATO-Russia BMD cooperation, if realized, may further reduce Russian suspicions.

China’s position is somewhat different. At the tactical level, China is considered a potential target when the United States is seeking BMD cooperation with its Asian allies, whereas at a strate-
gic level, China serves as a potential US partner in maintaining strategic stability. This contradiction is revealed in the *US Ballistic Missile Defense Review* published in February 2010. The report reiterated that Russia and China are *not* the focus of US BMD, but it also identified China’s conventional ballistic missiles as a potential threat to the United States (US Department of Defense 2010, 4–7).

There are two different views of Sino-US relations in the US academic community. One is that the United States should not seek strategic stability with China. Instead, the United States should use its technological advantages to maintain superiority over China. The other view is that US strategic vulnerability from China is already a fact (Roberts 2001, 2). In the *Nuclear Posture Review*, the Obama administration formally stated that the United States would maintain strategic stability with China, but the report did not specify any concrete measures to achieve this (US Department of Defense 2010, 28–29).

This article discusses the impact of global missile defense cooperation on China’s security. It provides a loose definition of missile defense cooperation, including early warning, mutual launch notification, joint development, and joint deployment. The first part of the article discusses US-Russia BMD cooperation, followed by a discussion of the possibility of Sino-US cooperation and analysis of potential costs and benefits. The last part analyzes BMD cooperation between the United States and its Asian allies and its potential impact on China.

**Russia-US Relations**

*Early Warning*

On January 25, 1995, a scientific rocket launched from Norway triggered the Russian early warning system. The flight characteristics of the rocket made it appear to be a Trident submarine–launched ballistic missile (SLBM) on the leading edge of a larger nuclear attack on Russia. This incident caused the United States and Russia to recognize the danger of false alarms and to begin to cooperate in this
area. The basic idea is that if a joint early-warning system is in operation, a false alarm generated by the early-warning system from either side would be identified by this joint early-warning system, greatly reducing the possibility of an accidental launch of a nuclear weapon.

This proposed joint system was called the Russian-American Observation Satellite (RAMOS). In the agreement reached in 1997, the United States and Russia agreed that each side would build one satellite with an orbit altitude of 500 km and a related ground station. Russia was in charge of launching both satellites. The satellites could also undertake environmental monitoring and scientific research (Bartschi et al. 1998). Later, the United States unilaterally made several adjustments. In the final plan, the United States would only provide detectors for the satellites, while Russia was responsible for building the two satellites, ground stations, and launch. Finally in 2004, the United States terminated the plan (Glass 2002; US Department of Defense 2010, 6).

In addition to a joint early-warning satellite system, another possibility was that both sides would exchange their early-warning system data. In 1998 the United States and Russia issued a joint statement on building the Joint Data Exchange Center (JDEC) in Moscow. In 1999 both sides established an ad hoc center for dealing with Y2K problems, and in 2000 they signed a related Memorandum of Understanding (MOU). Nevertheless, as tax and liability problems could not be properly solved, the center never became operational, and the JDEC MOU expired in June 2010 (Joint Statement 1998; Memorandum of Agreement 2000; Samson 2007).

In fact, the data submitted to the JDEC by both sides were not original and had been processed and filtered. Some scholars argued that the Russians were never confident of this plan, because if the United States planned to attack Russia, it could hide the information about a launch and provide only filtered data to Russia. As Forden says, JDEC is just a room with two computers showing data provided by the United States and Russia respectively. “Members of the Russian team can look over the shoulders of their American counterparts to see what is being shown on U.S. computer screens. The U.S. participants can do the same to see what is on the Russian computer screens” (Forden 2001, 15).
Launch Notification

The purpose of mutual launch notification is to prevent normal missile tests and space launches from being identified as nuclear attacks. The ultimate goal is to maintain strategic stability, reduce the chance of accidents associated with early-warning systems, and build mutual trust between nuclear powers. Mutual launch notification between the United States and Russia can be traced back to 1971. The latest agreement was signed on December 16, 2000. Early agreements were restricted to particular launches, such as a missile flying beyond one’s border. The current agreement encompasses all ICBMs, SLBMs, and space launch vehicles (SLVs). Notification includes the launch window, launch location, launch azimuth, planned impact area of the payload, and indication of a single or multiple launch (Memorandum of Understanding 2000).

In addition to bilateral agreements between the United States and Russia, there exist other multilateral mechanisms regarding launch notification, such as the International Code of Conduct against Ballistic Missile Proliferation (ICOC), based on the Missile Technology Control Regime (MTCR), and the Global Control System (GCS) under Russian supervision. Most of these mechanisms are not legally binding, and the member states commit to them on a voluntary basis. In 2008 Russia decided not to report its launches under the ICOC framework, claiming that its notifications were not being followed by other countries. In May 2010 the United States announced it would report all its space launches and most of its ICBM and SLBM launches under the ICOC framework (Charnysh 2010).

Impact on China

This section analyzes the impact of US-Russia BMD cooperation on China, with particular focus on its substantial effects on China’s national security rather than on psychological effects, such as Chinese feelings of isolation. First, US-Russia mutual notification has no direct impact on China, but the indirect impact is that cooperation as such provides a model for two potential adversaries to explore the limits of cooperation and transparency without reducing their own security. In addition to the bilateral agreements, the United
States and Russia also created some global launch notification mechanisms. Since these mechanisms are linked to other issue areas and were not subject to compulsory enforcement, the effects remained doubtful.

US-Russia joint early warning will have some impact on China’s national security, depending on the depth of the bilateral cooperation—namely, what kinds of sensors are included in the cooperation, whether the exchanged data are original or filtered, and whether the data only contain tracks of missile trajectories or more information, such as characteristics of warheads’ radar signatures. We do not have detailed information concerning current US-Russian negotiations and future possible plans, so the following analysis discusses all possibilities.

The first factor is the scope of the cooperative sensors. One possibility is that the cooperation may only consist of ground-based early-warning radars, which allow Russia to monitor Iranian activities, such as the Gabala radar. Since these sensors cannot “see” China, the system has no direct impact on China. The other possibility is that US-Russia cooperation may include sensors that can actually see China. In Russia’s early-warning system, two ground-based radars can monitor China’s missile activities; one is located in Mishelevka near Irkutsk and the other in Balkhash in Kazakhstan (Podvig 2002). Moreover, Russia is building a new early-warning radar, Voronezh-M, in Mishelevka (Podvig 2011). These activities have some impact on China’s national security, as discussed below.

If US-Russia cooperation were to involve sensors that could monitor China and the exchanged information only referred to data about the trajectories of ballistic missiles, the impact on China’s security would be limited. First of all, the United States could obtain more information about China’s missile launch tests. Without Russian cooperation, the United States could only use its early-warning satellite system, Defense Support Project (DSP), to monitor China. DSP satellites can only see the boost phase with limited accuracy. Russian radar would assist the United States to acquire comprehensive and more accurate information. Moreover, the United States would receive more information about the trajectories of China’s ballistic missiles through this kind of cooperation. A traditional ballistic missile is driven only by gravity outside the atmosphere, and its trajectory follows a predictable parabola. Yet according to US Department of De-
fense reports, newer versions of Chinese missiles are likely to have mid-course maneuver capabilities, which poses great challenges to US BMD (Office of the Secretary of Defense 2009, 30). If the United States can acquire more information about China’s missile tests through cooperation with Russia, it may receive more details about mid-course maneuver capabilities and use this information to upgrade its BMD system and improve its intercepting capabilities.

If US-Russia cooperation involves sensors that can monitor China and the exchanged information refers to raw signature data, then the impact on China’s security would be significant. A common understanding in US academia is that the biggest problem of US BMD is that it cannot effectively discriminate between real warheads and decoys, so the offensive side can defeat BMD easily by using countermeasures, such as decoys and stealth (Sessler et al. 2000). Very few of China’s nuclear warheads would survive a first strike from the United States because of the superiority of US nuclear forces. And a retaliation from China could be countered by a small-scale BMD system from the United States. But because of the low efficiency of US BMD, China can still maintain some confidence in its nuclear deterrent.

Once the United States collects the radar signature of China’s warheads and decoys through cooperation with Russia, however, the United States could develop corresponding software to distinguish between China’s warheads and its decoys. The susceptibility of US missile defense to countermeasures would be reduced, and China’s confidence would also be reduced. However, the threat should not be overestimated. Early-warning radar is not designed for discrimination, with a wavelength of about 1 meter. The mission of discriminating is assigned to fire-control radars, with a wavelength of about 3 centimeters (Gronlund, Wright, Lewis, and Coyle 2004, 30). As a result, the signature information about China’s warheads and decoys that the United States might obtain from cooperation with Russia would be limited.

In sum, the deeper the US-Russia early-warning cooperation, the deeper the US-Russia mutual trust and stability, means less confidence for China. If US-Russia cooperation contains radars covering China, China’s first reaction would be to quit the Sino-Russia mutual launch notification regime set up in 2009, which would be a major setback to global strategic stability (Perfilyev 2010). The purpose of US-Russia cooperation is to improve strategic stability and mutual trust,
which should not be based on the sacrifice of strategic stability with China. First, US-Russia cooperation should be limited to sharing tracking information of trajectories rather than radar signature of warheads and decoys. Second, US-Russia agreements should be open for China and other countries to join, so that China may build confidence. The implications of China joining future US-Russia cooperation is discussed in the next section.

Sino-US Cooperation

Talking about Sino-US BMD cooperation seems ridiculous at first glance, because China and the United States might conceivably engage in a military conflict. If so, China’s conventional ballistic missiles would be, at least politically, an effective weapon against the United States. In response, the United States is developing regional BMD systems to counter these Chinese missiles. In this field, Sino-US competition is a zero-sum game, and cooperation is unimaginable. But there is still some space for Sino-US BMD cooperation because, besides this zero-sum competition, China and the United States have common interests in building mutual trust, maintaining strategic stability, and avoiding nuclear war. It is precisely because China and the United States might engage in a conflict that these common interests are so important. This section discusses how to promote Sino-US BMD cooperation at the strategic level, where the benefits and costs of possible cooperation are analyzed. As in the case of US-Russia cooperation, two measures are addressed: early-warning cooperation and mutual launch notification.

Early Warning

In any war between China and the United States, both sides would seek to avoid escalation to nuclear war. The central questions are how an escalation might occur and how to prevent it. Two conditions exist for nuclear escalation: (1) if China was not confident of the survivability of its nuclear forces because of the asymmetry of the Sino-US nuclear weapons balance, the development of the US BMD system, US counterforce/damage-limiting strategy, US forward surveillance
activities, and the US conventional prompt global strike; and (2) if the United States attacks China’s nuclear weapons with conventional weapons either intentionally or inadvertently.

In such circumstances, China would not know whether an attack was an accident or a deliberate disarming strike. The worst situation would be if a conventional attack by the United States should cause a nuclear detonation, which China would be unable to distinguish from a nuclear attack. Without sufficient information, China would face a use-or-lose dilemma, and feel pressure to escalate. The less confidence China has in the survivability of its nuclear forces, the higher the pressure for escalation. So we conclude that a key factor in any Sino-US inadvertent nuclear escalation would be China’s insecurity. To avoid escalation, the most important measure would be to give China confidence.

In the US nuclear war plan, weapons assigned to attack China include the following: (1) SLBMs launched from ballistic missile submarines (SSBNs) patrolling in the Pacific on hard alert, used for a first-wave attack and for counterforce purposes; (2) SLBMs on other SSBNs in the Pacific that are not on hard alert, and cruise missiles and bombs carried by strategic bombers, used as a Strategic Reserve Force and for countervalue purposes; and (3) conventional precision attack weapons, used to complement the first two categories (Kristensen, Norris, and McKinzie 2006, 166–169; Kristensen 2010). From a US perspective, in preparing to attack China’s nuclear forces, there are three categories of targets: silos, underground facilities, and dispersed missiles. SLBMs are able to attack all three categories, whereas conventional weapons are only able to attack dispersed missiles. In other words, if the United States wanted to launch a disarming strike against China, SLBMs from the Pacific would have to be used. If China could get early-warning information showing that there was no launch from the Pacific, it could be confident that no disarming strike was under way, and China would not feel any use-or-lose pressure.

How can China get early-warning information? Traditionally, the early-warning system of a state consists of land-based radars and space-based infrared satellites. Land-based radar, however, is not a good choice for China because an early-warning radar is a big, vulnerable target, and the electromagnetic pulse produced by the deto-
nation of a nuclear bomb can black out the entire early-warning radar system. Compared to radars, an early-warning satellite is a better choice. At present, China is unable to build early-warning satellites. Specifically, China is unable to produce the infrared detectors of early-warning satellites, and it cannot import the detectors because of US export controls. So the only way for China to get early-warning information is through international cooperation.

One potential cooperative mode is for the United States to allow China to import the detectors needed, so that China could build its own satellites and share early-warning data with the United States and Russia. The waiver of the export control would apply only to this case, and the infrared detectors imported by China could only be used to build early-warning satellites. This mode of cooperation about early warning was presented by US scholars in discussions with the Russians (Postol 2011). For China, the advantages of this mode would be, first, that China would have its own satellite, increasing China’s confidence in the early-warning data; and second, that US, Russian, and Chinese early-warning systems would work simultaneously and independently, making the probability that false alarms might occur in all three systems very low. The disadvantage would be that the economic cost for China would be very high.

Another cooperative mode is that China might participate in an international regime, yet to be set up by the United States and Russia, to share early-warning data so that China would not have to build its own satellite. The advantage of this mode would be that the economic cost for China would be low. The disadvantage would be that China’s confidence in the early-warning data that it received would be low because the data would come only from the United States and Russia.

Sino-US early-warning cooperation might also contribute to improving mutual trust. It should be noted that early-warning cooperation cannot solve all the problems of inadvertent escalation, two specifically. One is that the United States might intentionally attack China’s nuclear weapons with conventional weapons in order to coerce China to terminate a conflict under conditions preferable to the United States. This was the US strategy reportedly envisaged in the Cold War against the Soviet Union (Posen 1982). The other problem is that China might worry that the United States could use its nuclear-
armed cruise missiles to disarm China, missiles that could not be detected by early-warning satellites. Early-warning cooperation cannot solve these two problems, but the danger would be reduced greatly by the mutual trust produced through early-warning cooperation.

The cost of early-warning cooperation for both sides would be very low. Early-warning satellites can monitor launches of ballistic missiles, including strategic and conventional ballistic missiles. From China’s perspective, sharing early-warning data with the United States would mean releasing early-warning data about its own conventional ballistic missiles. However, given US surveillance capabilities, regardless of whether China releases these data or not, the United States can monitor the launches, so transparency in this field has no cost for China. For the United States, because it has no conventional ballistic missiles, early-warning cooperation with China has no cost if it does not want to launch a nuclear attack on China.

Launch Notification

Although there is currently no mutual launch notification arrangement between China and the United States, this section discusses the benefit and cost of mutual launch notification. For China, the cost would be very low. As mentioned above, even if China does not notify the United States, the United States can monitor China’s launches. Cables released by WikiLeaks show that the United States was well aware of China’s BMD test in 2010 (WikiLeaks 2011). The cost is that the United States can verify the monitored data from its satellites using China’s notification, but this cost is limited because the information released by notification is limited. For the United States, the cost also would be very low. The United States would have to disclose some secret launches, but what is important is the payload rather than the launch itself. According to the US-Russia agreement of 2000, the United States only needs to disclose the launch point and the launch azimuth, not the payload.

Among the important benefits of mutual launch notification are that it can build confidence and trust and improve mutual transparency. In the Sino-US strategic dialogue, the United States is concerned about China’s transparency, including the modernization of China’s nuclear forces, while China is concerned about US space mil-
itarization, including its new orbital vehicle. Mutual launch notification can address the concerns of both sides. Moreover, mutual launch notification can be used as one of the verification measures for future space arms control initiatives, for example, an antisatellite (ASAT) test ban. Mutual launch notification cannot be an independent verification measure, however, because mutual notification itself needs to be verified. Yet, a mutual launch notification regime can promote communication between states, and can be used as a starting point for a more substantial verification regime.

US Cooperation in East Asia

US-Japan Cooperation

The Obama administration’s Phased Adaptive Approach (PAA) strategy for BMD development calls for an aggressive effort to modernize US SM-3 interceptors over time. In the four phases of this plan, SM-3 Block IA, IB, IIA, and IIB interceptors will be deployed, respectively. The burnout velocity of SM-3 Block IA/B is 3.0–3.5 kilometers per second (km/s) (O’Rourke 2008, 8), so SM-3 Block IA/B are not strategic BMD systems—that is, not systems to defend against an ICBM attack. SM-3 Block IIB is still under concept design, and SM-3 Block IA/B and IIB are not discussed here. This article focuses on the impact on China’s security of SM-3 Block IIA, which is being jointly developed by Japan and the United States and is planned for deployment in 2018.

The United States has not yet released the burnout velocity of SM-3 Block IIA. It is reported that it will be 4.5 km/s (Williams 2004, 1), but other sources indicate that it may reach a higher burnout velocity (Hildreth 2005, 28). My calculation shows that a twenty-one-inch interceptor can reach 5.5 km/s burnout velocity using more energetic propellants and lighter casing. A reasonable estimate would be that the burnout velocity of SM-3 Block IIA will be between 4.5 km/s and 5.5 km/s. Based on China’s worst-case assumption, we analyze here SM-3 Block IIA’s intercept capability based on the velocity of 5.5 km/s. The influence of a lower velocity on the intercept capability is also discussed.
SM-3 Block IIAs launched from a single location—say, Hokkaido, Japan—could engage almost all the SLBMs launched from China’s coastal waters that target the continental United States in their ascent phase (between the end of the powered phase and the apogee). SM-3 Block IIA could also engage China’s ICBMs in their ascent phase, as shown in Figure 1. SM-3 Block IIAs deployed off the Alaskan coast would supplement ground-based interceptors (GBIs) deployed in Alaska and California, and one system in principle could cover the entire United States (Wu 2011). The ascent-phase intercept capability provided by SM-3 is significant for two reasons. First, through early intercept, the United States could apply a “shoot-look-shoot” approach. Second and more important, by intercepting during the early flight phase of the target missile, the susceptibility of missile defense to countermeasures could be reduced.

Combined with GBIs, the United States could in principle construct a multilayered missile defense system against Chinese ICBMs and SLBMs launched from Chinese coastal waters. Such a system

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**Figure 1** Engagement of China’s ICBM by SM-3 Block IIA
(SM-3 launch time: 130 seconds after ICBM launch)

*Source: Author’s calculations.*
would include SM-3s deployed near the Chinese coast, GBIs deployed in Alaska and California, and SM-3s deployed off the US coast. From China’s perspective, the penetration probability of its retaliatory strike would be greatly reduced, and this situation might give US planners greater confidence in the US first-strike capability.

If the burnout velocity of SM-3 Block IIA is only 4.5 km/s, then the SM-3 system does not have ascent-phase intercept capability against Chinese ICBMs launched from China’s interior. Against SLBMs launched from China’s coastal waters, any SM-3 deployed near Japan would have limited intercept capability. Reducing descent-phase intercept capability would require two SM-3 systems to protect the entire continental United States. Thus, it can be concluded that a smaller burnout velocity has little impact on the system’s descent-phase intercept capability, but does have a significant impact on ascent-phase intercept capability.

In sum, SM-3 Block IIA’s burnout velocity is very important in evaluating its intercept capability. The United States and Japan have not yet released this data. Inevitably, China will choose the higher velocity to evaluate the situation based on a worst-case analysis. That will result in a more pessimistic estimate, possibly leading China to overreact to this deployment. Besides burnout velocity, the planned acquisition number and the deployment mode are also very important to China’s strategic evaluation. The United States and Japan should exchange information with China about these issues to improve transparency and avoid misunderstanding.

**US-Taiwan Cooperation**

A US-Taiwan BMD cooperation project that has strategic implications for China is the PAVE PAWS early-warning radar that the United States sold to Taiwan. These radars are used for ballistic missile early warning. There are three of these big radars in the United States in Clear, Alaska, Cape Cod, Massachusetts, and Beale Air Force Base, California. The detection range of the PAVE PAWS radar is 5,000 km (with a radar cross-section of 10 m²) (Gronlund, Wright, Lewis, and Coyle 2004, 69). Taiwan’s PAVE PAWS radar, under construction by Raytheon Corporation since 2005, is located in Hsinchu County (Hsu 2004; “Raytheon Awarded” 2005). The PAVE PAWS radars in the United States have two
antenna faces, each covering 120 degrees in azimuth. The radar in Taiwan should have only one antenna face, because 120 degrees is enough to cover mainland China. The detection capacity of Taiwan’s radar is reportedly lower than that of the United States’, but neither the United States nor Taiwan has so far disclosed the relevant data (Hsu 2004).

This radar’s performance far exceeds Taiwan’s defense requirements and threatens mainland China’s strategic missiles. Mainland China’s ballistic missiles targeting Taiwan are short range (several hundred kilometers), and for this reason purchasing an early-warning radar with a detection range of several thousand kilometers is a waste of money for Taiwan. From Taiwan’s perspective, however, promoting closer military ties with Washington is so important that any financial cost is worth the price. But the problem for Beijing is that this high-performance radar can track Beijing’s ICBM and SLBM launches. It is equivalent to moving US early-warning radars to mainland China’s southeast coast. Figure 2 shows the coverage of Taiwan’s PAVE PAWS radar. The radar’s position and boresight direction are hypothetical, with the three arcs representing the coverage for 1,000 km,

Figure 2  Coverage of PAVE PAWS in Taiwan

Source: Author’s calculations.
2,000 km, and 3,000 km detection range, respectively. The 3,000-km detection range is enough to cover most of mainland China, and the early flight phase of Beijing’s ICBMs would be tracked by this radar. If its detection range is 1,500 km, it could not see Beijing’s ICBM launches, but it would still be able to track Beijing’s SLBMs launched from the South China Sea. Figure 3 depicts the Taiwan PAVE PAWS radar’s tracking range on Beijing’s SLBM.

The upgrade potential of this radar should be noted. The PAVE PAWS radar is a phased-array radar, the antenna of which is constructed by numerous transmit/receive modules. The power, and in turn the detection range, of the radar are determined by the number of these transmit/receive modules. Given the structure of a radar, a less powerful version could be achieved by a “sparsely populated” phased-array system rather than a “fully populated” one. So even if the Taiwan
PAVE PAWS radar is currently less powerful than the radars in the United States, it could be easily upgraded to the same level by increasing the number of transmit/receive modules. Thus, from Beijing’s perspective, it must be assumed that the Taiwan system may be as powerful as the US one. In sum, the Taiwan PAVE PAWS radar has significant strategic implications. In order to maintain Sino-US and cross-strait stability and mutual trust, the United States and Taiwan should disclose the performance and upgrade potential of this radar.

**Conclusion**

There are two kinds of BMD cooperation: between allies in order to deal with common threats and between competitors in order to improve strategic stability. As this article has shown, these two purposes may come into conflict with each other. Usually this conflict takes the form of cooperation between allies, constituting a threat to strategic stability between nuclear powers. BMD cooperation between the United States and its East Asian allies (Japan and Taiwan), for example, would threaten Sino-US strategic stability. To compensate, the United States should aim to give China confidence by improving transparency and limiting its BMD performance. Similarly, US-Russian BMD cooperation would improve strategic stability between them, but this kind of cooperation would pose a potential threat to China’s strategic security, especially if it is a closed and deep cooperation. The United States and Russia should make their bilateral cooperation an open regime and allow China to join in, so that the improvement of US-Russia strategic stability would not sacrifice strategic stability with China. Finally, China and the United States may cooperate in BMD, too—for example, early-warning and mutual-launch notification. The security costs of these cooperative measures are very low, but the benefits would be the improvement of stability, confidence, and mutual trust among the actors.

**Notes**

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1. According to a US military estimate, the range of Beijing’s next-generation SLBM JL-2 is 7,200 km, which is not enough to target the continental United States from the South China Sea (Office of the Secretary of Defense 2009, 66). However, since an increase in the range of an SLBM can increase strategic submarines’ patrol area and promote submarines’ survivability, and inasmuch as China reportedly is constructing new submarine facilities in the Sanya/Yulin Naval Base in Hainan island (“Secret Sanya” 2008), it can be concluded that in the future the range of Beijing’s SLBMs will be increased to target the US continent from the South China Sea.

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