

Assessing the Desirability and Feasibility of Ballistic Missile Defenses

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Good afternoon. I've been asked to speak about how to assess the desirability and feasibility of ballistic-missile defenses. In thinking about this, I've been reminded of how King Solomon lamented in Ecclesiastes that "there is nothing new under the sun." It's terrible to admit this at a meeting for the advancement of science, but everything that I'm about to say has already been said many times before. The current dispute over the desirability and feasibility of missile defenses is just the most recent in a long series of debates that began in late 1950s, and the best that I can do is sort through the arguments that have been made on both sides, and offer some personal judgments.

It is sometimes said that every offensive weapon has spurred the creation of a defensive weapon to counter it—for every sword there is a shield. It is inevitable that ballistic missiles would stimulate a search for missile defenses. For many people, the analysis is simple: if missile defenses are feasible—and I believe that they are feasible, at least under certain circumstances—then they are desirable. After all, how can responsible leaders choose not to defend their country from attack if it is within their means and ability to do so?

I don't believe the analysis is that simple, of course, or I wouldn't be giving this talk. Deciding whether and what type of ballistic missile defense makes sense requires a detailed cost-benefit analysis, where we compare the benefits of deploying a particular type of missile defense against the costs we incur in doing so.

The benefits of a missile defense derive from the likelihood that such a system might deter or defeat attacks against the United States, its allies, or its troops. Conceptually, we might measure the benefits in the expected number of lives saved. There are also other, more indirect benefits. For example, Patriot may not have destroyed a single missile over Israel, but it helped the U.S. win the Gulf War by helping to keep Israel out of the war. Of course, it's hard to generalize from this

experience; once you know that a defense is ineffective, it loses its psychological power. And if the missiles had been armed with chemical, biological, or nuclear weapons, I'm sure that Patriot wouldn't have been sufficient to ward off Israeli retaliation. Even so, U.S. missile defenses might serve as an umbrella and help to maintain important security alliances in the face of a missile threat, and the overall benefits might be substantially greater than the number of intercepted missiles or avoided casualties would indicate.

What are the costs of defense? There is, of course, an economic cost measured in the tens of billions of dollars. In an era of declining defense budgets, this has an associated opportunity cost: ten billion dollars spent on missile defense is ten billion dollars that could have been spent on fighter aircraft, precision munitions, cargo planes and ships, intelligence gathering, and soldiers. So the benefits of a missile defense must outweigh the marginal benefit that could be obtained by spending the same amount of money on other things.

There are other costs, and these are more subtle and harder to measure. One has to do with how other countries react to the deployment of missile defenses by the United States. We must be careful to avoid what Herbert York calls "the fallacy of the last move." A U.S. missile defense will provoke reactions from Russia, China, and other countries, and the effect of these reactions must be included in our cost-benefit calculation.

The fallacy of the last move is a subset of the security dilemma, which refers to the fact that one nation's attempt to increase its security—by building ships and tanks and missiles to deter or defeat attacks—can make other nations less secure. These other nations will react by trying to improve their security, leading to an arms race that leaves no nation more secure. In assessing the desirability of missile defenses, we must consider the possibility that reactions by others could alter drastically the ratio of costs to benefits—for example, because they took defensive or offensive countermeasures that decreased the effectiveness of the defense or which resulted in an increase in the risk of attack.

Finally, even if the expected benefits of missile defense outweigh the costs, that does not necessarily mean that a missile defense is desirable. There may be other ways to achieve the benefits provided by a missile defense at lower cost, many of which cannot be pursued if we deploy missile defenses.

The Threat

An assessment of the desirability and feasibility of ballistic missile defense must begin with the nature of the threat posed by missiles to the United States, its allies, and its military forces deployed overseas. There are two types of threats:

- The first is the possibility that Russia or China might launch at a small number of missiles at the United States. Why a small number? A deliberate attack by Russia is considered extremely unlikely today, and it is highly unlikely that we could build a defensive system that would be effective against a massive attack. On the other hand, many people believe that the probability of an accidental, inadvertent, or unauthorized launch, which might involve a handful of Russian missiles, is much greater and is increasing.
- The second type of threat emanates from North Korea, Iraq, Iran, and other so-called “rogue” states. The ballistic missiles now fielded by such countries have ranges less than 1000 kilometers, and these may pose a threat to U.S. allies and military forces. Most of these missiles are armed with conventional high-explosive warheads, but chemical or even biological or nuclear warheads might be deployed in the future. Some people believe that these countries might build or buy missiles capable of reaching the U.S. homeland, but these fears are greatly exaggerated.

Accidental or Unauthorized Launch

First, let's assess the desirability and the feasibility of missile defenses to counter the threat of accidental or unauthorized launches from Russia, and also attacks by China. This was the main rationale for the GPALS system proposed by President Bush and the ALPS system proposed by Senator Nunn some years ago. The Missile Defense Act of 1991 called for “a highly effective defense of the United States against limited ballistic missile threats, including accidental or unauthorized launches...” This threat has also been cited in recent draft legislation by those who support a national missile defense.

The threat of accidental or unauthorized launch is real, and although it has been with us for some time, there are reasons to be more worried today: the political instability of Russia, in which coup d'état, anarchy, or civil war is a real possibility; the fragmentation which has left parts of Russia's nuclear forces and attack-warning system in other countries; and the lack of clear civilian authority over the Russian military and its nuclear forces. This is a legitimate concern worth insuring against, and a missile defense could be part of an insurance policy.

How large an attack should we guard against? An unauthorized attack might involve a regiment of ICBMs (9-10 missiles) or a boat-load of SLBMs (16-20 missiles). Assuming that Russia implements START II, this would be about 10 ICBM warheads or 100 SLBM warheads. China reportedly has deployed only five ICBMs and 24 SLBMs, so a full-scale attack by China might be about as large. An accidental or inadvertent Russian launch is often postulated to involve only one or a few missiles, but it's unclear why hundreds of missiles wouldn't be just as likely.

There are two approaches to designing a defense against small, 10-20 missile attacks from Russia or China. One approach is to deploy a land-based defense within the bounds of the ABM Treaty, with no more than 100 interceptors based at the site of the old Safeguard ABM system near Grand Forks, North Dakota. Another approach is to go beyond the bounds of the ABM Treaty and deploy interceptors at several sites, advanced space-based systems to provide accurate tracking data, and perhaps supplement this with air-, sea- or space-based interceptors to destroy missiles in their boost phase.

ABM-treaty-compliant system. A system that could defend the entire United States against limited attacks could not comply with the ABM Treaty, because the fundamental undertaking of parties (as stated in Article I of the Treaty) is “not to deploy ABM systems for a defense of the territory of its country and not to provide a base for such defense.” The single-site Safeguard and Galosh systems allowed by the Treaty could defend only a small portion of their respective countries. Those systems didn't provide a base for a nationwide defense, because expanding them would have required the construction of dozens of large radars, and this was considered a sufficiently large firebreak between limited and nationwide defenses. Thus, the recent statement by Lt. Gen. Jay Garner, commander of the Army Space and Strategic Defense Command, that it is possible to deploy a highly effective Treaty-compliant NMD that covers all 50 states, is pure nonsense. The Treaty was designed to prevent just such a defense.

One might take refuge in the statement by Presidents Clinton and Yeltsin, issued during the May 1995 summit, that defensive systems could be deployed as long as they do not “pose a realistic threat to the strategic nuclear force of the other side.” A system that was limited to one hundred missiles at Grand Forks—even one that could cover the entire country—would not seem to pose a threat to Russian strategic forces. It would, however, clearly provide a base for such a defense, because once the initial system was tested and deployed, the United States could expand it rapidly and easily by building more interceptors.

But even if Russia agreed that a small number of highly effective interceptors was allowed under the ABM Treaty, such a system could not protect the entire United States. A single-site, Treaty-compliant system can only intercept missiles that enter the view of the battle-management radar. As Lisbeth Gronlund and David Wright have shown, a radar at Grand Forks would never see warheads launched from China against cities on the West Coast, nor would it see warheads launched from bases or subs in eastern Russia against cities in the Pacific Northwest. Moreover, by depressing trajectories slightly, attacks on most major East and West Coast cities would fly under radar coverage. Russia would certainly modify missile trajectories in this way if the U.S. built such a defense, and any accidental or unauthorized launch would therefore fly under the defense.

One might imagine that it wouldn't be necessary for the radar at Grand Forks to see the warhead. Some people have suggested that advanced early warning radars or space-based sensors could relay track data to Grand Forks, or that a super-intelligent interceptor could locate and home on warheads on the basis of simple cueing data provided by satellites. But the ABM Treaty was designed to prevent this from happening by prohibiting other sensors from substituting for ABM radars. If the radar can't see the warhead, then something else must be performing the functions of the ABM radar, and that is prohibited by the Treaty.

But even if we ignore this restriction, a single-site system couldn't protect the entire United States from submarines off the U.S. coast. Six of the ten largest U.S. cities are more than 2,000 kilometers from Grand Forks, and Miami is 3,000 km away. It would be physically impossible for interceptors launched from Grand Forks to intercept SLBMs launched 2000–3000 km off U.S. coastlines, particularly if the missiles were launched on depressed trajectories. And a system at Grand Forks would be farther from Anchorage and Honolulu than Russian submarines based in the Sea of Okhotsk, so it could not protect these cities from accidental or unauthorized SLBM launches.

In summary, a Treaty-compliant system cannot protect the entire United States from limited attack, which may disappoint those who would like to accommodate such defenses within the bounds of the ABM Treaty. Such a system would violate Article I of the Treaty, which prohibits nationwide defense. In addition, a system at Grand Forks could not protect most coastal cities unless it substituted other sensors for ABM radars, which would violate Agreed Statement D. Even ignoring questions of compliance, a system at Grand Forks could not protect coastal cities from SLBMs launched a few thousand kilometers off shore, and it could not protect Alaska or Hawaii from missiles launched from the Russian Far-east.

Non-treaty-compliant system. If we are serious about providing a nationwide defense against small Russian or Chinese attacks, it doesn't make sense to do it within the ABM Treaty. A single-site system will be ineffective, and there's no reason to build an ineffective defense. We would have a much better chance of mounting an effective defense with a multi-site system, supplemented by sophisticated space-based tracking systems, and perhaps by some sort of system to intercept missiles in their boost phase. The GPALS system, which included 1000 ground-based interceptors at five sites and 1000 brilliant pebbles, is an example of a more serious approach to the problem.

Unfortunately, such approaches to nationwide defense run into a different sort of trouble: they would trigger reactions by Russia and China that would nullify the benefits of a defense. Any defense that would be capable of effectively defending the United States from a small attacks would throw Russia's second-strike capability into doubt, especially at or below START-II force levels. This may seem counterintuitive, given that Russia will have about 800 strategic missiles under START II. Russian alert levels are very low, however, and today fewer than 100 missiles are positioned to survive a first strike. In addition, a defensive system that is capable of intercepting, with very high kill probability, 10 or 20 missiles launched simultaneously from a single base or sub, and carrying up to 100 warheads aimed at a single region of the U.S., would be capable of intercepting up to ten times as many missiles and warheads, with lower kill probability, if the missile launches were distributed in time and space, as one might expect in a retaliatory strike. The fact that the United States would be likely to underestimate the performance its defensive system, while Russia would be likely to overestimate its effectiveness, would only make matters worse. Added to Russian concerns would be the potential for rapid expansion of the defense.

Russia has already given indications of how it would respond to the deployment of a nationwide missile defense by conditioning the ratification of START I on continued U.S. compliance with the ABM Treaty. It would be relatively cheap and easy for Russia to maintain MIRVed ICBMs. Alert levels could be increased, supplemented by plans to launch silo-based ICBMs and pier-side SLBMS upon warning of attack, thereby increasing the risk of accidental or unauthorized attack. Relatively cheap countermeasures, such as depressed trajectories, penetration aids, and decoys would degrade the effectiveness of the defense. The collapse of START and the ABM Treaty would fuel nationalist sentiment, making it more likely that such countermeasures would be taken—and increasing the risk of conflict between the United States and Russia.

To elaborate a bit further on possible countermeasures, Dick Garwin has suggested that mid-course intercept could be defeated simply by putting the warheads inside of balloons made out of super-insulation. Hit-to-kill interceptors would home on the balloon and puncture it, but the interceptor would be very unlikely to hit the small warhead within the large balloon. Multiple shots could be defeated by having more balloons inside the balloon. One could also use empty balloons as decoys. These countermeasures would force the defense to make the intercept within the atmosphere, after the balloons and other light decoys are swept away, but at altitudes high enough so that the interceptor's infrared sensor is not blinded by atmospheric heating. This would leave a very short period—10 or 15 seconds at most—to make the intercept.

A nationwide defense against small attacks would, of course, completely negate China's small strategic nuclear force. China could respond with defensive countermeasures and a significant expansion of its forces, which would increase the perceived threat to the United States, Russia, and perhaps India. If Russia chose to deploy a missile defense, the United Kingdom and France would face a similar decision to expand their forces. In short, deploying missile defenses outside the bounds of the ABM Treaty could ruin prospects for nuclear arms control.

Congress had these types of reactions in mind in the Missile Defense Act of 1991, which called for "a highly effective defense of the United States against limited ballistic missile threats...but below a threshold that would bring into question strategic stability." My tentative conclusion is that, in today's international environment, it is not possible to have both: we cannot build a highly effective nationwide defense against limited attacks without triggering reactions that would lead to a net decrease in U.S. security. This will be possible only when the nuclear powers no longer wish to hold each other at risk to nuclear attack, at which point the problem of accidental and unauthorized attack could be eliminated simply by getting rid of the weapons themselves.

If we dispense with the ABM Treaty and deploy a nationwide defense, we are likely to end up with the worst of both worlds: we will trigger Russian reactions that will put an end to nuclear arms control and other cooperative efforts to reduce nuclear risks—and may even increase these risks—while failing to provide a really effective defense against even limited missile attacks.

Fortunately, there are other ways to decrease the risk of attacks against the United States. The most straightforward is to implement the START I and START II reductions in the number of missiles and warheads and to pursue additional reductions down to at least 1000 warheads on each side. This could be done faster

than an effective defense could be built, and it would save, not spend, tens of billions of dollars. Even more important is reducing the alert level of nuclear forces, so that missiles are no longer poised for instant attack during peacetime. The risk of accidental and unauthorized attacks can also be reduced through other cooperative measures, such as detargeting, cooperative warning and verification of alert status, destruct-after-launch systems, and better use controls. All of these measures could be pursued in a cooperative security environment. Deploying nationwide defenses in violation of the ABM Treaty would make most of these measures impossible, and would breed suspicion, competition, and hostility rather than cooperation.

Missile Threat from Rogue Nations

Now let's turn to the second category of ballistic-missile threat: missiles in the hands of rogue nations that are hostile to the United States and the existing international order. The oft-repeated statement that "at least twenty countries already have or may be developing ballistic missiles" does not shed much light on the problem. Instead, we should focus on potentially hostile nations that have missiles, the ranges of those missiles, and the nature of the warheads that they may be armed with.

Many of the nations that have missiles—Israel, India, Pakistan, Saudi Arabia, South Korea, Taiwan, Egypt, and Kuwait—along with several that are capable of building missiles—Brazil, Argentina, and South Africa—are very unlikely to threaten U.S. interests. A number of somewhat less-friendly nations, such as Afghanistan, Algeria, Cuba, and Yemen, have only short-range, conventionally-armed missiles that do not pose a threat to U.S. allies or troops, and are unable to build or buy longer-range missiles or unconventional warheads. When we subtract these nations from the list of countries that have or are trying to acquire missiles, we find that the list of countries that we are really worried about is very short indeed: North Korea, Iraq, Iran, Libya, and Syria. According to the most recent National Intelligence Estimate, none of these countries is likely to build or otherwise acquire a ballistic missile capable of reaching the continental United States within the next 15 years. Thus, the missile proliferation threat to the U.S. boils down to five rogue states that might use missiles to threaten U.S. allies and troops.

When considering this threat, we should remember that a missile by itself is not a weapon; it's the warhead on top of the missile that concerns us. At one end of the spectrum are nuclear warheads, which are extremely worrisome. Fortunately, nuclear nonproliferation efforts have generally been very successful, and with the

possible exception of North Korea, none of the countries that we are worried about are likely to have them in the foreseeable future.

To date, all of the missiles used in war have been armed with conventional high-explosive warheads, and these pose little threat to U.S. military forces. Conventionally-armed ballistic missiles are useless against mobile and hardened targets, and are only a nuisance against soft, fixed targets like airfields and ports. Even as terror weapons against cities they remarkably inefficient, and the damage they cause is mostly indirect: a diversion of military resources to try to destroy the missiles, and panic that might prompt some unfortunate change in strategy.

Somewhere between conventional and nuclear weapons stand chemical and biological weapons. A number of countries have produced chemical agents and may have produced chemical warheads for missiles. U.S. troops are well-trained and equipped to deal with chemical attacks; attacks on cities could be expected to produce mass panic, but probably not massive casualties. Biological warheads have the potential to be far more deadly for unprotected civilians. Although a few countries are thought to have produced biological agents, no country is known to have stockpiled a biological warhead.

I dwell on warheads because we are most concerned with having a defense against chemical, biological, or nuclear weapons, not missiles *per se*. Missiles are only one way—and perhaps not the most likely way—that these weapons would be delivered. A country with one or two nuclear devices may be reluctant to mount them on missiles. Missiles are relatively unreliable, and they place limits on warhead weight, diameter, and safety that a primitive device may not be able to meet. And missiles are one of the least desirable ways to disperse chemical or biological agents; a cruise missile, airplane, or special operations forces would be much more efficient. So even if we deploy an effective missile defense, that doesn't necessarily mean we will be able to protect our allies or troops from attack. Indeed, the very act of deploying a missile defense will encourage adversaries to use other means of delivery.

At this point it is worth mentioning that the type of interceptors currently under discussion, which must hit warheads in order to destroy them, are suitable only for a defense against unitary warheads: nuclear warheads, large high-explosive warheads, and bulk-filled chemical and biological warheads. Except for nuclear weapons, this kill mechanism can be defeated by using submunitions that are released soon after the end of the boost phase. In fact, submunitions are the preferred way to deliver chemical and biological weapons on cities, where the object is to disperse the agent over a wide area. The chemical warheads developed

by the United States for the Little John, Honest John, and Sergeant missiles carried hundreds of bomblets. Submunitions would be well within the technical capability of a country that could produce ballistic missiles; indeed, it would be more difficult to develop a mechanism to disperse chemical or biological agents near ground level from a unitary warhead traveling several kilometers per second.

Now let's discuss the rouge states one by one:

North Korea. At the top of my list is North Korea. North Korea probably plans to use ballistic missiles early in a war to attack air bases and ports that are vital for U.S. reinforcement of South Korea. North Korea has chemical weapons and programs to develop biological and nuclear weapons, and it may use missiles armed with unconventional warheads to hold Seoul hostage if it begins to loose the war, or to threaten Japan if it allows the U.S. to use Japanese bases for the war effort.

North Korea has built and deployed its own versions of the Scud missile, and the 500-km-range Scud-C has been exported to Iran and Syria. North Korea has tested but has not yet deployed a further modification of the Scud, called the No Dong in the West; with a maximum range estimated at 1000-1300 kilometers, this missile could threaten most of Japan. There are reports that North Korea is planning a multi-stage missile with a range of 2000-3000 kilometers, but it is difficult to understand what strategic purpose such a missile would serve. The Scud and No Dong are capable of reaching major cities in South Korea, Japan, Russia, and China, and a North Korean missile would have to have a range of nearly 6000 km to reach the closest U.S. city, Anchorage, Alaska. If a multi-stage missile is under development, it may be intended for export.

Iran and Iraq. Iran and Iraq are next on my list. As you all know, Iraq had a massive program to develop long-range missiles and chemical, biological, and nuclear warheads. Most of the weapons, materials, and equipment used in these programs have been identified and destroyed by UNSCOM and the IAEA, which continue to monitor Iraq, under a mandate from the UN Security Council, to detect a revival of these programs. It is tempting to say that the threat from Iraq has passed, but Saddam Hussein is still in charge, and most of the scientists and engineers that worked on these programs are still in Iraq. International will to maintain and enforce sanctions will wane with time, and Iraq will undoubtedly try to test, weaken, and ultimately eliminate the monitoring of its programs. How long it might take to revive these programs is hard to say, but it could happen within a decade.

Iran is also a worry. Although Iran's entire defense budget is just \$2 billion, it has a large inventory of missiles, including Scud-B and Scud-C missiles purchased from North Korea, which would allow Iran to reach parts of Saudi Arabia and Turkey. Iran is known to have produced chemical weapons, which they used on Iraq nearly ten years ago. Iran is also said to have programs to develop biological and nuclear weapons; without massive foreign assistance, however, Iran could not produce a nuclear weapon in the next 10-15 years.

Syria and Libya. Rounding out the list of rogue states are Syria and Libya, both of which are believed to have short-range missiles and substantial stockpiles of chemical weapons. Neither country is able to produce missiles indigenously, and neither is capable of producing nuclear or biological weapons without substantial and sustained foreign assistance.

Libya's 300-km-range Scud-B missiles are incapable of reaching Europe. Syria's Scud-B and Scud-C missiles, which it purchased from North Korea, are capable of hitting Israel, empty parts of Saudi Arabia, and much of Turkey.

Summary. To summarize, the missile threat to U.S. interests over the next few years consists of

- North Korean missiles armed with conventional and chemical warheads aimed at South Korean and Japanese cities and U.S. forces stationed in South Korea and Japan;
- Iranian missiles armed with conventional and chemical warheads aimed at Saudi or Turkish cities, or at U.S. forces stationed in Turkey and Saudi Arabia.
- Syrian missiles armed with conventional and chemical warheads aimed at Israeli or Turkish cities, or at U.S. forces stationed in Turkey.

Within 10-15 years, this threat could expand in the following ways:

- North Korea could break out of its agreement with the United States and develop nuclear weapons;
- North Korea could sell the Nodong missile to Iran, Syria, or Libya. This would allow Iran to reach Israel; Syria to reach Greece; and Libya to reach Italy or Greece;
- North Korea could develop and sell 2,000-3,000-km-range missiles to the same list of countries, who could use them to threaten much of Western Europe.

- Finally, Iraq might break free of international sanctions and international monitoring and revive its missile and WMD programs.

An appropriate defense. What is an appropriate response to this threat? Certainly it would be good to have a defensive system capable of intercepting missiles with ranges up to 500 kilometers that are armed with conventional or chemical warheads. It would also be prudent to have systems capable of intercepting similarly-armed 1000-km-range missiles, in case North Korea deploys or sells the Nodong missile. At the same time, we should realize that deploying a missile defense would not necessarily protect allied cities or U.S. forces abroad. Even if it was highly effective against unitary warheads, submunitions would defeat the system. In addition, deploying a missile defense would lead countries to explore other means of delivery, such as airplanes, cruise missiles, mini-sub, and special operations forces.

Looking to the future, it is difficult to say what sort of system would represent a prudent insurance policy, because it mostly depends on how likely you think it is that North Korea will develop and sell longer-range missiles. Given that North Korea is on its knees economically, that it has no military use for longer-range missiles, and that it is trying to improve relations with the United States, it is not a sure bet that this will happen. It isn't very likely that any other country will emerge as a supplier of long-range missiles to rogue states, either.

Some people believe that it is prudent to develop defenses against missiles with ranges up to 3,000 kilometers or so, which is basically what THAAD is designed to do. Assuming that a defensive system can be fielded at modest cost that would be effective against a realistic threat (and I have serious doubts that this can be accomplished), this is not unreasonable.

But decisions about theater missile defenses must take into account the reaction of Russia and other countries. If theater defenses can be deployed without triggering the sort of reactions I discussed earlier, fine. But if they can't, the benefits of such defenses won't be worth the costs. The threat posed by long-range missiles in the hands of rogue states is so speculative, and the effectiveness of defenses in the face of simple countermeasures is so uncertain, that the expected contribution of theater defenses to U.S. security could not possibly outweigh the damage to U.S. security that would be done by triggering negative reactions by Russia and China.

Some analysts believe that if the Russian government agrees with the United States that THAAD-like theater defenses can be deployed under the ABM Treaty, then the above condition is fulfilled. This, however, ignores three important

considerations. First, agreement by the current Russian government is no guarantee that the Russian legislature or future Russian governments will share this assessment of the benign role of TMD, and they may react by failing to ratify or implement START. Second, even if proposed TMD systems do not trouble Russia at START-II levels of nuclear forces and current alert rates, they could nevertheless interfere with efforts to further reduce nuclear forces. Third, although Russia is our chief concern, the reactions of China, the U.K., and France must also be considered.

We should also remember that missile defense is only one way to reduce the risks of missile proliferation. The MTCR and related export controls have been surprisingly effective at reducing the scope of the potential problem, compared to what might have been expected five or ten years ago. The experience in handling Chinese missile exports and the North Korean nuclear problem gives some hope that even the most troubling missile programs might have diplomatic solutions. Even if we can't prevent the development or sale of missiles to potential adversaries, passive defenses can be over 90 percent effective at preventing casualties from chemical and biological weapons—a level that would be difficult to achieve with active defenses. There is also some hope that the Air Force can improve its ability to destroy launchers, in part because longer-range missiles require launchers that are much larger, more distinctive, and more difficult to hide than the Scud launchers that Iraq used. Finally, the fact that Iraq did not use chemical weapons during the Gulf War, despite the fact that it had chemical warheads for the Scud, shows that the use of unconventional warheads can be deterred even if a country is losing badly. In short, it simply isn't true that we are helpless if we don't have theater missile defense.

Conclusions

In conclusion, I'd like to emphasize that I consider all of these conclusions tentative. I hope that we would all have an open mind, and be willing to redo our cost-benefit analysis as technology and the international environment change. If North Korea or China start selling long-range missiles to potential adversaries, or Iraq or Iran start building such missiles; if engineers can demonstrate a effective counter to the early release of submunitions; and if Russia and China agree that limited defenses need not jeopardize cooperative efforts to reduce nuclear risks, then the case for missile defense is much stronger. U.S. security is not well served by dogma, whether it is for or against defenses.