Nuclear Games: A Tool for Examining Nuclear Stability in a Proliferated Setting

Baker Spring

This paper serves as a description of the findings of nuclear games exercises to test the stability outcomes of deploying defense systems in a proliferated environment in which seven players (nations) have nuclear weapons. These games were conducted at The Heritage Foundation from November 2004 until January 2005, and involved a wide range of policy experts.

The reasoning behind using games and game theory is based on the fact that they are, and have been, an important tool used to analyze the dynamics of war and peace.² The security environment in Asia was used as a model to conduct this Nuclear Game.

The outcomes of our exercises suggest that the presence of defenses in a multi-player setting not only does *not* feed instability, but also may contribute to stability.

- First, the outcome of the games generally showed that the more widespread the presence of defenses, the lower was the propensity to ready offensive (nuclear) arms and fire shots with these arms. It also showed a greater propensity to abandon offensive arms (disarm) as defenses became more widespread.
- Second, the more widespread the presence of defenses, the lower the propensity to adopt hostile attitudes toward one another or move to threaten each other.
- Third, the more widespread the defenses, the less likely an aggressive actor's conclusions favored aggressive actions.

Talking Points

- The outcome of "nuclear game" theory exercises showed that the more widespread the presence of defenses, the lower the propensity to ready nuclear arms and fire shots with these arms. It also showed a greater propensity to disarm as defenses became more widespread.
- Additionally, the more widespread the presence of defenses, the lower the propensity to adopt hostile attitudes toward one another or move to threaten each other; and the more widespread the defenses, the less likely an aggressive actor's conclusions favored aggressive actions.
- The United States can address the threat posed by nuclear proliferation and start taking steps to reverse a disturbing trend.
- The next step is to undertake aggressive nuclear weapons and missile development and deployment programs that match the policy direction that has been established over the past four years.

This paper, in its entirety, can be found at: www.heritage.org/Research/NationalSecurity/hl1066.cfm

Produced by the Douglas and Sarah Allison Center for Foreign Policy Studies of the Kathryn and Shelby Cullom Davis

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Published by The Heritage Foundation
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Washington, DC 20002–4999
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Heritage Lectures ____ Delivered November 15, 2007

Game Theory

During the Cold War, the use of game theory led many scholars to the counterintuitive conclusion that the best means for avoiding nuclear war was to make both sides—in this case the United States and the Soviet Union—as vulnerable as possible to nuclear war's devastating effects. Today, the United States finds itself in a fundamentally different security environment. The proliferation of nuclear weapons and the means to deliver them has resulted in the U.S. facing not only one opponent of roughly equivalent strength, but potentially multiple opponents of varying strengths.

Game practitioners and game theorists have recognized that the characteristics of games with more than two players are different from those of twoplayer games. Chief among these is the presence of the coalition dynamic. As a result, The Heritage Foundation was determined to explore whether games or game theory applications to a nuclear proliferated environment would reveal if the presence of missile defenses does or does not contribute to nuclear instability in a multi-player setting, despite earlier determinations by some that they were destabilizing in a two-player setting.

Thus, the game design attempts to approximate a multi-player nuclear environment that the U.S. may face in the future, particularly in regional settings.

In a gaming exercise four iterations are played, each assuming a different defensive force posture. The offensive nuclear force postures remained constant. The defensive force postures ranged from no defensive presence to the possibility of defenses becoming available to all the players.

The Hypothesis

The hypothesis this game exercise tested is that a balance of offensive and defensive forces is not a counterproductive force posture for the purpose of maintaining stability because it will not increase strike incentives, particularly with nuclear weapons, in a multi-player setting. Inherent in this hypothesis is the view that a multi-player environment is both so complex and so fluid that the risks associated with a posture of mutual vulnerability among all the players derived from an offense-dominant posture—in this case, in a seven-player setting—are intolerably high.

Therefore, this hypothesis rejects the proposition that all multi-player settings can be reduced through carefully chosen assumptions to two-player dynamics and stability outcomes calculated on the basis of the least stable two-player relationship. Game-based stability calculations in a multi-player environment must account for managing stability through times of potentially dramatic and unpredictable changes in coalitions among the players. These calculations cannot be based simply on set coalitions in the context of a discrete confrontation.

A New Game Design

The game is a seven-player, non-zero sum game. It assumes player rationality, but allows different goals for each of the seven players. The setting is analogous to a situation in which several states join the nuclear club.

The Players. The players correspond to nationstates in a regionally focused geographic setting. The game design uses abstract descriptions of these players (states) to allow the individuals playing the game a wider range of options than a strict adherence to the detailed characteristics of these states would allow. Nevertheless, the region corresponds roughly to East Asia.

The descriptions of both the capabilities and the security policy preferences of the players (beyond the basic goals of avoiding a situation in which they are "wounded" or "killed") are as follows:

^{2.} Brams and Kilgour define a game as "the sum total of the rules of play that describe it." They define game theory as "a mathematical theory of rational strategy selection used to analyze optimal choices in interdependent decision situations, wherein the outcome depends on the choices of two or more actors or players, and each player has his own preferences over all possible outcomes." See Steven J. Brams and D. Marc Kilgour, Game Theory and National Security (New York: Basil Blackwell, 1988), p. 180.



^{1.} For full results of the nuclear games, see Nuclear Stability Working Group, Nuclear Games: An Exercise Examining Stability and Defenses in a Proliferated World (Washington, D.C.: The Heritage Foundation, 2005), at www.heritage.org/upload/ NuclearGames.pdf.

- **Player A** is a lesser power. In the context of the game, he has an offensive capacity equivalent to a 15-shot automatic weapon. Not favoring the status quo, Player A is prepared to undertake aggression against Player B if given the opportunity. He also maintains a hostile policy toward Player G because of Player G's alliance relationship with Player B. Further, Player A has a high tolerance for risk and is prepared to consider aggression even if the likelihood of a high payoff is remote or prospects of losing the game (by being "killed") are significant. In part, this is because continuation of the status quo poses a significant risk of regime collapse due to internal economic and political weaknesses. Player As security goals, starting with the most immediate and ending with the most ambitious, are: 1) regime survival; 2) forcing Player G to withdraw from the region, thus breaking his alliance relationship with Player B; 3) hegemonic power over Player B; and 4) the conquest of Player B. Player A is roughly equivalent to North Korea.
- Player B is also a lesser power. He is allied with a major power (Player G). However, unlike player A, he prefers the *status quo* and is not likely to use force unless provoked. Likewise, he is a power with a low tolerance for risk. In fact, he is seeking ways to avoid confrontations with Player A. His security goals, starting with the most immediate, are: 1) deterring or, if necessary, defending against an attack by Player A; 2) settlement of the dispute with Player A and the establishment of a stable relationship; and 3) continuation of the alliance with Player G, at least until the dispute with Player A is settled. Player B is roughly equivalent to *South Korea*.
- Player C is the third lesser power in the game. While an independent power, he has a relatively close relationship with Player A and shades his position in favor of Player A in confrontations with Players B and G. This shading is in part a response to a view that Player G's involvement in Player C's region is a meddlesome presence. Like Player A, Player C is not a status quo power and will assert his position. He also has a high tolerance for risk. Player C's security goals, starting with the most immedi-

- ate, are: 1) lessening the likelihood of a military conflict between Player A and Player B; 2) facilitating the withdrawal of Player G from the region; 3) regional hegemony; and 4) the conquest of Player E. Player C is roughly equivalent to the *People's Republic of China*.
- **Player D** is the fourth lesser power in the game. While now an independent power, Player D formerly had an alliance relationship with Player G and maintains a friendly relationship with Player G. While Player D, at the outset of the game, is neutral regarding any possible confrontation between Player A and Player C on one side, and Players B and G on the other, he is likely to side with Players B and G if pressed. Like Player B, Player D is a status quo power and has a low tolerance for risk. He is not aggressive and seeks to avoid confrontation. His security goals, starting with the most immediate, are: 1) to avoid getting drawn into a military conflict, particularly as a means for avoiding attacks by either Player A or Player C; 2) a continued presence in the region by Player G; 3) nuclear disarmament by Players A and B; and 4) blocking regional hegemony by Player C. Player D is roughly equivalent to Japan.
- Player E is the final lesser power in the game. At the outset of the game, Player E is neutral regarding any confrontation between Player A and Player C on the one hand, and Player B and Player G on the other. Nevertheless, he historically has had a tense relationship with Player C. If drawn into the conflict, Player E is likely to side with Players B and G. Player E also is a status quo power and has a low tolerance for risk. Player E's security goals, starting with the most immediate, are: 1) deterring or, if necessary, defending against an attack by Player C; 2) continuing the presence in the region by Player G; and 3) blocking regional hegemony by Player C. Player E is roughly equivalent to Taiwan.
- Player F is the first of two major military powers in the game. In the context of the game, he has an offensive capability that is equivalent to a 200-shot chain gun. However, Player F's gun is not well maintained and has a propensity to malfunction. This limits the probability of a



high payoff if he uses his weapon. Regarding any confrontation between Players A and C and Players B and G, Player F is strictly neutral. In part, this is because he sees few vital interests at stake in such a confrontation. This same view leads Player F, at least in this instance, to view the *status quo* with satisfaction and to possess a relatively low tolerance for risk. Player F's primary security goals are: 1) to lessen the likelihood of a conflict between Players A and C and Players B and G; and 2) to avoid being drawn into such conflict, particularly if being drawn in could lead to a direct confrontation with either Player C or Player G. Player F is roughly equivalent to *Russia*.

Player G is the final player in the game. He is also the second of two major powers in the game, with an offensive capability equivalent to a 200-shot chain gun. Unlike Player F, however, his weapon is well maintained. In later iterations of the game, in order to test the hypothesis that defenses are not destabilizing in multiplayer games, Player G will be provided access to a defensive capability in the form of a bulletproof vest. He will have the option to furnish this capability to other players as well as himself. As indicated earlier, he is allied with Player B and, as a result, is subject to threats from Player A. As a major power, Player G prefers the status quo and has a low tolerance for risk. He is unlikely to resort to force unless provoked. On the other hand, he will seek a way to come to the defense of his ally, Player B, unless the risks of losing (being "killed") are quite high or the payoff for victory is exceedingly low. Player G's security goals, starting with the most immediate, are: 1) preventing a nuclear attack on his territory; 2) preventing an attack by Player A, particularly in collusion with Player C, on Player B; 3) nuclear disarmament by Players A and B in particular, and perhaps by others; and 4) continuation of his strong presence in the region. Player G is roughly equivalent to the United States.

The game works in the following way. It is divided into "moves" (decisions made by each player at one point in time) and "rounds" (the compilation of

the decisions made by all the players at the same point in time). The game requires each player to make moves within each round by reviewing his options on two levels—attitudes and force postures.

Player Attitudes. The first level is the diplomatic level. Here, each player assesses the relationship he would like to have with each of the other players. They are categorized as: 1) hostile; 2) unfriendly; 3) neutral; 4) friendly; and (5) allied.

Force Postures. The second level of options pertains to force postures and is also reviewed in every round. Five of the players, A through E, have a holstered automatic weapon, such as an Uzi (15-shot). The remaining two players (Players F and G) have chain guns (200 shots). These weapons correspond to nuclear-armed ballistic missiles. These offensive armament levels are held constant throughout the game in order to test the hypothesis in terms of various levels and configurations of defenses.

Any player can voluntarily disarm ("quit"), but the game is not designed as an arms control exercise. Any player can draw his weapon at any time ("ready"), which is necessary for him to shoot. Any player can put his readied weapon back into the holster ("holster"). Any readied weapon can be aimed at another player ("threaten"). Any player can fire a readied weapon at another player ("attack"). Any player can choose to hide his weapon hand with a shroud held by his off-hand ("shroud"), which precludes other players from knowing whether his weapon is ready. A decision either to threaten or to attack another player results in the lifting of the shroud, which may not be restored until after the relevant player holsters his weapon.

Player *G* can put on a bullet-proof vest in two turns, which reduces the number of penetrating shots from the other players. This limited defense takes the form of "defensive interceptors." Thus, it is neither a perfect defense nor capable of rebuffing large-scale strikes.

All players start out holstered, unshrouded, undefended, and functional.

Attack Outcomes. the game defines three possible outcomes for a player who is attacked: (1) "functional," which is the initial status for all players; (2) "wounded"; and (3) "killed." The requirements to



wound or kill are preset for each player and vary from player to player.

Communications. Private communications and public announcements among the players are used to augment the game structure. Private communications are limited. Each player is allowed to initiate one such communication between any two rounds (although it may be directed at more than one player) and to respond to any private communication directed at him, but only once.

The Game Manager. Finally, a game manager supervises the conduct of the game.³ The game manager is empowered to disallow a player's move on two grounds. The first ground is that the move is inconsistent with the description of the player that was provided. The second is that the move is disruptive to the testing of the hypothesis.

Results of the 2004–2005 Game Iterations

To test the hypothesis that defenses will not contribute to instability in a proliferated setting, four iterations of the game were played. Each corresponded to a different defensive posture, in which offensive forces were held constant through all four iterations.

Game Iteration #1: Multilateral Mutually Assured Destruction. The first iteration of the game has Player G opt not to put on the vest (furnish himself with defensive interceptors), despite the fact that he has the ability to do so. This decision also leads him to decide not to furnish the vest (defensive interceptors) to any other player. This policy is applied in a setting in which there are two obvious sources of confrontation—Player A's desire for the conquest of Player B and Player C's desire for the conquest of Player E—and the potential for a variety of less obvious confrontations. All of these sources of confrontation are of interest to Player G because of his deep involvement in the region as a global power. Inherent in this policy choice is the belief that the Cold War policy of relying exclusively on offensive forces to maintain security is the best approach, even in a proliferated (multi-player) setting.

General Observations. A shooting war ended the first iteration of the game and revealed that, at least in an environment in which no defenses are permitted, the inherent instabilities are quite serious. It is important to draw some specific conclusions from the first iteration of the game.

- Failing to account for multiple axes of possible confrontation and conflict is a serious mistake.
- Distinguishing between players that are aggressive, non–status quo powers and those that are not aggressive and in favor of the status quo is a key to maintaining stability.
- Crossing the nuclear threshold carries serious incentives for escalation.
- Players can be expected to mix their choices between deterrence and deception, with varying impacts on stability.
- The coalition dynamic is both complex and immensely important regarding stability.

Game Iteration #2: Lesser Power Vulnerability. In the second iteration Player G decides to put on the vest (deploy defensive interceptors), but adopts a policy that precludes him from furnishing the vest (defensive interceptors) to any other player.

This policy choice was based on the belief that the best option for stability was for Player G to focus on defending himself, while ruling out defenses for other players, because the presence of defenses in the region would exacerbate the tensions already present in the region.

General Observations. A shooting war ended the playing of this second iteration of the game, but it was not encouraged by the presence of the defenses in the hands of Player G. The results of the second iteration of the game confirmed the finding of the first iteration that offensive deterrence is a fragile concept for stability in this proliferated environment. This combination of low predictability and high stakes increased the risk that players would miscalculate and lead to shooting.

The shooting war, which resulted in the deaths of every player but Player G and the serious wounding of Player G, had two proximate causes. Both causes

3. The author of this paper served as the game manager.



were serious miscalculations by Players A, C, and F under the Red Alliance they formed in the course of the game.

There is no discernible evidence that Player G's defenses prompted the two miscalculations by the players of the Red Alliance.

The history of this iteration of the game drives the observer to conclude that it is inherently more difficult for a superpower to maintain the necessary credibility to bolster both deterrence and stability in this proliferated environment. This speaks to the issue of the fragility of deterrence that was raised at the outset of these general observations. A superpower's allies, with their own nuclear arsenals, are more likely to look to their own resources to provide for their security. They are also more likely to look to other outlets—namely, alliances with nuclear powers other than the superpower—to meet their security requirements. Adversaries, in turn, are more likely to see opportunities to divide the superpower from his friends and allies and pursue these divisive policies aggressively. Unfortunately for Player G, his credibility problems may have come with the territory. His defenses did not cause them. In fact, they contributed to his survival.

Game Iteration #3: Theater-Only Defenses. In the third iteration of the game Player G adopts a policy of not putting on the vest (deploying defensive interceptors) except that he decides to provide the vest (defensive interceptors) to other players on a case-by-case basis.

This policy choice is based on the belief that the best option for stability is for Player G to forgo defenses for himself while providing them to his friends and allies on the basis that fielding such defenses for himself would upset the strategic balance with Player F and jeopardize arms control initiatives between the two.

General Observations. The third iteration of the game revealed that in this proliferated setting, with defenses available to select players other than Player G, the potential for instability was significant; however, it was possible for the players to overcome this potential for instability. A shooting war was avoided in this instance. What was necessary to overcome these sources of instability was for the players to

find buffers that increased the predictability of their behavior and lessened the stakes resulting from swings in coalitions.

The presence of defenses in the hands of select players other than Player G did not contribute to a circumstance in which a conflict became imminent or make it more difficult to achieve the stable outcome. In fact, the evidence suggests that the defenses served as a source of buffers needed to avoid an exchange of shots.

While it would be wrong to suggest that the presence of defenses in the hands of select lesser powers was the only factor in generating this outcome, specific observations suggest that the defenses made a significant contribution.

- The ability of Player *G* to offer defenses to his friends and allies provided another means to bolster their confidence in him and limit opportunities by the aggressive powers to split Player *G* from his friends and allies.
- The presence of defenses in the hands of the nonaggressive powers lessened their reliance on offensive threats to pursue their security interests.
- The presence of defenses bolstered the deterrence capabilities of the non-aggressive powers by raising questions in the minds of the aggressive powers about the potential ineffectiveness of preemptive strikes.
- The presence of the defenses served to create a barrier against an aggressive nuclear alliance that included Player F.
- Player G's ability to confer defenses gave him an additional tool for inducing disarmament by other players.

Game Iteration #4: Global Offense–Defense Mix. In this case, Player *G* decides to put on the vest (deploy defensive interceptors) and provide it (defensive interceptors) to other players on a selective basis.

This policy choice was based on the belief that the best option for stability is for Player *G* to see the proliferation threat as a global problem that requires a concerted defensive effort that serves to protect Player *G* and others on equivalent terms.



General Observations. The fourth iteration of the game revealed that while the potential for instability remained high, it could be overcome. Again, no shooting war resulted. The coalition dynamic remained unpredictable and carried extremely high stakes for the players. This combination of low predictability and high stakes carried the risk that the players would miscalculate.

The question regarding the hypothesis was whether the presence of defenses in the hands of Player G and select other players hindered attempts to moderate tensions or undermined the steady progress made throughout the game toward select disarmament and a stable outcome. The answer was no. In fact, the evidence suggests that the opposite was true. Defenses served as a source of buffers, which were necessary to avoid either preemptive attacks or uncontrolled escalation.

At the surface level, the evidence suggested that, in this iteration of the game (as with the third iteration), this was the case because no shots were fired and no players were wounded or killed. Additional evidence to bolster this view resulted from the fact that at no point in this game did a player lodge a direct threat against another player and an exchange of shots was never more than unlikely. Several observations indicate why the presence of defenses certainly did not undermine, and may have contributed to, this positive outcome.

- As with the third iteration of the game, Player G's ability to offer defenses to his friends and allies served to bolster their confidence in him and to reduce the likelihood that they would act rashly.
- Player *G* was able to use the offer of defenses to temper the aggressive tendencies of players hostile to him.
- The presence of defenses in the hands of both aggressive and non-aggressive powers lessened their reliance on offensive threats to pursue their security interests.
- Player G's policy of providing defenses to himself as well as to others lessened the incentive for aggressive powers to threaten him as a source of political leverage.
- The presence of the defenses undermined Player F's effort to form an alliance with Player C.

• Player G's ability to confer defenses induced disarmament in a way that allowed a brief examination of the dynamic present in a circumstance of selective proliferation.

Comparing the Four Iterations

Comprehensive analysis requires comparing the outcome of each iteration with the outcomes of the other three. The following analysis reinforces the observations following each iteration of the game that the presence of defenses, far from inducing instability, actually appears to contribute to a stable outcome.

Force Posture Considerations. From the viewpoint of comparing stability outcomes in the four iterations in regard to the players' force postures, it is appropriate to examine three criteria. The first criterion is the propensity of the players to ready their offensive weapons, with a move to ready representing a step toward instability. The second criterion is the propensity of the players to disarm, with a move to disarm representing a step toward stability. The final criterion is the propensity of the players to strike. This is the most relevant criterion because the propensity to strike is tantamount to the definition of instability.

Comparing the four iterations of the game in light of these three criteria results in three observations:

Observation 1: The more widespread the defenses, the lower the propensity of players to ready their offensive forces.

The offensive readiness levels trend down across the four iterations. Generally speaking, there is a positive correlation between the incremental addition of defenses and the reduction in the players' propensity to ready their offensive weapons. Therefore, to the extent that lowered readiness postures contribute to stability, defenses may have played a contributing role in generating a stable outcome.

Observation 2: The more widespread the defenses, the higher the propensity of players to disarm.

Likewise, there was a positive correlation between the incremental increase in the presence of defenses and the propensity to disarm when all four iterations of the game are considered. Therefore, to



the extent that selective disarmament contributes to stability, it is fair to conclude that the presence of defenses may have contributed to stability.

Observation 3: The more widespread the defenses, the lower the propensity of players to strike.

When the analysis of the propensity to strike extends across all four iterations of the game, it is clear that the broadening presence of defenses corresponds to a lower propensity to strike on the part of all players. This is the most important criterion regarding the impact on stability brought about by the presence of defenses. The positive correlation between the increased presence of defenses and the players' lower propensity to strike suggests that the defenses contributed to stability.

Diplomatic Considerations

Two criteria are most applicable in assessing the factors for stability or instability in the game in the area of player relations. The first is the propensity of the players to adopt hostile attitudes toward one another. The second is the propensity of the players to threaten others, specifically with an offensive strike. Comparing the four iterations of the game in light of these two criteria results in two observations.

Observation 1: The more widespread the defenses, the lower the number of times that players adopted hostile attitudes toward one another.

In the first iteration of the game, with no defenses present, hostile attitudes held by one player toward another fluctuated between two and four throughout the game. The second iteration of the game, which allowed only Player G to field defenses, saw hostile attitudes range between five and six in each round until after Round 7. Thereafter, they escalated rapidly and peaked at 19. The third iteration of the game, with defenses in the hands of select players other than Player G, saw hostile attitudes dip from six following Round 1 to three at the beginning of Round 5. In the final iteration of the game, in which Player G fielded defenses and provided them to other players, the only hostile attitudes that persisted throughout the game were between Player C and Player E.

These observations reveal an anomaly between the first and second iterations of the game as appeared in the observations stemming from the relevant force postures. It is important to keep in mind, however, that the game manager terminated the game in the first iteration in a circumstance when additional hostile attitudes were likely to emerge in subsequent rounds. Further, the conflict that occurred in the second iteration of the game resulted from factors that had nothing to do with the presence of defenses. Nevertheless, when the observations are collected from all four iterations of the game, they show a positive correlation between the presence of defenses and relatively low numbers of hostile attitudes demonstrated by the players. This serves to bolster the argument that defenses may have contributed to stability in this proliferated setting.

Observation 2: The more widespread the defenses, the lower the number of times that players threatened one another.

Not surprisingly, these observations track closely with those made regarding hostile attitudes. The anomaly between the first and second iteration persists for reasons that do not involve Player G's possession of defenses. The comparison of all four iterations of the game shows a trend toward fewer threats as defenses are added. This positive correlation again suggests that the presence of the defenses contributed to stability.

Conclusion

This technical study suggests that President George W. Bush acted just in time when he decided in 2001 to accelerate the missile defense program and jettison the 1972 Anti-Ballistic Missile (ABM) Treaty and its underlying concept of mutually assured destruction (MAD). The results of playing the game indicate that multilateralizing MAD would have been a bad choice for stability. Further, the results suggest that President Bush was right in adopting a global approach to missile defense that brings the friends and allies of the U.S. into the program while extending the defense to U.S. territory. This is preferable to fielding defenses exclusively for U.S. territories or limiting the defense to theater settings.



This study also suggests that President Bush and the Department of Defense's 2002 Nuclear Posture Review were right in pointing to the need for a responsive nuclear infrastructure. The unpredictable nature of the proliferated environment makes this necessary. It is all but certain that such an environment will result in the need for new nuclear weapons to meet new military requirements. While there is a range of options for the proper mix of offensive and defensive forces, it is clear that the U.S. nuclear deterrent remains essential to maintaining peace and stability. Defenses cannot and should not become a substitute for offensive nuclear forces.

The proliferated setting assumed by the game presents the U.S. with sobering problems. The risks of a highly destructive conflict are significant. The President and Congress must address these problems, if for no other reason than because it presents an opportunity to prevent this proliferated environment from becoming a reality.

The good news is that President Bush and Congress, by opting for a policy that advances the U.S. toward a mix of offensive and defensive forces, have put the nation's defense posture on the right path. With determination, the United States can address the threat posed by nuclear proliferation and start taking steps to reverse a disturbing trend. The next step is to undertake aggressive nuclear weapons and missile development and deployment programs that match the policy direction that has been established over the past four years.

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