

American reservist count as more than one Soviet tank also driven by a reservist? Such comparisons are obviously subjective and not as amenable to quantification as tank range, accuracy, or speed. This is the case, too, with resupply and maintenance capability. Everyone knows that efficient ammunition and fuel resupply is necessary for the effective operation of a combat unit, but very few analysts have suggested ways to quantify such a capability. This shortcoming may be especially important because NATO devotes more of its resources to providing logistical support than does the Pact. NATO units do not receive credit for this effort in the WEI/WUV analysis, however. (See Appendix B for more detail on this point.)

Static comparisons like those using the WEI/WUV method also ignore other decisive variables, such as strategy, maneuver, terrain, and combat attrition, that determine the conduct of war. Indeed, the WEI/WUV method is useful primarily for evaluating the forces that each side could have at its disposal before the onset of hostilities, or the total forces that each side had mustered at a point after mobilization. Such comparisons, therefore, are more valuable for assessing the relative standing of opposing forces before a war starts, and are more useful for evaluating deterrence capability rather than war-fighting ability.

Finally, the WEI/WUV method assumes that the added benefit of additional weapons is linear--that is, more weapons of any kind continue to provide the same additional capability as the first such weapon. This assumption is called "constant marginal utility" in economic jargon and ignores the fact that, beyond a certain point, additional weapons of one kind might be redundant and therefore of no added utility. For this reason, WEI/WUV scores should not be used by themselves to determine the optimal mix of weapons in a division. Indeed, if this method were followed to its ultimate conclusion, a division would contain only those weapons that yielded the highest score for the least cost. Rather, the scores should be used to suggest how one mix of weapons deemed plausible by military experts might perform against another plausible mix.

Together these various limitations suggest that assessments of the conventional balance using WEI/WUV scores cannot predict the outcome of a confrontation between NATO and the Warsaw Pact.



WEI/WUV scores are, however, useful tools in investigating the effects of various assumptions on today's conventional balance.

THE BALANCE OF GROUND FORCES IN THE CENTRAL REGION

The balance of NATO and Warsaw Pact forces in the central region of Europe depends on the quantity and quality of each side's weapons, the amount of time needed to make the forces bearing those weapons available in the central region, and exactly which forces should be counted. Each of these factors introduces uncertainty that is important in assessing the balance.

Quantity and Quality of Weapons

The forces summarized in Table 2 include those available throughout the entire European theater, from Norway to Turkey. The debate concerning the Warsaw Pact/NATO balance typically focuses on the central region, which is confined to the inter-German border. Soviet doctrine calls for a quick victory in this area before the West's economic strength and manpower advantage can be fully mobilized.^{3/} In this region, the Pact could have an advantage in divisions of 121 to 72.^{4/} (See Appendix C for a detailed list of the forces included in this tally.)

When all divisions are converted to armored division equivalents (ADEs) using the WEI/WUV method, the ratio is reduced. When rated against a U.S. armored division, for example, a Soviet tank or motorized rifle division has about 60 percent to 70 percent of the U.S. armored division's capability, depending on the type of division and its state of readiness in peacetime. Thus, the Warsaw Pact's total of 121 divisions available to the central European theater would be equal to only 75 ADEs, and NATO's 72 divisions--a collection of many types of divisions from many nations--would be reduced to about 49 ADEs. Converting the two sides' combat divisions to ADEs therefore reduces

3. Christopher Redman, "Battle of the Bean Counters," *Time* (June 15, 1987), p. 33.

4. This region includes Pact divisions from East Germany, Poland, and Czechoslovakia, the Soviet divisions stationed in those countries, and those of the Soviet Union's western and central military districts.

the ratio from roughly 1.7 to 1.0 (121 to 72 divisions) to just about 1.5 to 1.0. This reduction in the Warsaw Pact's advantage stems primarily from the larger size of NATO's divisions and the generally superior quality of NATO's weapons.

Availability of Forces

To prevail in war, one must not only have high-quality weapons, but these weapons must be available when needed. Neither all of the Pact's 121 divisions nor all of NATO's 72 divisions are currently in place in the central European region. Each side would require a considerable period of time to aggregate such a large force near the East-West German border. In fact, only 42 of NATO's 72 divisions available for the central region are actually situated in or near West Germany. Similarly, only 40 of the Pact's 121 divisions are currently stationed in either East Germany or Czechoslovakia, the two Warsaw Pact countries that border on West Germany. All other divisions for both NATO and the Warsaw Pact are stationed out of the region and would have to be transported to the area in times of increasing tension. Twenty-five of NATO's divisions would have to be transferred from the continental United States. The same holds true for 64 Soviet divisions that would have to be transferred from their home districts in the Soviet Union to the European theater.

Questions arise concerning the readiness and availability of units that are not on active duty at the outbreak of hostilities. Most of NATO's 72 divisions are on active duty during peacetime; in fact, only 20 of the 72 divisions would be formed from reserve units, which usually train just a few days a month. In contrast, only 52 of the 121 Warsaw Pact divisions would be considered totally combat-ready during peacetime. Although all Warsaw Pact divisions are referred to as "active," they are maintained at various levels of readiness and have been labeled as Category I, II, or III based on the status of their personnel and equipment.^{5/} Category I divisions are maintained at full strength with a full set of modern equipment; Category II divisions are typically manned at 50 percent to 75 percent strength and have their full complement of fighting vehicles; Category III divi-

5. Definition of categories is from International Institute for Strategic Studies, *The Military Balance, 1987-1988*, p. 34.

sions are maintained at cadre strength (about 20 percent), and while they might have a full set of combat equipment, that set would typically include older models. Of the 69 Pact divisions that are not combat-ready, about 20 would be Category II and the rest Category III. Those spaces in Category II and III divisions that are not filled by people on active duty would have to be filled after mobilization began, either by new recruits who would need training or by reserve personnel. (Soviet reserves have had two years of military training but do not generally have any refresher training following their initial military service.)

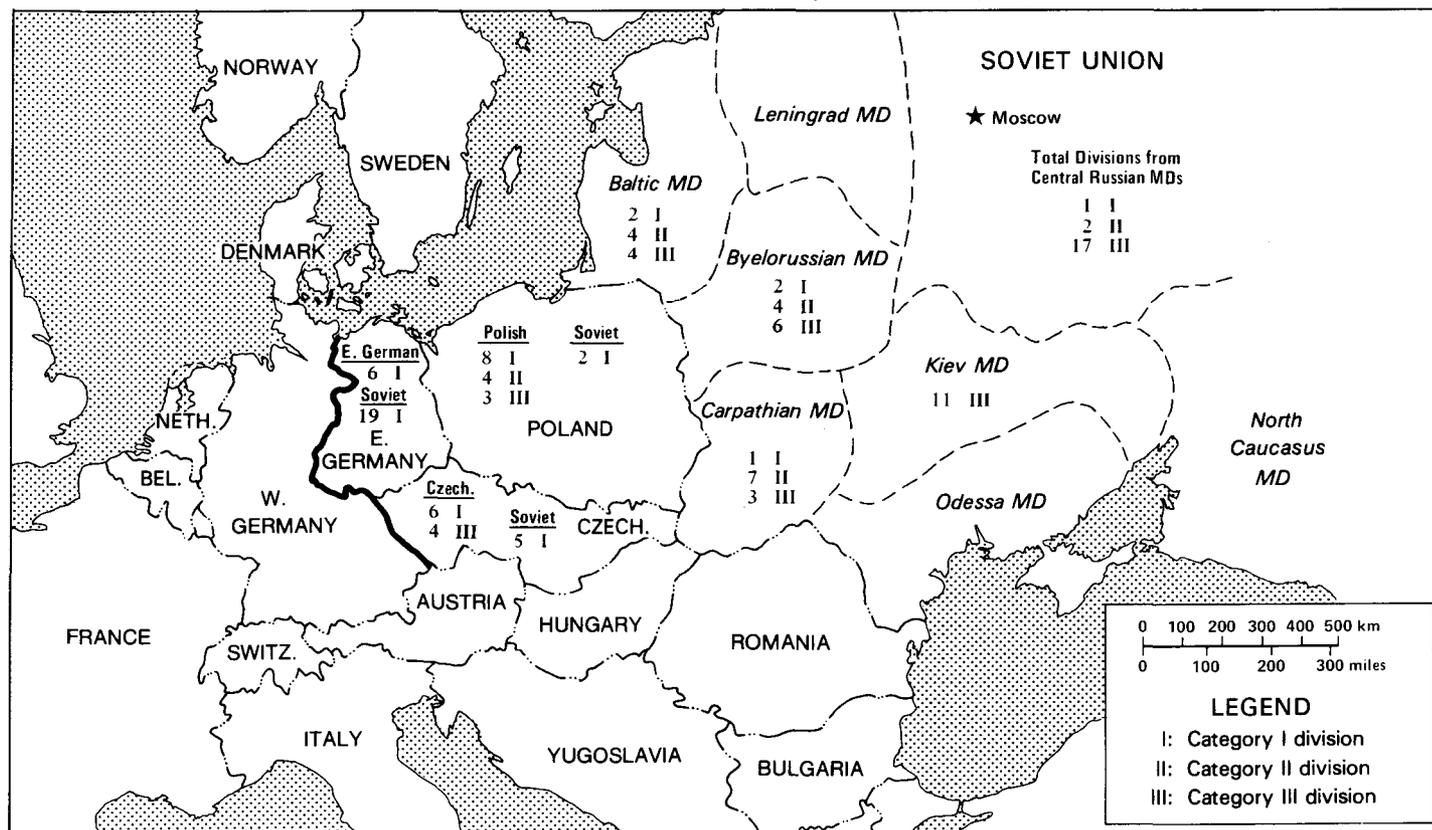
Unfortunately, unclassified literature contains little information on how long it might take the Warsaw Pact nations to prepare these less ready divisions for combat. Furthermore, most of the divisions that would have to travel long distances to reach the inter-German border would be Category II or III units (see Figure 2). Estimates of the time needed to ready all of these divisions for combat and to bring them from western and central Russia to the battlefield vary from just over two weeks to as long as four months.^{6/} Uncertainty also surrounds estimates of the time needed by the United States to ready its reserve divisions and transport them to Europe, even though official estimates put the delay at 11 weeks.^{7/}

Questions and doubts also exist as to the speediness with which NATO would detect and respond to a Warsaw Pact provocation. The shortest delay, of course, would be none, implying that NATO immediately detects the beginning of Warsaw Pact mobilization and decides to initiate its own. Longer delays are certainly possible, however, either because of difficulty in recognizing the beginning of Pact mobilization or because of political indecision within NATO. It seems plausible that delays of a week or more could occur between the beginning of Pact mobilization and the start of NATO mobilization.

6. Because some Soviet divisions have very few active-duty personnel, making them ready for combat could take much longer--perhaps many months rather than only a few.

7. Department of Defense, Office of the Assistant Secretary of Defense for Program Analysis and Evaluation, *NATO Center Region Military Balance Study, 1978-1984* (July 1979), Annex A.

Figure 2.
Peacetime Locations of Warsaw Pact Divisions Likely to Be Deployed to the Central Region



SOURCE: Congressional Budget Office based on information in International Institute for Strategic Studies, *The Military Balance, 1987-1988* (London: IISS, 1987); and in William P. Mako, *U.S. Ground Forces and the Defense of Central Europe* (Washington, D.C.: Brookings Institution, 1983).

NOTES: Category I divisions are at full strength with a full set of modern equipment. Category II divisions are typically at 50 percent to 75 percent strength with a full complement of fighting vehicles. Category III divisions are at 20 percent strength, might have a full set of combat equipment, but it would typically include older models.
MD = Military District.

Allied Participation

The final consideration that affects the number of forces available to each side is the role that various allies might play. In general, the NATO countries are considered to be more reliable allies than are the Warsaw Pact countries. Even France, though not a military member of NATO, is considered likely to contribute forces to the defense of western Europe. The French army currently includes 15 divisions, which could be available to defend the central region seven days after mobilization. These divisions represent about 20 percent of NATO's total ground forces. (France's 15 divisions account for only 8 percent of NATO's combat capability when measured in ADEs.) France's contribution cannot be taken for granted, however, since it is not bound by treaty to participate in NATO military activities.

Nor can the Soviet Union be extremely confident of the participation of its allies. Poland and Czechoslovakia, even though they have signed the Warsaw Pact, might not be willing to participate in an invasion of western Europe. Indeed, even if the political leadership of those countries should decide to follow the Soviet lead, it is not clear that such a decision would have the support of the enlisted forces or the general populace of either country.

A further asymmetry exists between NATO and the Warsaw Pact with respect to their allies. France's nonparticipation with the rest of NATO would, in theory, not hinder NATO's efforts. Based on current plans, NATO reinforcements would not need to traverse France, nor would NATO need to establish staging or air bases in France. On the other hand, France's participation and the availability of French ports and transportation networks could greatly enhance NATO's flexibility, should German ports or staging areas be lost.

In contrast, a Pact invasion of western Europe requires that Soviet reinforcements and supplies traverse Poland. If Polish units do not assist the Soviet forces by protecting these transit routes and helping to secure staging bases, some Soviet troops might need to be diverted to perform this mission. As a result, the Pact might lose the combat capability not only of its allied Polish units but also of the diverted Soviet troops.

Results Under Various Assumptions

The balance assessment in this study results from the use of the WEI/WUV method to calculate ADEs available to the Pact in the central region at each day after the Pact decides to mobilize; ADEs available to NATO forces on the same day are determined the same way. Thus, the results reflect both the quantity and quality of weapons available to each side and how quickly they arrive in the central region. Results are expressed as a ratio of Pact ADEs to those for NATO. A ratio exceeding 1.0 favors the Pact and vice versa.

No one can predict with certainty how long it will take the Pact forces to mobilize, what role the various allies will play, or how long NATO will take to mobilize after the Pact begins to do so. Therefore, rather than to assume arbitrarily one set of analytic conditions, it is more appropriate to examine the Pact/NATO ground force balance under varying conditions.

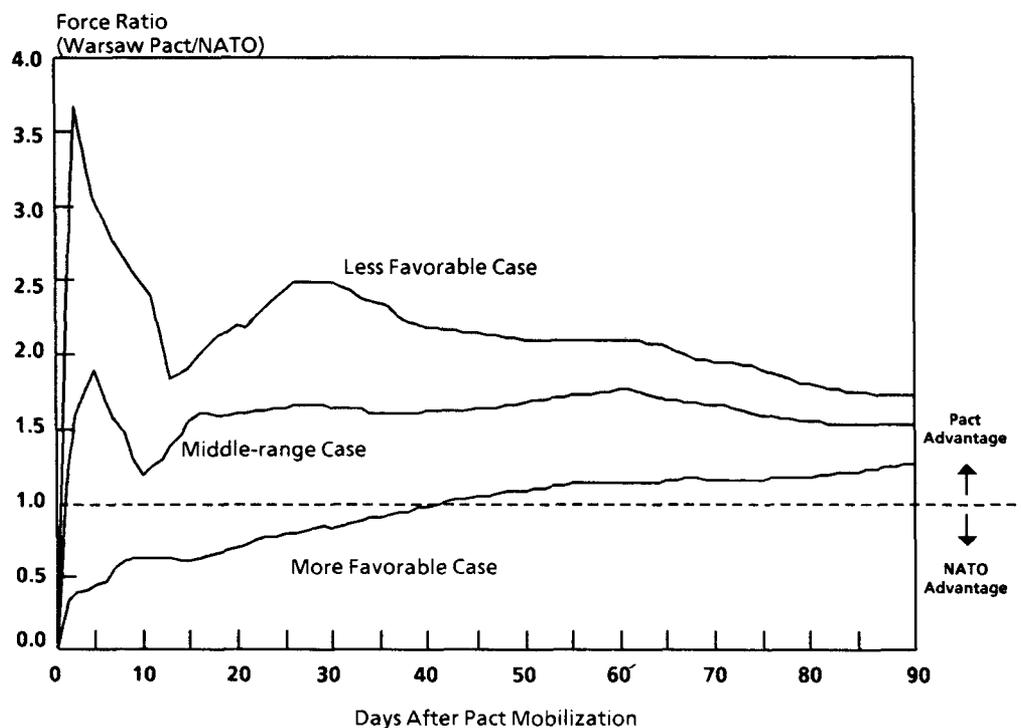
Case 1: More Favorable to NATO. A case that would be favorable to NATO would be one in which the Soviet Union's allies--Poland and Czechoslovakia--chose not to participate in a Soviet-led Warsaw Pact invasion and in which France contributed forces to NATO. (Although Soviet combat troops might have to be diverted to perform tasks that would otherwise be performed by Polish forces, this added disadvantage to the Pact is not taken into account here.) This case also assumes that NATO immediately detects a Pact mobilization and begins one of its own, and that the Pact mobilization schedule requires a long period--90 days--for the last of the Soviet divisions from the central military districts to reach the theater of operations.

The assumptions of this case yield analytic results suggesting that the Soviet Union and its Warsaw Pact allies might not achieve an advantageous position within 90 days of mobilization (see Figure 3). For the first 40 days after the Pact begins to mobilize, the ratio of available ADEs would be less than 1.0, suggesting inferior Pact capability and a NATO advantage. If the WEI/WUV analysis correctly represents the relative positions of the Warsaw Pact and NATO, then--under these circumstances--the Warsaw Pact might never attack, which would ensure deterrence.

Case 2: Less Favorable to NATO. Assumptions leading to the other extreme, the "less favorable case" for NATO, result in a situation that clearly favors the Warsaw Pact. This case assumes that the Soviet allies participate and France does not, that Soviet divisions from the central districts of the Soviet Union reach the front within 25 days after mobilization, and that it takes NATO seven days to detect the Pact's mobilization and to begin its own preparations for war.

Ratios of available forces that result from this set of assumptions are very different from those obtained previously, with the Pact achieving an advantage of 3.7 to 1.0 in the first few days after mobilization and a consistent advantage of greater than 1.7 to 1.0 (see Figure 3). Evidence of such an advantage, though not ensuring a

Figure 3.
Force Ratios in the European Central Region



SOURCE: Congressional Budget Office based on Department of Defense data and on William P. Mako, *U.S. Ground Forces and the Defense of Central Europe* (Washington, D.C.: Brookings Institution, 1983).

Warsaw Pact victory, could persuade the Pact that it could greatly outnumber and possibly overwhelm opposing NATO conventional forces, leaving NATO to rely on nuclear forces for deterrence.

Case 3: Middle Range of Assumptions. A final, middle-range scenario is based on the assumption that all allies from both sides participate, that the time to prepare the last of the Pact's less ready divisions and transport them to the front would be roughly two months, and that NATO would detect and would begin to prepare for war within four days after the Pact mobilizes. This set of assumptions produces ratios of ADEs in the central region that peak at about 1.9 on the fourth day after the Pact forces start to mobilize, drop to about 1.2 after nine days when all of NATO's divisions in the central region during peacetime are ready for combat, and then stabilize at a value of 1.6 or slightly higher for the next 75 days (see Figure 3). Thus, the ratios established by the WEI/WUV method in this middle-range case would also indicate that the Pact might have a numerical advantage in the central region, though not as overwhelming an edge as in the previous case.

What the Ratios Mean

But how much of an advantage would the Warsaw Pact need to be confident of victory? Are the ratios in the case of the middle-range assumptions (generally between 1.2 and 1.7) adequate? Or would confidence come only from higher ratios such as those in the case that is more favorable to the Warsaw Pact? Opinions differ widely.

In all these assessments, Warsaw Pact forces are assumed to be on the attack, attempting to push into NATO territory. Attackers have some advantages; for example, they can choose the point of attack and mass their forces there. But defenders also have advantages; they can assume protected positions on the periphery of the attacker's route and attempt to destroy attacking forces. Historical evidence and general military doctrine hold that, because of the defender's advantages, the attacker must achieve a force ratio of at least 3 to 1 at the point of attack in order to have confidence of success. Soviet defense literature suggests that they would try to achieve an advantage of at least 4 or 5 to 1 on their main axes of attack.



What theaterwide force ratio would allow an attacker to achieve a ratio of 3 to 1 or better at a point of attack while also attacking in smaller numbers elsewhere in order to pin down other NATO forces? The answer depends on how quickly each side could move its forces and on the strategies employed by both the attacker and the defender. As a result, many values have been suggested by defense analysts as necessary to achieve the needed local force ratios. Recent studies have concluded that if NATO can limit the Pact's theaterwide advantage to between 1.2 and 2.0, a Warsaw Pact invasion could be thwarted.^{8/}

This wide range of ratios, and of opinions about what ratio would provide confidence of victory, illustrates the uncertainty that faces any military planner, particularly the Soviet leaders. They cannot know ahead of time how their allies will react to a call to mobilize or how quickly NATO will respond. The theaterwide ratios determined here suggest that neither side can predict the outcome of any confrontation with certainty: the Warsaw Pact could not be confident of an easy victory, nor could NATO be sure of a steadfast defense.

Contribution of Tactical Air Forces

The relative standing of each side may also be affected by the impact of their tactical air forces, which was not considered in the ratios just discussed. Tactical air forces affect the conduct of the ground war by destroying equipment or the roads and bridges needed to move equipment. These forces consist of various types of aircraft with differing missions. Fighters and interceptors are designed to attack and destroy enemy aircraft and, by doing so, gain control of the skies. Fighter-bombers, also referred to as ground-attack aircraft, are designed to attack enemy equipment on the ground as well as targets like roads, bridges, and radar installations.

Most tallies of all the Warsaw Pact and NATO tactical aircraft throughout Europe give a significant advantage to the Pact. (The

8. John J. Mearsheimer, *Conventional Deterrence* (London: Cornell University Press, 1983), p. 174; Congressional Budget Office, *U.S. Ground Forces: Design and Cost Alternatives for NATO and Non-NATO Contingencies* (December 1980), p. 18; and Congressional Budget Office, *Army Ground Combat Modernization for the 1980s: Potential Costs and Effects for NATO* (November 1982), p. xiv.

TABLE 4. NATO AND WARSAW PACT TACTICAL AIRCRAFT IN THE CENTRAL REGION

	Before Mobilization			Ten Days After Mobilization		
	Fighters	Fighter-Bombers	Total	Fighters	Fighter-Bombers	Total
NATO	586	1,498	2,084	802	2,797	3,599
Pact	1,665 <u>a/</u>	1,204	2,869	2,015 <u>b/</u>	1,249	3,264

SOURCE: Compiled by the Congressional Budget Office based on data from International Institute for Strategic Studies, *The Military Balance, 1987-1988* (London: IISS, 1987); and The Analytic Sciences Corporation, "Preliminary Atlantic-to-the-Urals Unclassified Conventional Weapon Systems Data Base," Personal communication, Fall 1987.

- a. Includes 535 interceptors best suited for air defense.
b. Includes 795 interceptors.

estimates presented in Table 2, for example, yield a Pact/NATO ratio of 1.3 to 1.0.) Within the central region alone, however, the opposing tactical air forces appear more even. (See Table 4 and Appendix C for a more detailed listing of NATO and Warsaw Pact aircraft.) Furthermore, the composition of the Pact's air forces differs significantly from NATO's in that they include many more fighters that are interceptors designed specifically for defending the home country. Indeed, a comparison of the two sides' fighter-bomber aircraft--those most likely to influence the ground battle--within the central region shows NATO with a distinct advantage. Furthermore, most analysts credit NATO with pilots that are better trained, and aircraft and weapons that are more sophisticated, than their Pact counterparts.

Just as the WEI/WUV method attempts to reduce ground forces of differing quality to a common denominator, a similar method devised by The Analytical Sciences Corporation compares tactical aircraft.^{9/} The TASCFORM model, as the method is called, attempts to account for the superior sophistication and capability of NATO aircraft.

9. The Analytical Sciences Corporation, *The TASCFORM Methodology: A Technique for Assessing Comparative Force Modernization* (Arlington, Va.: TASC, January 1984).



Based on a simple numerical comparison, NATO aircraft outnumber Warsaw Pact aircraft in the central region by a ratio of 1.1 to 1.0 ten days after mobilization. When the relative effectiveness of each type of aircraft is taken into account using the TASCFORM model, however, the ratio increases to 1.5 to 1.0. If the Pact's interceptor aircraft are discounted because they are likely to be held back to defend home areas, the ratio increases further to 1.9 to 1.0. If the fighter-bomber category is considered alone, the ratio is even more decidedly in NATO's favor.

Thus, NATO's ground-attack aircraft may partially offset the Pact's advantage in ground forces. William Kaufmann equated the contribution of NATO's tactical aircraft to that of two and two-thirds armored division equivalents.^{10/} Adding two and two-thirds ADEs to NATO's total forces could result in about a 5 percent reduction in the Pact/NATO force ratio. Other studies have attributed even larger contributions to tactical aircraft.^{11/}

BALANCE IN CORPS SECTORS

It may not be sufficient to consider only the theaterwide or overall balance of forces within the central region. The Pact almost certainly would concentrate its forces in a few sections of the central region in hopes of penetrating NATO's lines. Once the Pact had broken through NATO defenses, NATO forces would face the difficult task of defending their rear areas as well as contending with attacks from

10. William W. Kaufmann, "Nonnuclear Deterrence," in John D. Steinbruner and Leon V. Sigal, eds., *Alliance Security* (Washington, D.C.: Brookings Institution, 1983), pp. 76 and 77.
11. In his analysis of the conventional balance in Europe, Barry Posen claims that NATO's tactical aircraft could help redress the generally unfavorable ground force ratio. He argues that in five weeks of combat, through superior weaponry and aircraft reliability, NATO ground-attack aircraft could destroy nine Pact ADEs. During the same period, he argues, Pact aircraft could destroy only four NATO ADEs, resulting in a net gain in NATO's favor of five ADEs. See Barry R. Posen, "Measuring the European Conventional Balance," *International Security*, vol. 9 (Winter 1984-1985), p. 73.

A study by the Office of the Secretary of Defense (OSD) conducted in 1979 also concluded that NATO's superior ground-attack aircraft could destroy up to 23,000 armored fighting vehicles, the equivalent of 17 ADEs, during a 30-day campaign. The study concluded that, with such a capability, "NATO's tactical air forces could significantly enhance the ground force's ability to contain a Warsaw Pact attack." (See Department of Defense, *NATO Center Region Military Balance Study, 1978-1984*, pp. II-32 and II-34.)

their front. Thus, it is important to consider not only the theaterwide balance but also the balance within each section. Individual sections, which are called corps, are designated by the name of the country defending that area and by a Roman numeral--for example, U.S. V Corps or British I Corps (see Figure 4).

An assessment of each corps is particularly important because the capabilities of the forces defending the corps vary widely. For example, in the U.S. V Corps, each of the four U.S. divisions defending the sector will soon have the advanced M1A1 tank and Bradley fighting vehicle, both regarded as superior to similar equipment in the Warsaw Pact forces. The British I Corps, however, though equipped with the Chieftain tank and the Ferret armored fighting vehicle (judged to be of about the same capability as the Soviet T-80 tank and BMP fighting vehicle, respectively) would only be defended by three divisions, each with less than half the number of tanks and fighting vehicles of corresponding U.S. armored divisions.

How great is this corp-to-corp disparity? As an illustration, CBO examined the force ratios in two corps--one from the northern area of the central region called NORTHAG and one from the central area, or CENTAG, discussed above. For the purposes of the numerical analysis, a specific corps was chosen from each section to serve as examples--the U.S. V Corps from CENTAG and the British I Corps from NORTHAG.¹² The overall assumptions in this analysis are the same as those in the middle-range case.

Assessing the balance of forces in each corps requires not only an assumption about total Warsaw Pact forces that could attack but also assumptions about *where* they attack. The assumptions in this analysis are arbitrary but plausible. The study assumes that Warsaw Pact forces make two attacks in NORTHAG and one in CENTAG (see Figure 4 and Table 5). Such a strategy seems plausible for several reasons. It would enable the Pact to mass its armored forces in the northern German plain--an area that has long been considered

12. The West German I Corps could also have served as a representative NORTHAG corps, since its capability is roughly equivalent to that of the British corps, and it is also opposite a main corridor of attack by Pact forces.

Figure 4.
Specific Corps Designations and Assumed Corridors of Pact Invasion



SOURCE: Adapted by Congressional Budget Office from Richard Lawrence and Jeffrey Record, *U.S. Force Structure in NATO* (Washington, D.C.: Brookings Institution, 1974), p. 31, and also from U.S. Army material.

NOTE: NORTHAG (Northern Army Group) and CENTAG (Central Army Group) are the two subdivisions of NATO forces in West Germany. The line dividing the two runs from Belgium through West Germany, just south of Bonn, and into East Germany.

TABLE 5. NUMBER OF ATTACKING WARSAW PACT ARMORED DIVISION EQUIVALENTS ASSUMED IN CORPS-TO-CORPS ANALYSIS

NATO Corps	Days After Soviet Mobilization			
	15	30	45	60
British I (or West German I)	15	17	19	21
U.S. V	9	11	13	15
All Other <u>a/</u>	3	3	3	3

SOURCE: Compiled by Congressional Budget Office based on Department of Defense data.

NOTE: Based on the distribution in Department of Defense, Office of the Assistant Secretary of Defense for Program Analysis and Evaluation, *NATO Center Region Military Balance Study, 1978-1984* (July 1979), until 15 days after mobilization. After that, one-third of the Pact reinforcing units is distributed to each of the three corps facing a main attack.

a. Per each of the five remaining corps facing only secondary attacks.

relatively favorable for tank warfare.^{13/} Furthermore, it would put a greater strain on NATO's NORTHAG, which has a smaller backup force than neighboring CENTAG. Finally, many defense analysts consider the NORTHAG corps to be more likely targets for the main Pact assaults because their defenses are less well equipped than those in CENTAG.^{14/}

The ratios of armored division equivalents in the two corps differ markedly (see Figure 5). Whereas, except for the fourth day after mobilization, ratios of Pact to NATO forces in the U.S. V Corps never exceed 1.5 to 1.0, those in the NORTHAG corps are, at some points, more than twice as high. Indeed, based on the assumptions used here, the force ratio exceeds 3 to 1 shortly after the Pact starts to mobilize. If this analysis, despite its shortcomings, actually reflects the likely

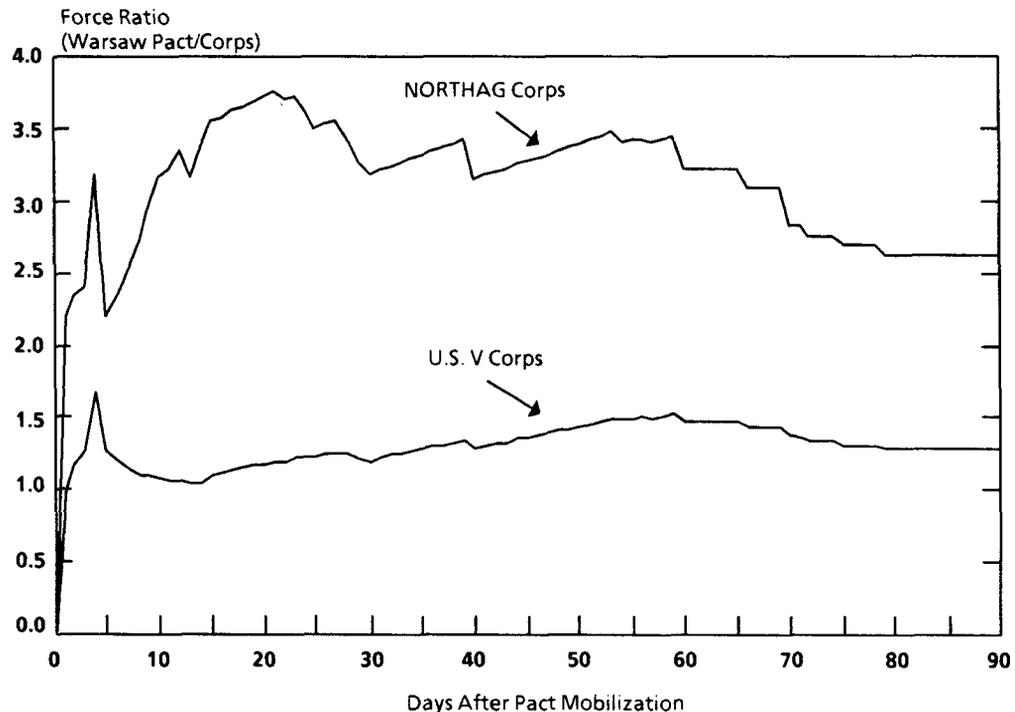
13. Although the northern German plain is better suited to armored operations than central Germany, attacking that region would not necessarily be easy. The region has numerous bogs and sinkholes and is cut north to south by several major rivers. Furthermore, much of northern Germany is being built up. Developed regions with densely packed buildings are formidable obstacles for any attacker.

14. John Barry and Russell Watson, "Can Europe Stand on Its Own Feet?" *Newsweek* (December 7, 1987), p. 31.

deployment of forces in a NORTHAG corps, the possibility of such a lopsided advantage could be seen as an encouragement, rather than as a deterrent, to a Pact attack.

As mentioned earlier in this chapter, static methods for analyzing force balances do not take many factors into account, combat losses being perhaps the most important. Dynamic methods, however, attempt to capture the effects of combat losses and, to some extent, support from tactical aircraft. Since combat conditions across a theater almost 800 kilometers wide would vary greatly, dynamic analyses are most useful when applied to the progress of combat in a particular corps sector.

Figure 5.
Illustrative Force Ratios in Two NATO Corps



SOURCE: Congressional Budget Office based on Department of Defense data.

To achieve a clearer understanding of the balance within a specific corps, this study supplemented static measures with the results from a simple dynamic model developed by Joshua Epstein of the Brookings Institution.^{15/} The model can be used to measure the combat capability and territory lost by NATO during a Warsaw Pact attack and attempts to simulate both ground combat and the contribution of each side's tactical aircraft to the ground war. (Appendix A discusses this model more fully and includes important critiques of this and other dynamic modeling techniques.)

Figures 6 and 7 reflect the results of the model's simulation of a Warsaw Pact attack with main corridors opposite the U.S. V Corps and two NORTHAG corps. The distribution of forces is the same as that assumed in generating the static force ratios shown in Figure 5. After actual hostilities commence (assumed here to be 15 days after the Pact starts to mobilize), however, the impact of combat losses is obvious. In particular, the assumed heavy combat losses in the NORTHAG corps cause the Warsaw Pact/corps force ratio to worsen progressively. Based on the dynamic analysis, the U.S. V Corps would be able to hold its own, again corroborating what would be expected based on the force ratios determined by the static method.

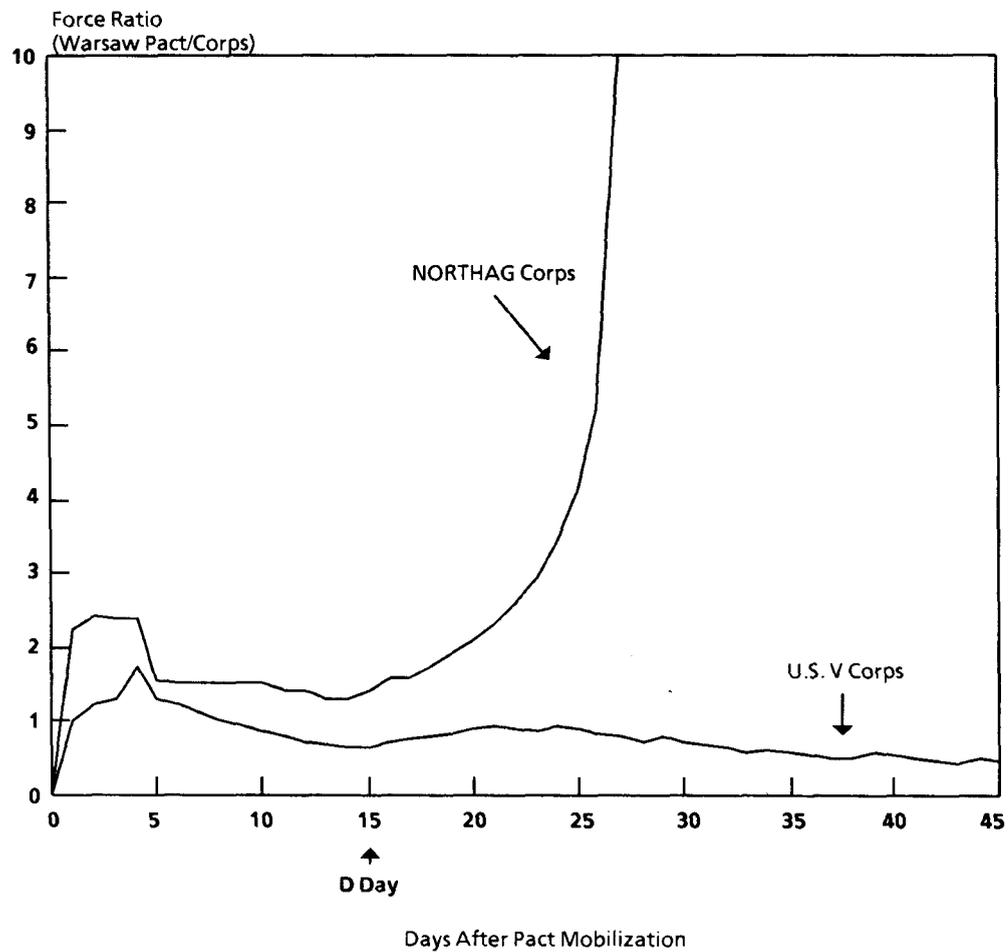
This particular dynamic model also simulates the amount of territory ceded by the defending forces as they attempt to limit their combat losses. As shown in Figure 7, much more territory would be abandoned by the hard-pressed NORTHAG corps than by the U.S. corps, which, based on the assumptions and methods associated with the model, is capable of fending off the attack.

The results of the dynamic model, as applied to individual corps sectors, should not be used to predict the outcome of a battle in those areas. Rather, they are intended as an illustration of the different types of results that can be obtained with dynamic versus static analyses. Neither method accurately reflects the actual capability of either side to conduct war, nor can either method predict the likely victor in the event of hostilities. There are too many intangibles, such as troop training and morale, leadership, and tactics, that cannot be captured by either method.

15. Joshua M. Epstein, *The Calculus of Conventional War: Dynamic Analysis Without Lanchester Theory* (Washington, D.C.: Brookings Institution, 1985).

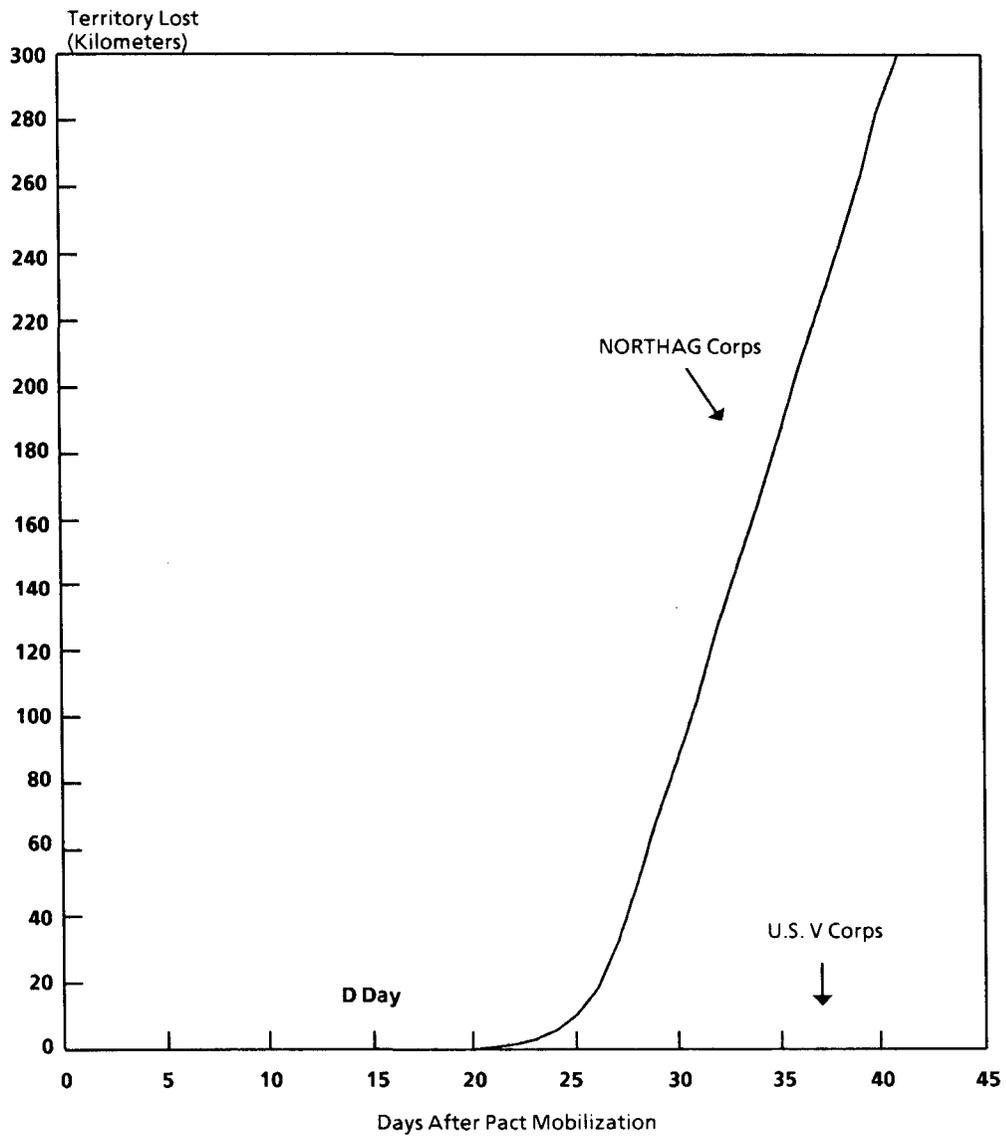
Models can, however, be used to highlight trends. In this case, it is analytically reassuring that both the dynamic and the static methods demonstrate the disparity in capability between the U.S. V Corps and a corps in NORTHAG. Because the specific force ratios

Figure 6.
Force Ratios in Two NATO Corps Based on Dynamic Analysis



SOURCE: Congressional Budget Office based on Department of Defense data.

Figure 7.
Simulation of Territory Lost in Two NATO Corps



SOURCE: Congressional Budget Office based on Department of Defense data.

NOTE: U.S. V Corps loses no territory in simulation.