

# What is the offense-defense balance and can we measure it?(Offense, Defense, and International Politics)

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**Offense-defense theory offers an optimistic view of international politics based on the argument that war can be prevented if defense gains an advantage over offense. It also argues that an effective arms control can reduce the risk of arms races and war. The theory has been useful in foreign policy analysis and in international relations scholarship since it is used to explain theoretical and policy issues and the causes of World War I and ethnic and civil wars and to predict post-Cold War Europe political relations.**

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Offense-defense theory (or security dilemma theory) is a quite optimistic theory of international politics, since it argues that when defense has the advantage over offense major war can be avoided. In addition, the likelihood of arms races and war can sometimes be further reduced by carefully designed arms control. Over the past two decades the theory has come to play an increasingly important role in both international relations scholarship and the analysis of foreign policy.(1) Scholars have employed the theory to address a wide array of theoretical and policy issues, including alliance behavior, comparative grand strategy, military doctrine, military competition and cooperation, nuclear strategy and policy, and conventional arms control.(2) Offense-defense logic has also been used to explain the causes of World War I, the causes and possible solutions of ethnic and civil wars, and the foreign policies of revolutionary states; to criticize U.S. grand strategy; and to predict the future of political relations in post-Cold War Europe as well as the size and number of independent states in the international system.(3)

Despite the theory's status as a growth industry, critics continue to question its utility. First, they argue - correctly - that the foundations of the theory are underdeveloped, holding, most important, that we lack an agreed definition of the theory's key independent variable, the offense-defense balance, which results in inconsistent application and testing of the theory.(4) Second, and more important, they contend that the theory contains inherent flaws, the most serious of which is that the offense-defense balance cannot be measured because the outcomes of wars are so uncertain.(5)

If the critics are right, a growing and influential body of international relations theory literature must be heavily discounted. Moreover, important policy implications would flow from the critics' insights. For example, the potential of arms control to maintain peace would be significantly lower and the probability of future major-power wars in Europe and Asia could be far greater than offense-defense

theorists suggest.(6)

This article responds to the critics by providing needed development of the theory's foundations and by showing that the claim that the offense-defense balance cannot be measured is simply incorrect. First, we argue that the offense-defense balance should be defined as the ratio of the cost of the forces that the attacker requires to take territory to the cost of the defender's forces. This definition of the balance is especially useful because the offense-defense balance then provides an essential link between a state's power and its military capability, that is, its ability to perform military missions.

Next, we explain six key assumptions and specifications that are required to operationalize any definition of the offense-defense balance, whether stated in terms of cost ratios or not. These are required to ensure that the balance is well defined and therefore measurable. Perhaps most important, we explain that the offense-defense balance should be assessed assuming optimality - that is, countries choose the best possible strategies and force postures for attack and defense. Offense-defense theory requires this assumption because it focuses on the effects of the constraints and opportunities presented by the international environment. As a result, states' decisions do not influence the offense-defense balance. Although poor choices about military doctrine or force posture will influence a state's military capabilities, this shortfall reflects the state's lack of military skill, not a change in the offense-defense balance.

Third, we argue that the basic logic of offense-defense theory requires what we term a "broad approach" to measuring the offense-defense balance. Some analysts favor a narrow approach in which military technology and geography are the only factors that influence the balance. However, once we define the offense-defense balance as the cost-ratio of offense to defense, all factors that could significantly shift this ratio - including such variables as the size of forces, the cumulatively of resources, and nationalism - should be included. We do, however, explain why two possible candidates - the nature of international alliance behavior and first-move advantages - should be

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excluded.

Fourth, we explore whether states can measure the offense-defense balance and find strong grounds for concluding that they can. The analytic tasks required to measure the offense-defense balance are essentially the same as those required to perform military net assessments. Most analysts believe that, within reasonable bounds, net assessment has been a feasible task and, therefore, should also believe that the offense-defense balance can be measured. We offer anecdotal evidence that supports our optimism, but in-depth empirical studies of how well states can conduct net assessments are required to resolve this question.

This article proceeds as follows. The first section provides a brief overview of offense-defense theory. The second section explains why we prefer the ratio definition and the assumptions required for operationalizing any definition of the offense-defense balance. The third section explores factors that influence the offense-defense balance, and the fourth presents our assessment of the challenge involved in measuring it. The final section recommends directions for further research.

## What Is Offense-Defense Theory?

Before proceeding we briefly summarize the propositions offered by offense-defense theory. The purpose of this article is not primarily to extend or modify this already large body of propositions. Instead, our contributions should provide confidence that these propositions are meaningful - that they are built on concepts that are well defined and that can be productively tested and applied to real-world security problems.

As originally described by Robert Jervis, the two key variables in the theory are (1) the offense-defense balance - whether it is "easier" to take territory or to defend it, and (2) offense-defense distinguishability - whether the forces that support offensive missions are different from those that support defensive missions. The basic predictions concerning the offense-defense balance are that as the advantage of offense increases, the security dilemma becomes more severe, arms races become more intense, and war becomes more likely.(7) When offense has the advantage, it is impossible for states of equal size to enjoy high levels of security simultaneously; arms races will be intense because when one country adds forces its adversary will have to make a larger addition to restore its ability to defend? Offense advantage makes war more likely for a variety of reasons: war will be quick and decisive and therefore profitable, so greedy states will find war more attractive; states will be more insecure, making

expansion more valuable, so security-seeking states will find war more attractive; and the advantage of striking first grows with offense advantage, which increases the probability of crises escalating via preemptive attacks and accidents.(9)

Stephen Van Evera has added hypotheses on how offense advantage fuels preventive war and encourages styles of diplomacy that increase the probability of war.(10) Offense advantage makes shifts in power more significant, which increases incentives for preventive war. When offense has the advantage states negotiate less and use fait accompli tactics more, and states become more secretive, which increases the probability of war by fueling miscalculations of military capabilities and interests.(11)

We envision offense-defense theory as a partial theory of military capabilities, that is, of a state's ability to perform the military missions that are required to successfully attack, deter, and defend. A more complete theory would include two additional variables: (1) power, measured in terms of relative resources; and (2) what we term "military skill," that is, a country's ability to effectively employ military technology, including designing military strategy and assessing adversaries' forces and strategy.(12) Offense-defense theory does not claim that the offense-defense balance is in general a more important determinant of military capabilities than is power or skill. Rather, each of the three variables has the potential to overwhelm the others in certain circumstances.

Offense-defense variables play a central role in recent work on structural realism - for example, defensive and contingent realism.(13) Unlike Kenneth Waltz's version of structural realism,(14) which focuses on power or the distribution of resources, these versions of realism focus on states' abilities to perform necessary military missions. Consequently, these theories need to introduce a variable that reflects a state's ability to convert power into military capabilities. This variable is the offense-defense balance.

These alternative versions of structural realism produce a number of explanations and predictions that diverge significantly from standard power-based structural realist analyses. For example, balance-of-power theory is indeterminate about the tightness of alliances, whereas defensive realism predicts that alliances will be tight when offense has the advantage, but loose when defense has the advantage. In addition, neorealist balance-of-power theory is pessimistic about the prospects for peace in a multipolar world, but contingent realism is optimistic if technological or other conditions strongly favor defense over offense, as can be the case in a world of strategic nuclear weapons.

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## Defining the Offense-Defense Balance

To measure the offense-defense balance, we must first define it. Adequately developing a definition is more complex than may be apparent, requiring that we spell out a number of assumptions and specifications that are rarely, if ever, recognized. This exercise is essential, because a variable that is not well defined cannot be measured reliably. In this section we make the case for defining the offense-defense balance as the cost ratio of attacker forces to defender forces. We then explore the additional requirements that are a necessary part of any definition of the balance.

## THE COST (INVESTMENT) RATIO OF OFFENSE TO DEFENSE

The offense-defense literature includes many different definitions of the offense-defense balance. Among these are that offense has the advantage (1) when "it is easier to destroy the other's army and take its territory than it is to defend one's own";(15) (2) when the defender has to outspend the attacker to offset an investment in offensive forces;(16) (3) when the costs of capturing territory are less than the value of the territory itself;(17) (4) when there is an incentive to strike first rather than to absorb the other's first strike;(18) (5) when a large portion of states' territory is likely to change hands as a result of war;(19) and (6) when weapons possess certain characteristics, for example, long range and especially mobility.(20)

We prefer to define the offense-defense balance as the ratio of the cost of the forces the attacker requires to take territory to the cost of the forces the defender has deployed.(21) That is, if the defender invests  $X$  in military assets, how large an investment  $Y$  must the attacker make to acquire the forces necessary for taking territory?(22) The offense-defense balance is the ratio  $Y/X$ .(23) Larger ratios indicate a balance more in favor of defense.

We arrive at our choice by focusing on the theoretical role that the balance needs to play. As we reviewed above, the offense-defense balance is one of two key variables, along with power, that determines states' abilities to perform military missions.(24) When we analyze whether a state can protect itself against potential adversaries, we need to know not only the relative resources (wealth, population, etc.) of the state and its adversaries, but also how effectively these resources can be used to produce offensive and defensive military capabilities.

Given this ratio definition, the attacker's power (i.e., the ratio of the attacker's resources to the defender's resources) divided by the offense-defense balance

indicates the attacker's prospects for successful offense. All else being equal, the larger this quotient, the greater the attacker's prospects for success.

Defined as the cost ratio, the offense-defense balance plays the proper role, in combination with power (and skill), in determining a state's potential military capability and therefore its ability to maintain its security, as well as attain other nonsecurity goals. For example, the balance can sometimes overcome disparities in states' resources. When defense has a large advantage, even a state that is much smaller than its adversaries may still be able to afford effective defense. Conversely, power imbalances can sometimes overwhelm the offense-defense balance. Even if defense has a large advantage, a much wealthier attacker might still be able to outspend a defender by a sufficient margin to gain an effective offensive capability.

## SPECIFICATIONS AND ASSUMPTIONS

Any definition of the offense-defense balance, whether or not based on cost ratios, requires a number of additional specifications and assumptions without which the balance is not well defined and cannot be measured. This section explains the requirements.(25)

## COST OF FIGHTING.

The attacker-to-defender cost ratio is not well defined until we specify the costs of fighting that the attacker would incur. This is because the cost of forces required to take territory varies with the costs of fighting the attacker would incur: all else being equal, more capable and expensive forces can usually take territory at lower costs of fighting than can less capable forces.(26)

Consequently, we need to set a cost of fighting at which the offense-defense balance will be defined. A useful way is to employ the conservative defense planning standards that are traditionally employed by defenders, which assume that other states may have very ambitious expansionary objectives and may be deterred only by the prospect of suffering extremely high losses in a war for such objectives.(27) With the cost of fighting set this way, the offense-defense balance will be the minimum investment ratio at which the attacker can not only take territory but can do so at an acceptable cost of fighting.

Operationalizing "extremely high" requires making subjective, contentious choices, but standards that are frequently used in analyzing security policy provide reasonable guidelines.(28) In the realm of modern conventional war, a typical standard is that virtually all states will value territory less than the costs of fighting a

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war of attrition, but that a determined expansionist might be willing to accept the costs of a successful blitzkrieg.(29) Importing this assumption into offense-defense theory means that we calculate the offense-defense balance by comparing the cost of forces the attacker requires to launch a successful blitzkrieg to the cost of the defender's forces.

In the nuclear realm, we focus on comparisons of the attacker's value for territory to the costs that the attacker would incur as a result of nuclear retaliation against its society. During the Cold War, an assured destruction capability was the standard most commonly used in gauging the adequacy of U.S. forces.(30) Given this standard, taking territory at an acceptable cost of fighting translates into the ability to eliminate the defender's assured destruction capability. The offense-defense balance would be the ratio of the cost of forces required to undermine the defender's assured destruction capability to the cost of the defender's forces. If we chose a lower level of retaliatory damage as our standard, the attacker's forces would have to be more effective, shifting the offense-defense balance further toward defense advantage.(31)

### ATTACKER'S TERRITORIAL GOAL.

The offense-defense balance depends on how much territory the attacker is trying to take. More ambitious offensive missions, those that are designed to take more territory, tend to be more difficult than less ambitious ones. Facing a given defensive force, the offensive force required for a more ambitious mission will have to be larger, more technologically advanced, or both, than would be required for a less ambitious mission. Consequently, the cost ratio of offense to defense increases with the ambition of the offensive mission, which shifts the offense-defense balance toward defense advantage. Therefore states will often face different offense-defense balances for different territorial goals, which may influence their behavior.(32)

Two examples illustrate the mission dependence of the offense-defense balance. The first compares the conventional forces required for gaining limited amounts of territory and for unlimited-aims offensives.(33) Limited aims are usually easier to achieve. Among the reasons are that the greater the distance the attacking forces must advance, the longer their supply lines and the shorter the defender's; and that the larger the area of enemy territory the attacker must occupy, the greater the cost of occupation. Thus the balance for a limited aims offensive often is more favorable to offense than would be the balance for an unlimited goal.(34)

The second example compares the nuclear forces required for an attacker to successfully challenge a defending state's minor interests to those required to successfully challenge its vital interests. When only minor interests are at stake, the balance of interests, and therefore the balance of resolve, may not favor the defender. Thus an attacker's nuclear threat could be effective even if the defender's nuclear retaliation would inflict equal or greater damage on the attacker, so the attacker may not need nuclear forces more capable or more expensive than the defender's. In contrast, a nuclear attacker challenging a defender's homeland would almost certainly face an unfavorable balance of resolve, and therefore would require a nuclear counterforce capability that could ensure that it would suffer far less damage in a nuclear war than would the defender. Attaining such a capability would certainly require the attacker to spend much more than the defender.

### WARS, NOT BATTLES.

We argue that of the three levels of war recognized by most analysts - strategic, operational, and tactical - the offense-defense balance should be defined at the strategic level.(35) Offense-defense theory addresses states' decisions about whether to go to war based on their judgments about whether war is likely to be successful. Consequently, when we say "take territory" we really mean "take and hold territory against counterattacks," because seizing territory only to lose it thereafter would not seem worthwhile to most attackers.(36) Thus the offense-defense balance should be defined in terms of final war outcomes, not the results of intermediate battles or campaigns.(37)

This is not to say that tactical and operational analyses are irrelevant to the balance. To gain territory an attacker must conduct offensive tactical battles and offensive operations, and to hold territory once gained may have to engage in tactical and operational defense.(38)

### OPTIMALITY.

As a structural theory, which attempts to predict states' behavior by focusing on the constraints and opportunities presented by their external environment, offense-defense theory must assume that states act optimally.(39) That is, within reasonable limits of analysis, states make the best possible decisions for attack or defense, taking into account their own and their opponents' options for strategy and force posture. In other words, all relevant countries are assumed to have a high level of military skill.(40) Thus the offense-defense balance is the cost ratio of the attacker's best possible offense to the defender's best

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possible defense.

Because the offense-defense balance is defined assuming optimality, military doctrines and force deployments cannot influence the balance. Instead, when states act optimally, doctrine and deployments merely reflect the balance; they are outputs of the optimization process, given the constraints imposed by the offense-defense balance and the distribution of resources. Suboptimal choices will influence a state's deployed capabilities but not the offense-defense balance.(41)

This also means that when states do engage in suboptimal behavior, our ability to determine the offense-defense balance by observing military policies and war outcomes is greatly reduced. Because states have chosen the wrong forces and/or doctrines, comparing the states' capabilities for offense and defense sheds little light on the offense-defense balance. For example, early in World War II the Germans had already deployed forces and doctrines that took advantage of improved motor vehicles, portable radios, and other interwar innovations that made the blitzkrieg possible, but the Allies had not. Consequently, to evaluate the impact of these innovations on the offense-defense balance, we should focus not on the evidence from 1939-40, but instead on evidence from 1943-45 when the Allies had also realized the uses of these technological advances and deployed appropriate forces and doctrines on a broadly even footing with the Germans.(42)

Actual state behavior is not always optimal, but analysis performed assuming optimality remains useful. First, if state behavior is usually responsive to structural constraints, even if not optimal, a structural theory may predict well.(43) Second, the optimality assumption is useful in formulating policy because states should often assume that their opponents will act optimally. Finally, we need to assume optimality in order to assess whether states have acted suboptimally and to appreciate the implications of policy errors. For example, if under optimality defense has a large advantage, then states will have to adopt very bad policies before offensives will be successful. Deploying nuclear weapons in vulnerable basing modes is clearly suboptimal, but given the enormous destructive potential of nuclear weapons, even highly vulnerable basing may leave adequate capabilities for deterrence.

Although the offense-defense balance is most often applied to situations in which both countries have access to the same means for converting resources into military capabilities, in practice states do not always have access to the same geography, technology, or forms of political

organization, especially if they have unequal resources.(44) Thus states face asymmetric opportunities and, even with optimal behavior by both sides, the different constraints may result in asymmetries in states' force postures. Examples include the inability of revolutionary France's absolutist enemies to recruit equally committed citizen-soldiers, and the inability of Japan or Germany to deploy nuclear weapons during World War II.

Under such asymmetries, the offense-defense balance will depend on which country is the attacker, because asymmetric development of an innovation will usually enable the advantaged country to do better both on offense and on defense, even if symmetric deployment of that innovation would strongly favor defense (or offense). For example, although the nuclear revolution strongly favors defense, in the 1940s the United States might have been able to use its nuclear monopoly to conquer the Soviet Union. Consequently, under such asymmetries the offense-defense balance shifts toward offense when the advantaged state is the attacker and toward defense when it is the defender.(45)

The offense-defense balance that would exist if both countries had deployed the innovation, that is, the balance for the symmetric case, does provide information that is useful for understanding the asymmetric case. Because technology lags usually erode, the symmetric case helps us understand the future offense-defense balance that the innovation will eventually create. States' behavior under asymmetry will be influenced by their expectations about this future balance.(46)

## DYADIC, NOT SYSTEMIC BALANCES.

The offense-defense balance is well defined only for specific dyads of states, not for the entire international system. As we discuss below, the offense-defense balance depends on a number of diverse factors - including geography, cumulativeness of resources, and nationalism - some of which are often not shared across dyads. Consequently, the offense-defense balance will frequently vary across dyads.

Whether the international system or a region within it can be usefully characterized in terms of a single value of the offense-defense balance depends on the nature and extent of variation in the factors that influence the relevant dyadic balances. Offense-defense theory will make predictions that hold across the system when factors that do not vary across the system dominate those factors that do vary. The most obvious example is nuclear weapons: this technology so heavily favors defense that when all the major powers have nuclear weapons variation in other

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factors becomes relatively unimportant.

## THE COMPOUND OFFENSE-DEFENSE BALANCE.

As noted in our discussion of asymmetry, within each dyad of states there are really two offense-defense balances: one with state A as the attacker and state B as the defender, and one with B attacking A. These two "directional balances," as we call them, will sometimes be identical - the symmetric case - but will be unequal when one state has advantages over the other in one or more of the factors that influence the balance (e.g. technology or geography). For example, before 1914 the Vosges Mountains on the French side of the Franco-German border would have hindered any German offensive against France on that front but not vice versa.(47)

In such cases the directional balances alone can answer some of the questions posed by offense-defense theory (e.g., whether a certain greedy state is likely to succeed in conquering a particular target), but will not be sufficient to answer the two most important questions posed by the security dilemma: whether a security-seeking state should choose a defensive strategy for protecting its territory, and whether there are possible force postures that would allow both states to be secure.

To answer these questions, we introduce the "compound balance." A status quo state's preference for offense or defense depends on the cost of defending its territory with a defensive strategy compared to the cost of doing so with an offensive strategy. Each of the two directional balances, however, can supply only half of the answer. Within a dyad, the balance with the state as defender tells us how much it must invest to succeed on the defense, but nothing about the cost of an offensive approach. The other directional balance - with the same state as the attacker - tells us the cost of an offensive strategy but not that of a defensive one. The state's strategy preference is determined by the arithmetic product of the two balances - the compound balance. If the product is greater than 1, the state can defend at lower cost than it can attack and therefore should prefer a defensive strategy; if less than 1, it can attack at lower cost than it can defend and should prefer an offensive strategy.(48)

For instance, suppose that the directional balance with the state on defense is 1 to 2 (favoring offense) and the one with it on offense is 6 to 1 (favoring defense). The compound balance is  $1/2 \times 6 = 3$ . Because this value is greater than 1, the state should prefer defense, even though the directional balance with the state on defense favors offense. Given that both directional balances are unfavorable, this state cannot be secure unless it

outspends its opponent, which it may not be able to do. No matter how adequate or inadequate the state's resources, however, it will be better off choosing defense, because offensive strategies would cost three times as much to reach the same level of capability.

This discussion rarities three important points. First, the most common usage of the concept of the offense-defense balance - the directional balance - does not determine whether security-seeking states should prefer offense or defense. This depends not on either directional balance but on whether their product is greater or less than 1. Second, security-seeking states' preferences for offense or defense are often much stronger than would be suggested by looking at either directional balance, even in the case of symmetry. Given that the relative cost of offense and defense is provided by the product of the two directional balances, whenever both are greater than 1 (or both are less than 1) the compound balance will reveal a more extreme offense-defense cost ratio than either directional balance alone. For example, consider a dyad for which the offense-defense balance is 3 to 1 in each direction. Assume that one state spends X on offense. To have an adequate defense, the second state needs to spend only X/3. If the second state chooses to fight on the offense, however, then the 3 to 1 ratio works against it, and it must spend 3X to succeed. The compound balance is  $3 \times 3 = 9$ ; successful offense would cost 9 times as much as successful defense. Third, whether or not the directional balances in a dyad are symmetric, both countries always face the same compound balance. Therefore, if both are pure security seekers, they will always have the same preference for offense versus defense.(49)

## Factors That Influence the Offense-Defense Balance

In this section we make three points. First, we argue that the basic logic of offense-defense theory requires a "broad" approach to operationalizing the offense-defense balance, in contrast to what we call the "narrow" approach that includes only technology and geography. Second, we enumerate the major causal factors that we believe should be included in operationalizations of the offense-defense balance - technology, geography, force size, nationalism, and cumulativity of resources. Third, we explain why two factors that are sometimes included in a broad approach - alliance behavior and first-move advantages - should be excluded.

## BROAD VERSUS NARROW APPROACHES TO OPERATIONALIZING THE BALANCE

Offense-defense analysts are divided over how widely to cast their nets in identifying the causal factors that

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determine the balance. Advocates of the narrow approach argue that measures of the balance should incorporate only technology and geography variables,(50) whereas proponents of the broad approach include many additional, often diverse factors.(51)

Critics of the broad approach argue that it makes the offense-defense balance impossible to calculate and the theory impossible to use.(52) This objection has merit because increasing the number of factors does heighten the difficulty of measuring the balance. Moreover, given that offense-defense theory focuses on military capabilities, it may seem natural to limit analysis to the most obviously military inputs.

Nevertheless, the purpose of the theory, which is to explain states' decisions based on expectations of how structural constraints will mold military outcomes, requires the broad approach because these expectations are often influenced by factors in addition to technology. An attempt, for example, to measure the strategic offense-defense balance in Europe in 1939 that omitted the possible impact of cumulative resources would not have been helpful in estimating the likely outcome of a major war or in predicting the behavior of Germany or of other states.(53)

Equally important, the broad approach is required because appropriate operationalizations must follow from the definition of the balance. Once we have defined the offense-defense balance as the cost ratio, in principle our operationalization should include all material factors that can have a sizable impact on this ratio. In practice, however, we may have to exclude certain factors that make measurement especially difficult or create problems of logical consistency. In addition, parsimony versus power trade-offs are always present, so for some research questions it may be useful to omit certain factors even though they are tractable. For instance, a measure of incentives for a strategic nuclear arms race in the year 2000 could probably ignore geography and cumulativeness of resources, but a measure of incentives for an arms race in Europe in 1900 could not.

### CRITICAL FACTORS

Changes in any one of the following factors can have a significant effect on the offense-defense balance, making offensive projects feasible that would be otherwise be infeasible and vice versa: technology, geography, force size, nationalism, and the cumulativeness of resources.

### TECHNOLOGY.

The factor most frequently cited as influencing the

offense-defense balance is technology. The offense-defense impact of a specific weapons or technology innovation cannot be assessed simply by considering its performance properties in isolation; rather, we must assess its impact on states' abilities to perform offensive and defensive missions. The most critical question in this process is how the innovation differentially affects advancing forces and nonadvancing forces.(54) Innovations that are usable only or primarily by nonadvancing forces will tend to favor defense, while innovations that are equally usable by forces that are advancing into enemy-controlled territory will favor the offense.(55) Six major areas of technology are relevant: mobility, firepower, protection, logistics, communication, and detection.

The most widely agreed proposition is that improvements in mobility favor offense.(56) Only offense inherently requires mobility; a force that cannot move cannot attack, and a defender that can hold its positions need not move. The critical issue, however, is the relationship between the two stages of a successful offensive: the attacker must first achieve a breakthrough by defeating or destroying a section of the defender's front; the attacker must then exploit this breakthrough to advance into the defender's rear.(57) Breakthrough is logically and temporally prior to exploitation, and substantively more important because the issue of exploitation arises only if and when breakthrough succeeds.

Improvements in operational mobility (the ability to move, supply, and concentrate forces for battle), such as the introduction of motor trucks, mobile bridging equipment, and long-range combat aircraft, improve the attacker's ability to outflank the defender or concentrate to assault the defender's weakest points.(58) Increases in tactical mobility (the ability to move under fire and survive), such as the introduction of tanks, reduce the attacker's losses while assaulting defending positions.(59) Thus increases in mobility make breakthroughs more likely and therefore generally favor offense.

The implications of mobility for exploitation and counterexploitation operations are less clear, because in this phase both sides may be maneuvering to concentrate or attack enemy forces simultaneously. Within the exploitation stage, it is not clear whether the attacker or defender is favored by increases in mobility. The likelihood of reaching this stage, however, depends on the offense-defense balance in the breakthrough stage, including mobility. Thus, whenever achieving a successful breakthrough is difficult or uncertain, mobility improvements will favor offense. Only when attack is so easy that a successful breakthrough is virtually assured

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does the impact of mobility become indeterminate.

Nearly all historical advances in military mobility - chariots, horse cavalry, tanks, motor trucks, aircraft, mobile bridging equipment - are generally considered to have favored the offense, while major countermobility innovations - moats, barbed wire, tank traps, land mines - have favored defense. The effect of mobility improvements, however, does depend on whether they are equally usable by attackers and defenders, which in turn depends on their dependence on infrastructure. Railroads, which depend on elaborate networks of infrastructure which can easily be destroyed by retreating defenders but which cannot be extended quickly, are much more useful to forces operating in friendly controlled territory than they are to advancing forces. Thus they favor defense in comparison with motor trucks or helicopters, which require less infrastructure and so can more easily operate at or near the spearhead of an advance.

Improvements in firepower are generally considered to favor defense on essentially the reverse of the logic that applies to mobility. In battle, attackers are usually more vulnerable to fire than are defenders because they must advance, often in plain sight of defenders, making them easy to detect and to hit, whereas defenders are often well dug-in and camouflaged. Firepower innovations usually considered to have favored defense include machine guns in World War I, infantry antitank weapons during World War II, and antitank guided missiles (ATGMs) and surface-to-air missiles today. At the operational level, the need to concentrate forces to achieve local superiority means attackers are often more vulnerable than defenders to area-effect weapons such as artillery and tactical nuclear weapons.(60) As with mobility, there can be exceptions when specific firepower innovations are differentially useful against defenders, such as heavy siege artillery before World War II, whose main use was against fixed fortifications, or today's antiradiation missiles, whose function is to attack air defenses.(61)

The effects of innovations in protection, logistics, communication, and detection are more varied, depending on how specific innovations interact with force behavior; those whose full benefit can be realized only by nonadvancing forces or only against advancing ones will favor defense, whereas those with benefits that are equally available to both advancing and nonadvancing forces will favor offense (at least compared with technologies of unequal usefulness). The earliest tanks strengthened the offense mainly because they provided troops with protection that, unlike trenches and bomb shelters, they could take with them as they advanced. Military communications based on land-line telephones favor

defense compared with systems based on portable radios. Early radar, which could detect incoming enemy aircraft but not stationary ground targets, favored defense compared with modern downward-looking systems such as airborne warning and control systems and joint surveillance target attack radar systems, which can detect low-altitude aircraft and land vehicles deep in enemy territory.

### GEOGRAPHY.

The implications of geography are perhaps the least controversial of all the factors that affect the offense-defense balance.(62) Generally speaking, barriers to movement, cover, and distance all favor defenders more than does the absence of these conditions.

First, terrain that slows or channelizes movement, or that strains logistics, strengthens the defense more than terrain that does not. This includes forests and swamps with few roads, mountains with few passes, and rivers with few bridges, or simply any region with sparse infrastructure. Such barriers channelize advances into the few roads, bridges, or passes that are available, thus reducing the defender's intelligence difficulties as well as shortening the length of front requiring serious defense. Sparse infrastructure also limits logistic throughput, decreasing the amount of force that the attacker can deploy forward of the barrier even after crossing it. NATO plans for defending West Germany focused on the North German plain and the Fulda Gap in the south because these were the only two places along the inner German border where major mechanized offensives seemed feasible.

Second, terrain that provides cover in which defenders can hide - such as forests, mountains, and cities - strengthens defense. Cover reduces the speed at which an attacker can advance because the attacker must reconnoiter every possible location that could hide an ambush. The denser the cover - the more hiding places per unit of area - the more the attackers' speed is reduced.(63) Attackers often prefer to avoid areas of dense cover if at all possible, in which case the cover has a channelizing effect rather than a delaying effect.(64)

Finally, distance favors defense. If the attacker must travel a considerable distance just to reach the defender's territory, the amount of force it can project is reduced by the costs of transporting and supplying the projected force, as well as the costs of defending long lines of communication. The Atlantic and Pacific Oceans have always made it difficult to invade the United States, and would make it difficult for the United States to attack opponents overseas unless it had allies in the region. If the



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intervening distance is not water but land occupied by neutral or hostile states, the costs of overcoming their resistance may further reduce the attacker's ability to project power against the ultimate defender.(65)

More than other factors, the impact of geography is often asymmetric. When Syria held the Golan Heights, they reduced Israel's offensive options against Syria but not vice versa. Before World War II, Britain was secured by a water barrier against German attack, while Germany's open western frontier still left it vulnerable to Britain and its continental allies. In such cases, the effect of geography is to shift one directional balance of the dyad toward defense, while the other is unaffected or even shifted toward offense.

### FORCE SIZE.

The offense-defense balance can depend on the size of the forces deployed. At least two examples of this phenomenon are readily available. First, many analysts argue that the prospects for success in conventional offensives depend not only on force-to-force ratios but also on force-to-space ratios, that is, the size of forces in relation to the length of the front. The basic reason is that the defender's ability to compel the attacker to make expensive frontal assaults depends on being able to man all viable axes of advance thickly enough that the attacker cannot achieve a quick breakthrough by overwhelming a weakly held area. Thus the offense-defense balance generally shifts in favor of the defense as force size increases.(66)

Second, nuclear offense, which is usually evaluated in terms of the ability to reduce an opponent's retaliatory capability below a specified "assured destruction" level, becomes more difficult as force size increases. As the size of the defender's force increases, maintaining a given probability of success requires either a larger ratio of attacker forces to defender forces or more sophisticated attacker forces, or both. Thus nuclear offense-defense balances shift in favor of the defense as force size increases.

### NATIONALISM.

Nationalism can influence the offense-defense balance in two ways. First, to the extent that people are imbued with nationalist consciousness, they may become willing to fight harder for territory that they understand to be part of their national homeland and less willing to fight for other territories.(67) As a result, provided that prewar borders more or less match nationalist claims, an attacker will have to invest more to defeat a given defender than would

otherwise be the case.(68) Second, nationalism can provide the defender with a wartime extraction advantage, enabling the defender to forgo some peacetime military investment, thereby further shifting the balance. One implication of nationalism is that, at least in much of Europe, South and East Asia, and the Americas, values of the offense-defense balance should generally be more favorable to defense in today's "age of nationalism" than they once were.

### CUMULATIVITY OF RESOURCES.

Attackers can sometimes pay part of the cost of achieving expansionist objectives with resources extracted during the war from parts of the target territory itself. Such "cumulative resources" reduce the requirement for military investment before the war, thus shifting the balance in favor of offense.(69) Examples include Germany in 1939 and Japan in 1941, both of which realized that their domestic resources were insufficient to achieve their planned conquests and expected to "bootstrap" their campaigns using captured resources.(70) Relevant resources may include both natural resources extracted directly from occupied territory, as well as productive effort which can be obtained from the occupied population.(71)

The extent to which resources from captured territories are cumulative depends not only on the resources extracted by the attacker, but also on the costs to the attacker of extracting them, including costs of controlling the occupied population and of repairing sabotage. The degree of cumulativeness is therefore affected by the fierceness of popular resistance and by the organization and technological level of the local economy.(72) If resistance is fierce, it may be impossible for the attacker to achieve a net gain in resources. In addition, the extent of cumulativeness depends on the resources lost by the dispossessed defender. If the attacker can seize or destroy resources the defender planned to employ, then the attacker can invest less, which shifts the balance toward offense. The overall degree of cumulativeness equals the attacker's net gain in resources plus the defender's loss of resources.

The term "cumulativeness of resources" is also often used in a second sense, referring to the postwar effects on the international balance of power of resource changes resulting from conquest, rather than to intrawar effects. In fact this use of the term is more common than ours.(73) This kind of cumulativeness, however, does not affect the requirements for the conquest itself, and therefore does not directly affect the offense-defense balance. Although it does not reduce the prewar investment ratio required to take territory, postwar cumulativeness may still affect the probability of war by increasing prospective attackers'

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assessments of the value of taking territory. Thus reasonable assumptions about states' values for territory in an environment where cumulativity is high will be different than when it is low.

### EXCLUDED VARIABLES

Although both the nature of international alliance behavior and first-move advantages can have large effects on war outcomes, we exclude both from our operationalization of the offense-defense balance, although for different reasons. We exclude alliance behavior on theoretical grounds; although alliances affect the probability of offensive success, they do so in ways that lie outside the offense-defense balance. First-move advantages, by contrast, should be excluded because including them would introduce logical incoherence in the definition of the balance that we see no way to resolve.

### NATURE OF INTERNATIONAL ALLIANCE BEHAVIOR.

Some offense-defense theorists suggest that the balance is affected by the nature of international alliance behavior - that is, whether balancing or bandwagoning is the norm. Bandwagoning is said to favor offense, balancing defense.(74) While balancing certainly does increase an attacker's problems, we conclude that alliance behavior is best excluded from the offense-defense balance for three reasons.

First, and most fundamental, including alliance behavior in the offense-defense balance is inconsistent with the central goal of offense-defense theory.(75) The goal of offense-defense theory (and of structural theories generally) is to explain the behavior of states based on the material constraints imposed by the international system. Although other states' alliance decisions could influence an attacker's prospects, including this effect in the offense-defense balance would mean that the balance would then be translating one type of state behavior into another type of behavior, not structural constraints into behavior. Because alliance choices can depend on nonstructural factors, states' intentions among them, including alliance behavior would create an offense-defense balance that lies outside the structural boundary of the theory.

Second, alliance behavior may often be determined in part by the offense-defense balance itself, so that including it as a factor influencing the balance would create an intractable circularity in which the balance depends on alliance behavior, which in turn depends on the balance. A theory of alliance behavior that could separate endogenous and exogenous effects would be complex,

and has not been developed.(76)

Third, a complete theory of alliance behavior requires dyadic offense-defense balances as an input variable, because states decide their alliance choices based in part on the offense-defense balance between likely frontline adversaries.(77) Consequently, we must start with an offense-defense balance that excludes alliance behavior.

Our argument has significant implications for the current literature. The most extensive test of offense-defense arguments has been performed by Van Evera, who attempts to predict outcomes based on both a "military offense-defense balance" (which corresponds to the offense-defense balance as we define it) and a "diplomatic offense-defense balance" (whether states tend to balance or bandwagon).(78) Van Evera finds strong support for the main propositions of offense-defense theory. He does not, however, explore how well the military offense-defense balance does on its own, nor does he offer a theory that explains how much of alliance behavior is explained by the offense-defense balance and how much by other factors. As a result, we cannot determine from his analysis how much variation in the incidence of war is explained by an offense-defense balance that is defined only in terms of structural constraints.

In addition, a state's contribution to Van Evera's combined offense-defense balance (i.e., the balance including the effects of alliance behavior) is a function not only of its willingness to balance but also of its capability, thereby including power in his definition of the offense-defense balance. Bundling in power, however, would mean that the balance then represents not the relative ease of offense compared to defense, but instead measures an attacker's prospects for winning a particular war. For example, when Van Evera says that the relative decline of British power in the late nineteenth century shifted the balance in favor of offense, he does not mean that European states in general became easier to conquer, but rather that given Britain's likely alliance choices, British decline improved Germany's chances of winning in an offensive war against France or Russia.(79) Thus Van Evera is describing an effect of a shift in relative power, not of a shift in the offense-defense balance as we define it.

A better way to incorporate alliance behavior into a structural theory of military capabilities is to understand it entirely in terms of its impact on the balance of power between opposing sides. Given a theory of alliances, which could depend in part on dyadic offense-defense balances, states could then predict which alliances were likely, thus identifying the likely sides in a conflict. We could then define a "coalition offense-defense balance" as

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the ratio of investment required by the attacking side to take territory from the defending side in a conflict.(80) Given this formulation, adding allies to a side increases that side's power, but might or might not yield a coalition offense-defense balance different from the frontline dyadic balance. The coalition balance might be different if, for instance, the war were likely to be fought on multiple fronts with differing geography, or if the nationalism of some members of one or both alliances was more fully engaged in the dispute than that of others.(81)

## FIRST-MOVE ADVANTAGES.

A first-move advantage - sometimes called a "first-strike advantage" - exists when the sides' military prospects in a potential conflict differ depending on which side acts first. We prefer the term "first-move advantage" because the important action need not involve actual combat; examples of first moves include raising standing forces to a higher level of alert, calling up reserves, moving forces to positions from which they can defend (or attack) more effectively, and actually firing on opposing forces or territory.(82)

Many formulations of offense-defense theory have treated first-move advantages as an important factor that influences the offense-defense balance. The argument is that the larger the first-move advantage, the greater the dominance of the offense.(83) We believe, however, that treating first-move advantages as part of the offense-defense balance would create confusion. First, whenever there is a first-move advantage, a directional balance that attempts to incorporate its impact will not be well defined.(84) By definition, if there is a first-move advantage, the investment ratio that the attacker requires for success is different depending on which side moves first. The attacker - the side attempting to take territory from the other - will not always be the side that moves first, however. Whenever a first-move advantage exists, the defender will have an incentive to move first, even if the defender has no ambition, or even any possibility, of taking any territory from the attacker. First-move advantages are always mutual; both sides have an incentive to move first, if only to avoid the consequences of letting the other side move first.(85) The result is that a first-move advantage will not always help the attacker, because its existence makes uncertain which side will move first. Thus incorporating a first-move advantage into the offense-defense balance would yield two balances and no obvious way to choose between them.

Second, including first-move advantages in the offense-defense balance would mean that the balance would vary with the level of alert at which states place their

forces, with the result that the balance would vary with political conditions and would change during crises. Consequently, even if we knew which side was going to move first, the balance would not be well defined.

For these reasons, we define the directional balance by assuming that first-move advantages are zero. To assess the balance given this assumption, we envision wars in which offensives are launched after the country that moves second has had the opportunity to react to the other's first move, thereby offsetting the advantage of the first move. For example, when first-move advantages reflect the value of mobilizing first, we assess the balance assuming that both countries fully mobilize before the attacker launches its offensive. We choose this assumption not because it is empirically reasonable, but because it is useful for separating the effects of the offense-defense balance and of first-move advantages.

## Measuring the Offense-Defense Balance

A common criticism of offense-defense theory is that the offense-defense balance cannot be measured, and therefore, the theory cannot predict or explain anything. According to this argument, war is too complex and too poorly understood to predict outcomes with any degree of confidence. For example, Colin Gray argues that "policymakers can never know reliably in advance the costs of the military decision they seek."(86) If we cannot estimate whether an attacker will succeed, then we cannot measure the offense-defense balance.(87)

We argue that critics have overstated the difficulty of measuring the balance for four reasons. First, they have exaggerated the difficulty of integrating across levels of warfare. Second, the analytical tasks required to measure the offense-defense balance are the same as those required for military net assessments, a task for which capable analytic tools exist. Third, the precision with which the theory requires the balance to be measured is often lower than critics may realize: ballpark estimates of the balance are sometimes sufficient to provide the theory with substantial predictive and explanatory capabilities. Fourth, critics are mistaken when they argue that the indistinguishability of offense and defense makes measurement of the balance impossible.

## INTEGRATING ACROSS LEVELS OF WARFARE

Since the offense-defense balance is defined at the level of whole wars, but many of the factors that influence it have their direct impact only at the tactical or operational levels, measuring the offense-defense balance requires integrating effects across the tactical, operational, and

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strategic levels. This integration problem breaks down into two parts: direction and magnitude.

Assessing the direction of effect is normally straightforward: a change that shifts the balance in a given direction at one level will usually also shift it in the same direction at all higher levels. Since any strategic offensive necessarily requires offensive operations, and offensive operations require offensive tactical battles, a change that makes tactical offense harder will usually also make operational offense harder, which in turn makes strategic offense more difficult.(88)

Some analysts contest this point, arguing that, because defenders need counteroffensive capabilities for retaking lost territory, in practice the strategic defender may actually engage in just as much or more offensive action at the operational and tactical levels as the strategic attacker. Therefore it is unclear whether a tactical or operational offense-defense balance that favors, say, defense will have the same effect - or indeed any predictable effect - on the strategic offense-defense balance.(89)

This objection is overstated because offense is logically and temporally prior to counteroffense, and substantively more important to the outcomes of strategic offensives; counteroffense only arises if and to the extent that initial offensives succeed. If the attacker's initial offensive operations fail, the likelihood that a hypothetical counteroffensive might also fail is irrelevant because the defender will not need to undertake it. Conversely, arguments that offense-strengthening innovations might make the difference in the defender's ability to recover lost ground must confront the possibility that they might also multiply the attacker's initial success to the point that the defender would be unable to regain the initiative. Thus the more the operational and tactical offense-defense balances favor defense, the less likely initial offensives are to succeed, the less counteroffensive capabilities matter, and the more the overall strategic balance favors defense.

Compared to the direction of effect, assessing the magnitude of the effect of lower-level changes on the strategic offense-defense balance is more complex. Even where the effect of certain factors on tactical- or operational-level outcomes is relatively well understood - such as the impact of ATGMs on tank battles or of trucks in place of railroads on troops' rate of advance - the magnitude of the effect on the strategic offense-defense balance will depend on how states' optimal strategies are affected by complex combinations of operational and tactical constraints and opportunities. Evaluating these effects requires detailed strategic net assessments that incorporate the key factors at all levels of war.

We can, however, often take advantage of a shortcut. Assessments of large-scale conflicts can often be simplified by focusing on one campaign or theater of operations whose outcome will be critical for the outcome of the entire conflict. Most net assessments of a Warsaw Pact offensive against NATO's Central Front, for example, did not assess the entire campaign but instead only its first phase, the breakthrough battle. They did this partly for tractability, but also because the breakthrough battle would be the most important phase in determining the final outcome. While Pact success in the breakthrough battle would not guarantee victory, failure would make it very unlikely. For the same reason, analyses of strategic nuclear wars focus on the initial rounds of nuclear counterforce exchanges.

### THE BALANCE IS MEASURED WITH NET ASSESSMENT TECHNIQUES

Measuring the offense-defense balance is no harder (or easier) than performing net assessments - analyses of the ability of a country's forces to perform military missions against the forces of an opponent. Measuring the offense-defense balance requires working through essentially the same steps as performing a net assessment: for given military missions, the analyst develops a model of how the forces will interact in combat, and explores the predictions of the model under different scenarios.

Although estimating the offense-defense balance requires the same analytical tools as standard net assessments, they are employed slightly differently. Net assessment was developed, and is most commonly used, to analyze the adequacy of particular force postures. The question is usually put in the form: "Are our existing forces sufficient to defeat this contingency? If not, would this alternative force be sufficient?" In contrast, to estimate the offense-defense balance we posit forces for the defender, then manipulate the size of the attacker's forces, asking "Exactly how much force would the attacker need to succeed?"(90) This difference, however, does not pose any additional analytic problems. If reliable net assessment is feasible, then reliable estimates of the offense-defense balance are also feasible.(91)

To illustrate that net assessments address many of the factors that influence the balance, we consider a sophisticated example from the unclassified literature. Barry Posen's net assessment of a possible Warsaw Pact conventional offensive in the 1980s required assessments of contemporary weapons, transportation, communications, and detection technologies in order to make judgments about likely mobilization and

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concentration rates, as well as about casualty exchange ratios.(92) Judgments about the number of plausible Warsaw Pact attack sectors required consideration of the effects of geography and force-to-space ratios. Posen's decision to analyze a breakthrough attempt rather than an attrition campaign or a limited-aims offensive reflected assumptions about the Warsaw Pact's likely military objectives, as well as its tolerance for losses in an effort to conquer Western Europe. These are the same sorts of assumptions about the attacker's territorial goals and the costs of fighting to take territory that are needed for measuring the offense-defense balance.

For example, Posen's assessment that a Warsaw Pact offensive with a 1.2 to 1 advantage in forces would be unlikely to succeed is equivalent to a finding that the offense-defense balance for that scenario was greater than 1.2. By rerunning the model and increasing Warsaw Pact forces until they do prevail, we could estimate the balance for that scenario. Given the essential identity of the two modes of analysis, those who criticize offense-defense theory on the ground that the balance cannot be measured must argue that reliable net assessment is infeasible.(93)

Although it is beyond the scope of this article to settle the question of whether net assessment is feasible, there are important reasons for thinking that net assessment techniques can be used to effectively evaluate military capabilities. One reason for optimism is simply that many analysts have concluded that it is a useful tool. Military organizations have been investing substantial resources in net assessment for centuries, joined in recent decades by civilian experts inside and outside of government. Sophisticated analytic tools have been developed that incorporate information about terrain and the performance of weapons systems, extrapolations from previous battles and wars, and educated guesses about difficult-to-quantify factors such as human performance. During the Cold War, net assessments performed by civilian analysts established the foundation for extensive debate over NATO's prospects for defeating a possible Soviet offensive in Central Europe.(94)

More important, the historical record suggests that reasonably reliable net assessment has been feasible in the past. Although there has been extensive criticism of the quality of certain past net assessments, much of this criticism finds that the flaws were politically and/or bureaucratically motivated, not due to any inherent infeasibility of the task. Certainly the most famous of all net assessment failures are the overestimations before 1914 by the French, German, Russian, and other European militaries of the prospects for successful offensives against

each other, generally known as the "cult of the offensive."(95) While all European militaries recognized that increased firepower and higher force densities would make frontal assaults drastically more expensive, certain militaries, because of combinations of bureaucratic incentives, class interests (especially in Britain), and domestic political threats (especially in France), chose to believe that "morale" would somehow overcome bullets. In fact, however, this escape from the structural constraint was not only infeasible, but its infeasibility was knowable in advance. The evidence from the American Civil War, Franco-Prussian War, Russo-Turkish War, Boer War, and Russo-Japanese War was already in. Unbiased observers, both civilians as well as some junior officers, correctly predicted that frontal assaults would be impossible, as did the German military.(96)

The German army, recognizing that frontal assaults would be infeasible, but motivated by bureaucratic and political needs to find an offensive solution to a two-front war against France and Russia, chose to pin its hopes on a wide flanking maneuver through Belgium (the Schlieffen Plan). This, however, was logistically impossible, given the distances that the advancing Germans and their supplies would have to cover by foot and horse-drawn wagon, while the French and British defenders could react by rail. This too was knowable, and in fact known to the General Staff. Chief of Staff Helmuth von Moltke, who was maligned for weakening Schlieffen's original commitment to an overwhelmingly strong "Right Wing," was later only recognizing logistic reality.(97) Thus the errors of 1914 were avoidable; accurate net assessment, and therefore accurate estimation of the offense-defense balance, was feasible.

Finally, many debates over particular net assessments are not about the validity of the analytic tools but rather about scenarios - whether the scenario being modeled is actually a likely contingency - or data, such as the sides' orders of battle. Debates about these sorts of questions are relevant to whether a given net assessment is useful for a particular policy purpose, but not to the validity of net assessment as a technique, or to whether it can be used to estimate the offense-defense balance.(98)

### BALLPARK ESTIMATES OF THE BALANCE MAY BE SUFFICIENT

Critics have overstated the difficulty of measuring the offense-defense balance by overestimating the degree of measurement precision required by the theory. Most of the predictions of offense-defense theory are qualitative, not quantitative. For example, the theory expects more intense arms racing, tighter alliances, and a higher likelihood of

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war when the offense-defense balance is close to 1 (i.e., relatively favorable to offense) than when it is much greater than 1 (i.e., greatly favors defense); this prediction does not depend on knowing the exact numerical value of the balance.

Because the offense-defense balance is stated in terms of attacker to defender cost ratios, the boundaries of the meaningful ranges depend on the resource ratios between states. If the offense-defense balance for a particular attacker versus a certain defender is much greater than the ratio of the state's resources, then the defender should be able to achieve a high degree of security; if the balance is close to or less than the resource ratio, then the defender will be unable to achieve a high degree of security. Thus, if we can estimate whether the offense-defense balance is close to or far from 1, and especially how it compares to resource ratios, this is often sufficient for explanation, prediction, and policy use.

Some important net assessments have strongly suggested that the offense-defense balance often lies within a range that makes predictions possible. The easiest case concerns nuclear weapons. Repeated detailed examinations of possible U.S.-Soviet nuclear exchanges showed that neither country could get close to having a damage-limitation capability, implying that the defense had a large advantage.<sup>(99)</sup> It seems likely that unbiased net assessment before World War I would have shown that the advantage of defense was so large that no European major power could attack another with much chance of success. Nicholas Spykman's estimate in 1942 that even if Germany and Japan succeeded in subjugating and integrating the whole economic potential of Eurasia, the United States would still be able to defend North America against military invasion amounted to a judgment that the offense-defense balance was more favorable to defense than the resource ratio between the United States and Eurasia.<sup>(100)</sup>

Another way in which critics exaggerate the precision required of net assessments is by overlooking the value of relative net assessment, which is easier to perform than absolute net assessment. Even in circumstances where the balance cannot be measured even within the broad ranges just discussed, relative measures can often be made. That is, it is often possible to say whether the offense-defense balance for one dyad (or one time period) favors defense more or less than the balance for another. This is useful because many of the predictions and policy implications of offense-defense theory are cast in relative terms - for example, shifting the balance toward defense reduces incentives to arms race and to attack. Thus, even when we cannot say quantitatively how much the balance

has shifted from one situation to another, knowing in which direction it has shifted tells us something about the behavior we expect in the second situation compared to the first.

### MEASUREMENT DOES NOT REQUIRE THAT OFFENSE AND DEFENSE BE DISTINGUISHABLE

Critics have argued that the indistinguishability of offense and defense prevents measurement of the offense-defense balance. For example, John Mearsheimer argues that determining the offense-defense balance is problematic because "it is very difficult to distinguish between offensive and defensive weapons."<sup>(101)</sup> This criticism is mistaken, however, because it conflates distinguishability with the offense-defense balance two analytically separable concepts. Whether or not particular weapons are distinguishable has no effect on our ability to calculate the offense-defense balance.<sup>(102)</sup>

To assess the offense-defense balance, we assume that the attacker and the defender act optimally, deploying the weapons that best enable them to achieve their respective missions. The attacker's and the defender's optimal force structures may or may not include some of the same types of weapons. Either way, given these forces, measuring the balance then requires performing the kind of net assessment described above. The ability to performing this net assessment is not impeded by having some of the same types of weapons on both sides.<sup>(103)</sup>

To appreciate this, imagine the extreme hypothetical case in which only one type of weapon exists. All states must rely on this weapon for both offense and defense, which in effect leaves offense and defense indistinguishable. Assessing the offense-defense balance might still be easy, however. Consider two worlds: in the first, the only available weapons are fast but rather thin-skinned tanks; in the second, only artillery pieces so heavy that they cannot be moved are available. In both worlds offense and defense are indistinguishable. It is clear, however, even from a causal inspection that defense has a much greater advantage in the second world than in the first; net assessment is in no way impeded by the indistinguishability of the weapons.

### The Offense-Defense Balance and the Status of Offense-Defense Theory

We believe that this article should lay to rest the concern that the underdevelopment of the concept of the offense-defense balance could undermine offense-defense theory. In addition, we show that the barriers to measuring the offense-defense balance are less severe than critics

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suggest. The key point is that the skills required for net assessment are essentially the same as those required to measure the balance, and net assessment is often feasible.

We do, however, anticipate that our approach may generate one new criticism. The understanding of the offense-defense balance that we have developed in this article is complex, so much so that some readers may conclude that it is too complex to operationalize, or that if operationalized it will not generate enough additional explanatory power to warrant the effort. While appreciating the theory's complexity, we do not see this as a crippling problem. First, most international relations theories are complex, if one looks carefully. Offense-defense theory is not significantly more complex than balance-of-power theory, once one takes operationalization of power seriously. In balance-of-power theory, power means above all the ability to win wars. Operationalizing power thus requires many of the same steps as measuring the offense-defense balance. To measure either, we must know how resources of various kinds are converted into military forces and, most important, how different kinds of military capability are related to war outcomes.(104) If it were true that the offense-defense balance cannot be measured because we do not understand the determinants of war outcomes, then all structural theories of war and peace would be in trouble.

Our suggestions for research reflect our conclusion that the feasibility of measuring the offense-defense balance depends directly on the feasibility of net assessment. First, we need research that improves our understanding of the factors, including cumulativity and nationalism, that influence states' abilities to convert power into offensive and defensive capabilities.(105) For some of this we will need to reach beyond political science disciplinary boundaries to military scientists and historians, economic historians, and students of the sociology of nationalism.

Second, we need additional research on the feasibility and accuracy of past net assessments. We have argued, based on a preliminary examination, that reasonably effective net assessments have often been feasible. Given the importance of this issue, especially given critics' claim that the offense-defense theory is of little value because the balance cannot be measured, thorough studies of feasibility would be very valuable.(106)

In closing, this article has placed offense-defense theory on a firmer foundation by thoroughly exploring the cost-ratio definition of the offense-defense balance and the assumptions that are required to operationalize any definition of the balance, and by emphasizing the close

relationship between the feasibility of net assessment and the feasibility of measuring the offense-defense balance. The result should be increased confidence in the potential of the growing literature that employs offense-defense theory to tackle important historical, theoretical, and policy questions.

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Although not cast in offense-defense terms, offense-defense differentiation plays a central role in qualitative arms control; see Thomas C. Schelling and Morton H. Halperin, *Strategy and Arms Control* (New York: Twentieth Century Fund, 1961). The 1972 ABM treaty and certain provisions of the START treaties were justified on offense-defense logic. On conventional arms control see Jack Snyder, "Limiting Offensive Conventional Forces: Soviet Proposals and Western Options," *International Security*, Vol. 12, No. 4 (Spring 1988), pp. 48-77; Ivan Oelrich, *Conventional Arms Control: The Limits and Their Verification* (Cambridge, Mass.: Center for Science and International Affairs, Harvard University, 1990); and Anders Boserup and Robert Neild, eds., *The Foundations of Defensive Defence* (New York: St. Martin's, 1990).

3. On World War I, see Jack L. Snyder, *The Ideology of the Offensive: Military Decision Making and the Disasters of 1914* (Ithaca, N.Y.: Cornell University Press, 1984); and Stephen Van Evera, "The Cult of the Offensive and the Origins of the First World War," *International Security*, Vol. 9, No. 1 (Summer 1984), pp. 58-107. On ethnic conflict see Barry R. Posen, "The Security Dilemma in Ethnic Conflict," in Michael E. Brown, ed., *Ethnic Conflict and International Security* (Princeton, N.J.: Princeton University Press, 1993), pp. 103-124; and Chaim Kaufmann, "Possible and Impossible Solutions to Ethnic Civil Wars," *International Security*, Vol. 20, No. 4 (Spring 1996), pp. 136-175. On revolutionary states, see Stephen M. Walt, *Revolution and War* (Ithaca, N.Y.: Cornell University Press, 1996). On U.S. grand strategy, see Stephen M. Walt, "The Case for Finite Containment: Analyzing U.S. Grand Strategy," *International Security*, Vol. 14, No. 1 (Summer 1989), pp. 5-49; and Barry R. Posen, *Inadvertent Escalation: Conventional War and Nuclear Risks* (Ithaca, N.Y.: Cornell University Press, 1991). On the future of Europe, see Stephen Van Evera, "Primed for Peace: Europe after the Cold War," *International Security*, Vol. 15, No. 3 (Winter 1990/91), pp. 7-57. On the number of states, see Stanislav Andreski, *Military Organization and Society* (London: Routledge and Keegan Paul, 1968), pp. 75-76; and Robert Gilpin, *War and Change in World Politics* (Cambridge, U.K.: Cambridge University Press, 1981), p. 61.

4. Jack S. Levy, "The Offensive/Defensive Balance of Military Technology: A Theoretical and Historical Analysis," *International Studies Quarterly*, Vol. 38, No. 2 (June 1984), pp. 219-238.

5. Other criticisms include that ingenuity, not structural constraints, determine the balance; that state behavior is determined by perceptions, not the "objective" offense-defense balance; and that offense and defense

cannot be distinguished. Many of these criticisms are addressed by Sean M. Lynn-Jones, "Offense-Defense Theory and Its Critics," *Security Studies*, Vol. 4, No. 4 (Summer 1995), pp. 660-691.

6. For example, Van Evera's optimistic assessment of the future of Europe in his "Primed for Peace" relies on the judgment that the offense-defense balance greatly favors defense.

7. Jervis, "Cooperation under the Security Dilemma," pp. 187-194, 199-206.

8. For related analysis, see Malcolm W. Hoag, "On Stability in Deterrent Races," *World Politics*, Vol. 13, No. 4 (July 1961), pp. 505-527.

9. On the relationship between first strike-advantages, preemption, and accidents, see Schelling and Halperin, *Strategy and Arms Control*, pp. 14-16.

10. Van Evera, *Causes of War*, pp. 191-245.

11. The deductive strength of this body of offense-defense hypotheses has gone largely unchallenged, but recent work has questioned the relationship between offense advantage and the frequency of war. Because the risks of war could be greater for the attacker (not only the defender) when offense has the advantage, potential attackers should face countervailing pressures that make them more cautious, especially when considering large wars. James D. Fearon, "Rationalist Explanations for War," *International Organization*, Vol. 49, No. 3 (Summer 1995), pp. 402-403.

12. A variety of literatures bear on military skill, including work on states' evaluative capabilities, such as Stephen Van Evera, "Why States Believe Foolish Ideas: Non-Self-Evaluation by Government and Society" (Paper presented at the annual meeting of the American Political Science Association, Washington, D.C., 1988); organization theory, for example, Snyder, *Ideology of the Offensive*; Posen, *Sources of Military Doctrine*; and culture, including Trevor N. Dupuy, *A Genius for War: The German Army and General Staff, 1807-1945* (Englewood Cliffs, N.J.: Prentice-Hall, 1977); Elizabeth Kier, *Imagining War: French and British Military Doctrines between the Wars* (Princeton, N.J.: Princeton University Press, 1997); and Stephen P. Rosen, "Military Effectiveness: Why Society Matters," *International Security*, Vol. 19, No. 4 (Spring 1995), pp. 5-31.

13. See Charles L. Glaser, "Realists as Optimists: Cooperation as Self-Help," *International Security*, Vol. 19,



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No. 3 (Winter 1994/95), pp. 50-90; Sean M. Lynn-Jones, "Rivalry and Rapprochement: Accommodation between Adversaries in International Politics" (Ph.D. dissertation, Harvard University, in progress); Jack Snyder, *Myths of Empire* (Ithaca, N.Y.: Cornell University Press, 1991), pp. 11-12; and Van Evera, *Causes of War*. For similar efforts that combine perceptions of the offense-defense balance and power, see Christensen and Snyder, "Chain Gangs and Passed Bucks," and Christensen, "Perceptions and Allies in Europe, 1865-1940."

14. Kenneth N. Waltz, *Theory of International Politics* (Reading, Mass.: Addison-Wesley, 1979).

15. Jervis, "Cooperation under the Security Dilemma," p. 178.

16. *Ibid.*; and Gilpin, *War and Change in World Politics*, p. 62; see also Quester, *Offense and Defense in the International System*, for a definition cast in terms of force ratios instead of investment.

17. Gilpin, *War and Change in World Politics*, p. 63.

18. Jervis, "Cooperation under the Security Dilemma," p. 178. Fearon, "The Offense-Defense Balance and War since 1648," paper prepared for the Annual Meeting of the International Studies Association, Chicago, 1995, defines the balance in terms of the expected costs and benefits of attacking versus defending.

19. Stephen W. Van Evera, "Causes of War" (Ph.D. dissertation, University of California, Berkeley, 1984), p. 78.

20. Levy, "The Offense/Defense Balance of Military Technology," pp. 222-230, reviews works that use this definition as well as the ones above.

21. We do not claim that this is the only workable definition of the offense-defense balance. Instead, we explain the advantages of the cost-ratio definition and develop some of its important, less apparent features.

22. Although in principle "investment" is a straightforward concept, in practice it raises some complicated issues. For instance, what countries pay for resources may not reflect the value they place on them. An obvious example is when two countries pay different amounts to field soldiers of comparable quality, as can happen when one country has a draft system and the other has a volunteer army. However, although these systems allow countries to pay different amounts for soldiers, we may prefer to say that adding an equal number of equal-quality soldiers

represents an equal investment.

23. The offense-defense balance should be calculated in terms of the countries' peacetime force requirements: by what ratio must the attacker outspend the defender before the start of the war, taking into account likely wartime mobilization by both sides? This choice is best for two reasons: first, the main questions addressed by the security dilemma focus on judgments made about peacetime national security policy choices, such as: how secure can my state be? and, how intensely do I need to arms race? Second, if defenders have an advantage in wartime extraction, for example, because of nationalism, incorporating this wartime spending would have the perverse effect of making the balance appear to shift toward offense when conquest was actually becoming more difficult.

24. As we have suggested, a more complete theory would include a third key variable - military skill. Structural theories do not focus on this variable, assuming that states have high and roughly equal levels of skill.

25. To be precise, the first specification below is required for some but not all definitions of the balance; the others are required for all definitions.

26. The same observation applies to the probability of taking territory: forces that are expected to succeed in taking territory with a higher probability will be more expensive.

27. Even the theories that we think of as most purely structural must make assumptions about actors' values. Waltz, *Theory of International Politics*, pp. 105-106, for example, assumes that states value security far more than expansion. Randall Schweller, "Neorealism's Status Quo Bias: What Security Dilemma?" *Security Studies*, Vol. 5, No. 3 (Spring 1996), pp. 90-121, argues that changing this assumption would lead to quite different predictions.

28. Because the level at which the cost of taking territory is set can dramatically influence the offense-defense balance, it is essential that users of offense-defense theory be explicit about this choice.

29. John J. Mearsheimer, *Conventional Deterrence* (Ithaca, N.Y.: Cornell University Press, 1983), applies this standard to large-scale offensive campaigns that aim to take a large part or all of the defender's territory; willingness to accept costs for limited gains would presumably be lower. Consensus on this is not complete. For example, some participants in the Cold War debate over the conventional balance in Europe argued that

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Soviet willingness to pay costs for expansion might be higher than Mearsheimer's standard. See Samuel P. Huntington, "Conventional Deterrence and Conventional Retaliation in Europe," *International Security*, Vol. 8, No. 3 (Winter 1983/84), pp. 325-6; and Eliot A. Cohen, "Toward Better Net Assessment: Rethinking the European Conventional Balance," *International Security*, Vol. 13, No. 1 (Summer 1988), pp. 50-89.

30. Many would consider this a highly conservative standard, although some argued that the United States needed to be able to destroy Soviet forces and leadership, as well as Soviet society. Reviewing this debate is Charles L. Glaser, "Why Do Strategists Disagree about the Requirements of Deterrence?" in Lynn Eden and Steven E. Miller, eds., *Nuclear Arguments* (Ithaca, N.Y.: Cornell University Press, 1989).

31. The preceding discussion makes clear why, although the balance is defined in terms of the relative cost of forces, the cost of fighting a war nevertheless influences the balance. If the costs of fighting increase, the balance shifts toward defense because the attacker must pay more to acquire forces that enable it to take territory at the specified cost of fighting.

32. This implies that the offense-defense theory can be useful in predicting not only the likelihood of war, but also the scale of likely wars.

33. On limited aims strategies, see Mearsheimer, *Conventional Deterrence*, pp. 53-56.

34. For a model of some of the issues involved, see Stephen D. Biddle, "The Determinants of Offensiveness and Defensiveness in Conventional Land Warfare" (Ph.D. dissertation, Harvard University, 1992). Limited offensives are not always easier than unlimited ones. Early conquests could promote rather than retard additional gains if the attacker can extract militarily useful benefits that exceed the costs of occupation (see the discussion of cumulative resources below). Also, if the tactical and operational balances favor the offense at least as strongly as the strategic balance, then it may be easier to achieve total victory than to hold early gains against later counterattacks. For instance, given the powerful punch but small size of the Germans' mechanized forces in 1940, it may have been more practical for them to conquer all of France than to try to hold just Belgium and northern France.

35. Strategy is generally understood as decisions concerning the achievement of ultimate war goals, such as mobilization of forces and their allocation to different

campaigns or theaters of conflict. Operations concerns the movement of forces within a campaign or theater in order to ensure that battles are fought on favorable terms. Tactics concerns actions taken within a particular battle in order to win that battle. Edward N. Luttwak, *Strategy: The Logic of War and Peace* (Cambridge, Mass.: Harvard University Press, 1987), pp. 69-70. On the difference between strategic and tactical offense-defense balances, see Ted Hopf, "Polarity, the Offense-Defense Balance, and War," *American Political Science Review*, Vol. 85, No. 2 (June 1991), pp. 475-493.

36. Quincy Wright, *A Study of War* (Chicago: University of Chicago Press, 1965), p. 808; and Biddle, "Determinants of Offensiveness and Defensiveness," p. 59.

37. Any answer to the question of how long must the attacker hold its territorial gains to count as offensive success must be somewhat arbitrary. In keeping with the traditional primarily military focus of offense-defense theory, we prefer to consider an offensive a success if the territorial gain is maintained until the end of continuous military efforts to take it back, that is, until the end of the current war. One could make a case for a longer time horizon - for example, until the defender loses interest in retaking the territory - on the grounds that the attacker must expend effort even in peacetime to hold the territory as long as a revanchist campaign is imaginable. For instance, our definition would count Napoleon's victories over Prussia and Austria as offensive successes, although one could argue that he was never secure in the fruits of those campaigns. The problem with such a long time horizon is that it would be extremely difficult to measure, and in some cases might never expire.

38. The need to integrate across levels of warfare raises issues that are addressed on pages 73-74.

39. The meaning of "structure" used here is softer than the one favored by some structural realists, which excludes all unit-level attributes. Rather, we use "structure" to mean that states judge adversaries' goals and therefore the threat they pose based on the information provided by their military and foreign policies, not properties of their domestic systems. We do not, however, preclude states from considering properties of other states or their own state - such as the degree of technological sophistication and nationalism - in assessing military capabilities.

40. Jonathan Shimshoni, "Technology, Military Advantage, and World War I: A Case for Military Entrepreneurship," *International Security*, Vol. 15, No. 3 (Winter 1990/91), pp. 187-215, argues that the offense-defense balance has little practical meaning, because states can design strategy to

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shift it. Shimshoni's criticism is flawed, however, because he relaxes the assumption of optimality. All of his examples of military entrepreneurship hinge on states having significant advantages in military skill over their opponents.

41. On this point, we disagree with Van Evera, *Causes of War*, pp. 261-273; and Jervis, "Cooperation under the Security Dilemma," p. 212.

42. On the degree to which German success in 1940 depended on suboptimal Allied doctrines, see Len Deighton, *Blitzkrieg* (New York: Ballantine, 1979).

43. Posen, *Sources of Military Doctrine*, pp. 228-236, argues that the greater the degree of threat, the closer states' military doctrines approach optimal choice.

44. We argue that such asymmetries should not simply be treated as a difference in military skill, because they are sometimes (not always) the result of differences in scientific or gross economic resources or rigidities in societal structure that even optimal policy cannot rectify quickly.

45. Such asymmetries can yield situations where, even with equal resources, one state of a dyad may be able to defeat the other on either offense or defense. Predictions about such cases will be more uncertain than other equal-resource cases, because they require greater information about states' goals; greedy states might attack when security seekers would not.

46. For example, the United States was less likely to use its nuclear monopoly to prevent Soviet development of nuclear weapons and an assured destruction capability because nuclear superiority was going to decay into a world of mutual assured destruction capabilities, (MAD), in which defense has a large advantage. See Glaser, *Analyzing Strategic Nuclear Policy*, chap. 5.

47. Since war outcomes are determined by power and skill as well as the offense-defense balance, this does not necessarily mean that France would have been more likely to win a war.

48. Given that the function of the offense-defense balance is to compare the efficacy of offensive strategies to defensive ones, situations where both sides choose offensive strategies create anomalies for offense-defense theory. This can happen in two ways: when the compound balance is less than 1, both sides could choose offense on efficiency grounds. The theory then predicts the states' strategy choices, but since the theory does not define an

"offense-offense balance," it may tell us little about likely war outcomes. Second, when the compound balance is not much greater than 1 and one state chooses offense for nonsecurity reasons (i.e., because it is greedy), then the theory may not be able to predict the second state's strategy choice. Normally, if the compound balance is greater than 1 the second state would choose defense on efficiency grounds. We should expect, however, that an offensive strategy by the second state will do better against the first state's offense (since it is not optimized for defense) than it would against an opposing defense (which, by definition, is), but because we have no way of estimating how much better, we cannot predict the second state's best choice or whether it can achieve security. We do not have a solution for this, and are unaware of discussions that have addressed this issue.

49. At first glance, this may seem surprising, but there is an intuitive explanation. Whenever we say that one side can do better on defense than on offense, we must also be saying that the second side would do worse on offense (against the first side's defense) than on defense (against the first side's offense); thus both will prefer defense to offense.

50. Jervis, "Cooperation under the Security Dilemma," pp. 194-199. Quester, *Offense and Defense in the International System*, focuses mainly on technology. Both Lynn-Jones, "Offense-Defense Theory and Its Critics," p. 668; and Levy, "The Offensive/Defensive Balance of Military Technology," pp. 225-227, 229, argue explicitly for limiting the concept to technology.

51. See, for example, Hopf, "Polarity, the Offense-Defense Balance, and War"; and Van Evera, *Causes of War*, pp. 261-273. Stephen Walt, *Revolution and War*, pp. 37-43, suggests that the permeability of societies to ideas as a cause of offense dominance.

52. Additional arguments include claims that only technology is constant across the international system, and that the narrow definition is already the accepted one in the scholarly community. See Lynn-Jones, "Offense-Defense Theory and Its Critics," p. 668.

53. Analysts who reject the broad approach appreciate that additional factors besides technology and geography do influence the cost ratio of offensive to defensive strategies. Lynn-Jones, "Offense-Defense Theory and Its Critics," pp. 668-670. Thus this is not a deep disagreement about how the world works, but rather over how best to build theories.

54. A related, although not identical, distinction is the effect

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of a technology on moving versus nonmoving forces. The impact of both distinctions on the feasibility of offensive and defensive missions, however, is in most instances so similar that we often characterize the offense-defense implications of a given technology based on either distinction.

55. At least compared with technologies which are only usable by nonadvancing forces; in practice technologies that are actually more usable by advancing forces are rare because almost all tasks are easier to carry out while stationary than while moving.

56. Basil H. Liddell Hart, "Aggression and the Problem of Weapons," *English Review* 55 (1932), p. 73; Marion W. Boggs, "Attempts to Limit 'Aggressive' Armament in Diplomacy and Strategy" (Ph.D. dissertation, University of Missouri, 1941), p. 85; Quester, *Offense and Defense in the International System*, pp. 2-3; Oelrich, *Conventional Arms Control*, pp. 14-25; Anders Boserup, "Mutual Defensive Superiority and the Problem of Mobility along an Extended Front," in Boserup and Nield, eds., *Foundations of Defensive Defense*, pp. 63-78; and Catherine M. Kelleher, "Indicators of Defensive Intent in Conventional Force Structures and Operations in Europe," in Lawrence Freedman, ed., *Military Power in Europe* (New York: St. Martin's, 1990), pp. 165 - 168.

57. This rather abstract discussion does not distinguish between attritional and blitzkrieg-style offensives, although actually both proceed in essentially the same two stages. The difference is the attacker's confidence that a breakthrough can be produced using a narrow versus a wide-front assault, and can be produced quickly and easily. On the two types of offensives, see Mearsheimer, *Conventional Deterrence*, pp. 33-43. On the role of breakthrough in attrition offensives, see C.R.M.F. Cruttwell's treatment of the 1917 Cambrai assault in *A History of the Great War, 1914-1918*, 2d ed. (Oxford, U.K.: Clarendon Press, 1936), pp. 467-477.

58. Another way to put this is that mobility multiplies the attacker's advantage of the initiative. There is always a time lag between the initiation of an offensive action and the beginning of effective response by the defender because of the time needed to (1) detect the action, (2) assess the threat, (3) decide on a response, and (4) disseminate instructions to begin implementing the response. Increased mobility means that the attacker can accomplish more with an initiative lag of any given duration. For a formal model illustrating this, see Robert Nield, "The Relationship of Mobility to Defensive Stability," *Defense Analysis*, Vol. 8, No. 2 (August 1992), pp. 199-201. Mearsheimer, *Conventional Deterrence*, p. 26,

disagrees with this logic, arguing that the attacker can use the advantage of the initiative to position its forces at leisure, while once the offensive begins the defender must redeploy with great speed to meet the threat; thus increases in operational mobility actually favor defenders. This argument, however, has two weaknesses. First, it requires a huge initiative lag, sufficient to allow attacker forces to reposition virtually anywhere in the theater, before the defender detects anything. Second, it does not touch the differential value of tactical mobility to attackers.

59. Strategic mobility (the ability to transport and support large forces far from one's centers of mobilization) may not have much effect in the offense-defense balance in wars between small or medium-sized powers, but is essential to any long-distance offensive. See George Modelski and William R. Thompson, *Seapower in Global Politics, 1494-1983* (Seattle: University of Washington Press, 1987), on the concept of the power/distance gradient; improvements in strategic mobility can be understood as a "flattening" of this gradient. In the special case where two sides share a traversable land border but one relies more heavily than the other on reinforcement from overseas territories and allies - for example, France in 1939-40 - better strategic mobility will simply favor the power of that side more than it favors either defense or offense.

60. Another reason why tactical nuclear weapons and the most powerful conventional munitions favor defense is that they destroy transportation infrastructure, thus reducing mobility.

61. On heavy artillery, see Liddell Hart, "Aggression and the Problem of Weapons," p. 73.

62. A standard discussion is Jervis, "Cooperation under the Security Dilemma," pp. 194-196.

63. Very dense cover, especially cities, is often extremely costly to capture because there is no way for advancing units to avoid exposing themselves to fire from defended positions, often at very short range. The German attackers at Stalingrad in 1942 and the Russians at Grozny in 1994-95 both suffered heavily despite possessing much more force than the defenders.

64. Heavy cover, such as stone or concrete buildings, or mountainous terrain in which caves or tunnels can be dug, can further delay an attacker by requiring very heavy firepower to destroy defenders even after they are located, although precision guided missiles are making this less important.

65. Some have argued that a neutral Eastern Europe

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would provide the United States and Russia better protection against each other than would expansion of NATO. See Mueller, "Alignment Balancing and Stability in Eastern Europe," pp. 67-76.

66. Liddell Hart, "The Ratio of Troops to Space," *Military Review*, Vol. 40 (April 1960), pp. 3-14; Mearsheimer, "Why the Soviets Can't Win Quickly in Central Europe," *International Security*, Vol. 7, No. 1 (Summer 1982), pp. 3-39 at 26-30; and Biddle, "Offensiveness and Defensiveness," pp. 164-169. Biddle suggests that at extremely low force-to-space ratios, still lower densities can strengthen defense, down to the point at which offense is impossible because there are no forces at all.

67. Jervis, "Cooperation under the Security Dilemma," p. 204. Examples include the many Confederate soldiers who deserted the Army of Northern Virginia at the Potomac in 1862 because "they felt that they were fighting to defend Virginia's soil, not to invade the North" and Hitler's unwillingness to risk imposing full war mobilization on Germany until the failure of Barbarossa opened the possibility that Germany's own homeland security might be threatened. Bruce Catton, *Mr. Lincoln's Army* (Garden City, N.Y.: Doubleday, 1951), p. 252; and Alan S. Milward, *War, Economy, and Society 1939-1945* (Berkeley: University of California Press, 1977), pp. 76-80.

68. Where there are significant irredenta, however, nationalists may fight just as hard on offense as on defense. More important, where multinational empires rule disgruntled subject people, nationalism may actually favor offense by raising the probability that invaders will not be resisted but welcomed as liberators. Examples include subject towns of both the Romans and Carthaginians which opened their gates to the other side in the First and Second Punic Wars, as well as the contrast between the collaboration of some Soviet subject peoples from 1941 to 1944 and the fierce resistance of ethnic Russians. Polybius, *The Histories* Vol. 4, trans. W.R. Taton (Cambridge, Mass.: Harvard University Press, 1925), pp. 445-447, 455.

69. The decisiveness of cumulative resources to the outcome of a particular war depends on how quickly they can be converted to military power and on the length of the war.

70. Milward, *War, Economy, and Society*, pp. 18-36; and Michael A. Barnhart, *Japan Prepares for Total War: The Search for Economic Security, 1919-1941* (Ithaca, N.Y.: Cornell University Press, 1987).

71. Cumulative resources need not be directly military in

nature if they substitute for domestic resources which the attacker can then shift to military production. For instance, German strategic plans in both world wars counted on acquiring grain from Eastern Europe to release German workers for war industries, and Germany's war effort in 1918 was severely hampered by failure to gain control of agricultural areas in the Ukraine in time to collect the 1917 harvest.

72. The importance of popular resistance means that cumulativeness depends in part on the intensity of nationalism. On the economic side, Van Evera, *Causes of War*, pp. 180-183, argues that the transition to information-age economies may reduce cumulativeness because these economies cannot function without a level of free communication which an occupier cannot safely permit. Peter Liberman, *Does Conquest Pay? The Exploitation of Advanced Industrial Societies* (Princeton, N.J.: Princeton University Press, 1996), argues oppositely that increasing specialization makes it easier for attackers to use control of the food supply to compel urban workers to produce.

73. See Liberman, *Does Conquest Pay?*; and Van Evera, *Causes of War*, pp. 161-183.

74. Van Evera, *Causes of War*; and Hopf, "Polarity, the Offense Defense Balance, and War."

75. Fearon, "The Offense-Defense Balance and War Since 1648," pp. 11-12, makes a similar argument.

76. A theory of alliance behavior is required because the behavior that matters for measuring the balance is the behavior that states can reasonably expect in advance of war (and actually as far back as its decisions to procure forces and design its strategy), which may not be the same as what actually happens.

77. Christensen and Snyder, "Chain Gangs and Passed Bucks"; and Christensen, "Perceptions and Allies in Europe, 1865-1040."

78. Van Evera, *Causes of War*, pp. 261-273.

79. *Ibid.*, p. 270.

80. We are indebted to Karl Mueller for this insight.

81. For example, the formation of NATO not only increased the power resources available to resist a possible Soviet invasion of West Germany, but may also have shifted the offense-defense balance toward defense because of the likelihood that some NATO members might

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have been unwilling to participate in offensive military operations aimed at unifying East and West Germany.

82. Van Evera, *ibid.*, pp. 52-54, uses the term the same way we do.

83. Jervis, "Cooperation under the Security Dilemma," pp. 188-189; and Van Evera, *Causes of War*, unnumbered page after p. 52 and pp. 73-74. Important works that predate offense-defense theory include Albert Wohlstetter, "The Delicate Balance of Terror," *Foreign Affairs*, Vol. 37, No. 2 (January 1959), pp. 211-234; and, Schelling, *Arms and Influence*, pp. 221-259. Dan Reiter, "Exploding the Powder Keg Myth: Pre-emptive Wars Almost Never Happen," *International Security*, Vol. 20, No. 2 (Fall 1995), pp. 5-34, argues that preemptive wars have been rare.

84. Much of the existing offense-defense literature has ignored this problem, apparently assuming that attackers always go first.

85. For example, if one side can destroy the other's unalerted air force on the ground, the other has an incentive to alert its planes simply to avoid this, even if it has no prospect of destroying the first side's air force.

86. Colin Gray, *Weapons Don't Make War: Policy, Strategy, and Military Technology* (Lawrence: University Press of Kansas, 1993), p. 23. For a skeptical view of the feasibility of reliable net assessment, see Cohen, "Toward Better Net Assessment."

87. To be more precise, the accuracy of our estimates of the offense-defense balance depends on the completeness of our model of the determinants of war outcomes. The better our understanding of war, the narrower the bands of uncertainty around our estimates of the balance. This problem is a central one in military history, with a large and active literature; a few political scientists are also beginning to take an interest, for example, Biddle, "Determinants of Offensiveness and Defensiveness."

88. Exceptions are possible where two or more different factors interact. For instance, an improvement in naval transport might normally favor offensive operations, but could favor defense at the strategic level if the major beneficiary was an offshore balancer that was too weak to attack any continental power but strong enough to assist certain of them in defense against others.

89. Shimshoni, "Technology, Military Advantage, and World War I," p. 192; and Gray, *Weapons Don't Make War*, pp. 36-37.

90. To be more precise, after answering this question, we then calculate the cost of these forces relative to the cost of the defender's forces.

91. Military assessments are sometimes stated in ways which are especially easily translatable into offense-defense terms. For example, Basil Liddell Hart's finding that in World War II Allied ground offensives rarely succeeded unless the attackers had a superiority of at least 5 to 1, together with domination of the air, amounts to an a statement that the offense-defense balance, at least at the tactical level, for these offensives was greater than 5. Liddell Hart, *Deterrent or Defense* (London: Stevens, 1960), p. 179. The recent discussion of the "3 to 1 rule" favored by the U.S. military and others is similar. FM 100-5: *Operations* (Washington, D.C.: U.S. Department of the Army, 1976); Major H.F. Stoeckli, *Soviet Operational Planning: Superiority Ratios vs. Casualty Ratios* (Sandhurst, U.K.: Royal Military Academy, 1985); John J. Mearsheimer, "Assessing the Conventional Balance: The 3:1 Rule and Its Critics," *International Security*, Vol. 13, No. 4 (Spring 1989), pp. 54-89; and Joshua Epstein, "The 3:1 Rule, the Adaptive Dynamic Model, and the Future of Security Studies," *International Security*, Vol. 13, No. 4 (Spring 1989), pp. 90-127.

92. Barry Posen, "Measuring the European Conventional Balance: Coping with Complexity in Threat Assessment," *International Security*, Vol. 9, No. 3 (Winter 1984/85), pp. 47-88.

93. Thus Mearsheimer's insistence that the balance cannot be measured is belied by his net assessment work.

94. Examples include Mearsheimer, "Why the Soviets Can't Win Quickly in Europe"; Posen, "Measuring the European Conventional Balance"; Joshua Epstein, *Measuring Military Power: The Soviet Air Threat to Europe* (Princeton, N.J.: Princeton University Press, 1984); and Cohen, "Toward Better Net Assessment," as well as official studies such as James Blaker and Andrew Hamilton, *Assessing the NATO/Warsaw Pact Military Balance* (Washington, D.C.: Congressional Budget Office, December 1977).

95. Van Evera, "The Cult of the Offensive and the Origins of the First World War." On the generally better, but often still flawed, net assessments before World War II, see Williamson Murray and Allan Millet, eds., *Calculations: Net Assessments and the Coming of World War II* (New York: Free Press, 1992).

96. Michael Howard, "Men against Fire: Expectations of War in 1914," *International Security*, Vol. 9, No. 1

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(Summer 1984), pp. 41-57. Snyder, Ideology of the Offensive, and Van Evera, Causes of War, pp. 316-394, argue that prewar estimates were wrong because of bias, not inherent complexity. Scott Sagan, "1914 Revisited: Allies, Offense, and Instability," *International Security*, Vol. 11, No. 2 (Fall 1986), pp. 151-176, argues that European powers' prewar estimates were reasonably accurate. On the British, see Edward L. Katzenbach, Jr., "The Horse Cavalry in the Twentieth Century," *Public Policy* (1958), pp. 120-149. John Ellis, *The Social History of the Machine Gun* (New York: Arno, 1975), argues that European racism contributed to the underestimation of firepower. On the evidence from late-nineteenth- and early-twentieth-century wars and the reports of military observers, see William McElwee, *The Art of War: Waterloo to Mons* (Bloomington: Indiana University Press, 1974), pp. 147-255. The most famous, accurate, contemporary civilian analysis is Ivan Bloch, *The Future of War in Its Technical, Economic, and Political Aspects: Is War Now Impossible?* trans. R. C. Long (New York: Doubleday and McClure, 1899).

97. Martin Van Creveld, *Supplying War: Logistics from Wallerstein to Patton* (Cambridge, U.K.: Cambridge University Press, 1977), pp. 109-141.

98. Cohen, "Toward Better Net Assessment," argued that even the best net assessments of the Central Front did not do justice to the complexity of the problem. Most of his specific criticisms of Mearsheimer, Posen, and Epstein, however, concern scenario issues, such as inclusion of certain Soviet units, possible Warsaw Pact advances through Austria or Denmark, the likelihood of airdrops in the NATO rear, or the possibility that NATO might not mobilize in time. A few of Cohen's criticisms - for example, that these authors overestimated force-to-space constraints on Warsaw Pact ground offensives as well as the effectiveness of NATO compared to Warsaw Pact airpower - are relevant to the quality of our understanding of modern land warfare, although the weight of opinion on these questions seems to be against Cohen. See John J. Mearsheimer, Barry R. Posen, and Eliot A. Cohen, "Correspondence: Reassessing Net Assessment," *International Security*, Vol. 13, No. 4 (Spring 1989), pp. 128-179.

99. See, for example, Congressional Budget Office, *Counterforce Issues for the U.S. Strategic Offensive Forces* (Washington, D.C.: U.S. Government Printing Office, 1978); and Michael M. May, George E. Bing, and John D. Steinbruner, "Strategic Arsenals after START: The Implications of Deep Cuts," *International Security*, Vol. 13, No. 1 (Summer 1988), pp. 90-133.

100. Nicholas Spykman, *America's Strategy in World*

*Politics: The United States and the Balance of Power* (New York: Harcourt Brace Jovanovich, 1942), esp. 389-457.

101. John J. Mearsheimer, "The False Promise of International Institutions," *International Security*, Vol. 19, No. 3 (Winter 1994/95), p. 23; see also Shimshoni, "Technology, Military Advantage, and World War I," pp. 190-191.

102. In a forthcoming article we argue that offensive and defensive weapons and force postures generally are distinguishable.

103. Lynn-Jones, "Offense-Defense Theory and Its Critics," pp. 674-676, makes essentially the same argument. Biddle, "Determinants of Offensiveness and Defensiveness," pp. 17-19 and 341-343, concludes that defense has the advantage, although he argues that distinguishing offensive and defensive weapons is hard.

104. On the difficulty of operationalizing power and the relevant literature, see William C. Wohlforth, *The Elusive Balance: Power and Perceptions during the Cold War* (Ithaca, N.Y.: Cornell University Press, 1993); see also Aaron Friedberg, *The Weary Titan: Britain and the Experience of Relative Decline, 1895-1905* (Princeton, N.J.: Princeton University Press, 1988).

105. For example, Liberman's study of the net resources that Germany was able to extract during World War II contributes to a research agenda on cumulativeness; see Liberman, *Does Conquest Pay?* 106. For example, Biddle's work on the determinants of the relative success and failure of different stages of the German Spring Offensive of 1918 bears on the relative explanatory power of technology, terrain, numbers, and skill; Biddle, "Determinants of Offensiveness and Defensiveness," pp. 241-311. Sean Lynn-Jones in a personal communication has suggested that "experimental net assessment" using the sorts of techniques developed for the U.S. Army's National Training Center (NTC) might be a useful measurement approach for a variety of tactical- and operational-level questions. On the methods used at NTC, see Daniel Bolger, *Dragons at War* (Novato, Calif.: Presidio, 1986).

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