WAR GAMES: MILITARY STRATEGY AND ECONOMIC GAME THEORY

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Confining the use of economic models to explaining economic phenomena ignores the insights such models can provide in a variety of other areas. In this paper, Peter Devine illustrates one such alternative application by examining how economic models based on game theory and guided by so-called 'Just War Principles' could help guide military policy intended to reduce civilian casualties in a counterinsurgency. He uses the current example of the war in Iraq as the basis of this study.

Introduction

In the current war in Iraq, many innocent civilians are being killed by coalition forces in the process of defending the Iraqi government and people from a guerrilla insurgency. While the goal of the counterinsurgency is to protect civilian lives, implementing policies to achieve that objective can be complex. Many factors affect how competing incentives interact and some outcomes can be counterproductive, causing even greater harm to civilians than would otherwise be the case.

Economic modelling based on game theory and guided by Just War Principles could be employed to more accurately characterize the interaction of competing incentives and, in the process, help counterinsurgent commanders to make informed decisions that greatly decrease civilian casualties. While a model that completely characterizes the dynamics of the Iraq War would be extremely complex, a simplified model that analyses the key trade-offs is still broadly useful. Furthermore, a simple model can be incrementally expanded and improved upon by including institutional effects that incorporate individual nuances of the situation.

Civilian Casualties are Unacceptable Losses

Since the 2003 US led invasion 655,000 more people have died in Iraq than would have otherwise (Burnham et al., 2006). Of those excess deaths, 31% were attributed to coalition forces. It can't be disputed that too many innocent civilians have been killed in the conflict for no obvious reason. As recently as October of 2007, Iraqi Prime Minister Nuri al-Maliki complained of the 'excessive force' used in a raid by American troops which killed 13 civilians, two of which were toddlers, and injured 69 others (Raheem and Kami, 2007). In fact, between January and May of 2007, US and NATO forces have killed more civilians in Afghanistan than the insurgent forces (USA Today, 2007). In reaction, Afghan President Hamid Karzai declared that US and NATO forces viewed civilian lives as 'cheap' (ibid). In many circumstances civilian casualties are extremely difficult, perhaps impossible, to avoid during military operations. However, soldiers and policy makers should aim to prevent civilian deaths. Innocent lives deserve that sincere effort.

The Competing Incentives of an Insurgent War

The problems associated with countering an insurgency fought within an urban environment are complex. Coalition forces currently engaged in Iraq are struggling with the insurgents' ability to fight while dispersed among the civilian population where a significant number of deaths of innocent civilians can be attributed to the counterinsurgency (O'Hanlon and Campbell, 2007; Burnham et al., 2006). Military strategy affects the duration of the conflict, the number of civilian casualties, influencing public opinion in favour of, or opposed to, the counterinsurgency (Patraeus and Mattis, 2006; Walzer, 2006). Decisions not only need to be effective in terms of overcoming the insurgency, they also need to protect the rights of civilians by abiding to the limits of waging a just war (Walzer, 2006).

The goal of the counterinsurgent force is to re-establish the legitimacy of the government by gaining the support of the local population. Minimization of civilian casualties is an essential aspect of achieving that goal and the conflict cannot be won if the local population feels an excessive number of innocent civilians are dying unnecessarily: 'The cornerstone of any [counterinsurgent] effort is security for the civilian population' (Patraeus and Mattis, 2006).

In every insurgent conflict there are three categories of civilians: a minority which actively supports the insurgents, a minority which actively supports the counterinsurgents and a neutral majority (ibid). It is the third group,

the majority, whose support must be won in order for the government to attain legitimacy. The only way to win the support of the majority is by providing for their security and establishing the rule of law (ibid). From this perspective, every counterinsurgent operation is won or lost by the counterinsurgent force's ability to protect the public. A successful counterinsurgency requires that combatant commanders and troops have the safety of civilians as their primary concern. To do so, the counterinsurgent forces have to assume greater personal and company risk in order to protect the civilian population in which they operate (ibid).

While avoiding civilian casualties is the primary focus, military commanders are still faced with difficult strategy decisions on how to accomplish that goal. Stringently avoiding any action that might harm civilians could paradoxically have the opposite effect and actually increase civilian casualties. For instance, a policy that prioritizes civilians' safety makes civilians valuable shields to hide behind. A policy that is not affected by the presence of civilians eliminates their value as shields but creates a moral dilemma. Even if the policy decreases the net civilian casualty rate over the course of the conflict, innocent civilians may still be harmed. This example demonstrates that in order to minimize civilian casualties it may actually be necessary to accept some level of endangerment to civilian lives. To do otherwise may cause harm to a greater number of civilians in the long run. However, any policy that causes increased civilian deaths in the short term in order to reduce civilian deaths over the long term risks causing the local population to lose sight of potential long-term benefits.

The Theory of Just War

It is warranted under the Theory of Just War to fight a counterinsurgency where civilian casualties occur so long as the act of war satisfies the criteria of the Double Effect Principle (Walzer, 2006). The Double Effect Principle outlines criteria under which an act that has unintended harmful effects is justified by the more significant and intended helpful effects. The Double Effect Principle declares that a good or helpful act which yields unintended, harmful effects (the double effect) is justified if the following four criteria are met:

1. The nature of the act is itself good
2. The intention is for the good effect and not the bad
3. The good effect sufficiently outweighs the bad effect to merit the risk of yielding the bad effect
4. The good effect is not a result of the bad effect.

Civilian casualties may be acceptable under the Theory of Just War so long as maximum effort is employed to protect against them. The Counterinsurgent field manual requires combat units to accept greater company risk in order to provide greater security for the public (Patraeus and Mattis, 2006).

How an Economic Model Can be Useful

Decision makers trying to choose between warfare strategies need tools for predicting outcomes arising from various courses of action. It is extremely difficult to determine the optimum level of force that will meet a military objective while protecting civilians to the maximum extent possible. The impact of a military action can be counterintuitive leading to bad decisions and lost civilian lives. An economic model that characterizes the competing incentives could be useful to evaluate courses of action against expected outcomes.

The complexities associated with implementing a Just War policy to counter an insurgency dispersed among a civilian population need to be better understood. Economic modelling and game theory can help study and characterize those complexities by supplying decision makers with tools to objectively evaluate various battlefield strategies against likely results (Osborne and Rubinstein, 1994; Gibbons, 1992; Straffin, 1993; Walzer, 2006; O'Brien, 1981; Yoder, 2001). The projection models proposed are based on existing economic/game theory and can be tailored to take into account the limits imposed by *'Jus in Bello'*.[1] For example, a model that characterizes the tendency of an insurgent force to fight dispersed within a civilian population can be structured as a two-player game in which the costs and benefits to each 'player' are modelled as a function of the level of force employed by the counterinsurgents and the dispersion level of the insurgents. Various military strategies could be analyzed in terms of predicted civilian casualties. The model's outcome projections represent one source of objective data points which decision makers could use to refute or support a proposed strategy.

[1] '*Jus in Bello'* is a term which describes fighting a war justly.

The Dispersed Insurgent Force Model

A Dispersed Insurgent Force Model could be developed to characterize the effects of increased aggression against an insurgent force that is dispersed within a civilian population. The description below is just a starting point for such a model and is, therefore, highly simplistic. It is structured as a two-player game where each player seeks to maximize their own benefit to cost ratio. The counterinsurgent force is characterized by a cost-benefit curve in which increased aggressiveness against the dispersed insurgent force eliminates more insurgents yielding a benefit but at a decreasing rate. However, by increasing power the dominant counterinsurgent force also incurs a cost (civilian casualties) at an exponentially increasing rate. The net cost-benefit curve then shows a level of aggression at which an incremental increase in power would incur a cost greater than the benefit. Total cost (counterinsurgent) [1] is differentiated with respect to p to calculate marginal cost [2], where p is power and λ is dispersal:

$$p\lambda \quad [1]$$

$$\lambda \quad [2]$$

Total benefit [3] is differentiated to calculate marginal benefit [4], where α is the reciprocal of the duration:

$$(0.5p^{0.5}\alpha)/\ \lambda \quad [3]$$

$$\alpha/(4\ \lambda p^{0.5}) \quad [4]$$

By equating the marginal cost and marginal benefit we find the level of p at which benefit is maximized as discussed above:

$$\lambda = \alpha/(4\ \lambda p^{0.5}) \quad [5]$$

Solving for p:

$$p = \alpha^2/(16\lambda^4) \quad [6]$$

This yields the dominant counterinsurgent force's best response function, that is the level of p that will maximize the counterinsurgent's benefit for a given dispersal λ.

Similarly with the insurgent force, there is a cost-benefit curve for effectiveness and dispersal for a particular level of aggressiveness by the counterinsurgent force. As the dispersal rate increases, the insurgent forces gain protection. However, there is an inflection point where too great a dispersal reduces overall effectiveness because of a lack of organization and communication amongst the insurgents. Mathematically, total benefit [7] is differentiated to yield marginal benefit [8]:

$$\frac{1}{p} - (\frac{3p^2}{2} - \lambda)^2 \qquad [7]$$

$$3p^2 - 2\lambda \qquad [8]$$

By setting the marginal benefit equal to zero we find the level of dispersal λ which yields the maximum benefit to the insurgent force. Solving for λ:

$$\lambda = \frac{3p^2}{2} \qquad [9]$$

This yields the insurgent force's best response function; the level of dispersal λ that maximizes the insurgent's benefit for a given power setting p. Solving the two response functions yields an optimal Nash equilibrium. Substituting [9] into [6]:

$$p = \frac{1}{16(3p^2/2)^4} \qquad [10]$$

Note: We are assuming that duration α is not a factor – that is, the duration is not so long that the local public opinion turns against the counterinsurgency – α is set to 1.

$$p = 0.61369\ldots \qquad [11]$$

Substitute this value for *p* into [9] and solve for λ:

$$\lambda = 0.56492\ldots \qquad [12]$$

Therefore total civilian casualty rate in this case would be:

$$p\lambda = 0.34668\ldots \quad [13]$$

A field commander could use a model like this to predict the insurgents' dispersal rate given his ordered rate of aggression and thus calculate a projected civilian casualty rate.

Further Research Is Needed

In this example, only the most basic trade-offs are analyzed. In reality, fighting a guerrilla war is extremely complex and a model would have to include many variables. Extensive data would have to be collected and evaluated to construct accurate models for each player's costs and benefits. However, it is precisely because of its complex nature that such a model is needed to help manage the problem. Formal models help one comprehend how competing incentives interact. Although the problem being examined is complex, a simple model can be used to capture what are thought to be the key trade-offs. This framework could be potentially expanded to characterize institutional effects and nuances missed by the simpler model.

Furthermore the model needs to be extended from a one-shot simultaneous game to a sequential game. A counterinsurgent campaign is drawn out and highly adaptable by nature. There may be an element of simultaneous choice in each time period. However, a model needs to incorporate past reputation and follow sequential choice in order to be effective over the entire war.

An exciting possibility is that the amount of intelligence gathered on the insurgents' strategy and tactics could be a way to change the insurgents' cost-benefit curve. If so, the counterinsurgent force could significantly reduce civilian casualties by making choices that decrease the insurgents' dispersal within the civilian population.

Civilian support for counterinsurgent operations could be a free rider problem. While the civilian population may determine that it would be better off if the insurgent force were eliminated, no individual may be willing to take the first action against the insurgents because of fear of retribution. Increased security would result in higher net social benefit, but some will be harmed more than others in the process of opposing the insurgents. To incorporate this in the model, further research is required to analyse how the local government and the counterinsurgent forces would deal with this market failure.

Finally, how the duration of the conflict factors into the model needs to be better understood. In the model presented, duration is factored out for simplicity.

In reality, duration could be a significant factor. If the insurgency lingers on for an extended period, the indigenous population could begin to resent the counterinsurgents and their support for the counterinsurgency could erode.

Bibliography

Brown, D. 2006. 'Study Claims Iraq's 'Excess' Death Toll Has Reached 655,000'. *The Washington Post*. 11/10/2006:A12.

Burnham, G., Lafta, R., Doocy, S., and Roberts, L. 2006. 'Mortality After The 2003 Invasion Of Iraq: A Cross-sectional Cluster Sample Survey'. *The Lancet* 368:1421–28.

Gibbons, R. 1992. *A Primer in Game Theory*. New Jersey: Princeton University Press.

USA Today. 2007.' Afghan civilians reportedly killed more by U.S., NATO than insurgents'. 24/6/2007.

O'Brien, W. 1981. *The Conduct of Just and Limited Wars*. New York: Praeger Publishers.

O'Hanlon, M. and Campbell, J. 2007. 'Iraq Index: Tracking Variables of Reconstruction & Security in Post-Saddam Iraq'. *The Brookings Institution*. Viewed at: http://www.brookings.edu/iraqindex

Osborne, M. and Rubinstein, A. 1994. *A Course in Game Theory*. Cambridge: MIT Press.

Patraeus, D. and Mattis, J. 2006. 'U.S. Field Manual/Fleet Marine Force Manual'. FM 3-24/MCWP 3-33.5 Counterinsurgency. Washington.

Raheem, S. and Kami, A. 2007. 'U.S. military says kills 49 in Baghdad raid'. Reuters.com. 10/21/2007. Viewed at: http://www.reuters.com/article/newsOne/idUSCOL53898220071021

Straffin, P. 1993. *Game Theory and Strategy*. MAA.

Walzer, M. 2006. *Just and Unjust Wars* 4th ed. New York: Basic Books.

Yoder, J. 2001. *When War is Unjust* 2nd ed. Eugene: Wipf & Stock Publishers.