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Abstract

Purpose – Among the many perspectives to analyze war, such as rational actor, organizational process, governmental politics and ethics, the perspective that actually incorporates the costs and benefits into a systematic theoretical structure has hardly been analyzed. The purpose of this paper is to analyze the costs and benefits perspective.

Design/methodology/approach – Three kinds of value are distinguished, i.e. human, economic and influence. Different actors (politicians, populations, stakeholders, etc). assign different weights to the three kinds of value. Six gradually more complicated models are developed. The first subtracts losses from gains for the three kinds of value. Thereafter, the paper accounts for multiple periods, time discounting, attitude towards risk, multiple stakeholders, subcategories for the three kinds of value, sequential decision-making and game theory.

Findings – The rich theoretical structure enables assessing costs and benefits more systematically and illuminatingly. The cost benefit analysis is illustrated with the 2003-2011 Iraq War. The paper estimates gained and lost value of human lives, economic value and influence value, and show how different weights impact the decision of whether to initiate war differently.

Originality/value – The paper provides scientists and policy makers with a theoretical structure within which to evaluate the costs and benefits of war, accounting for how different actors estimate weights, the future, risk and a variety of parameter values differently.

Keywords Cost, Risk, Value of human lives, War, Benefit, Expected utility, Economic value, Influence value

Paper type Research paper

1. Introduction

1.1 This paper's contribution

Wars are started for all kinds of reasons and sometimes apparently without reasons. This paper seeks to establish cost benefit reasoning for starting wars. That which makes war costlier or less beneficial will reduce its likelihood. Hence, determining the actual costs and benefits of war, incorporated into a scientific framework for analysis, is essential. This is an extraordinarily complex phenomenon to analyze. Cost benefit analysis of war is largely missing or incomplete in the literature. A war may cause human life to be saved versus lost, economic value gained versus lost and influence value gained versus lost, assigned suitable weights determined by societal priorities. Although laws in industrial nations assign infinite value to human life, e.g. illegalizing slavery, scarce resources preclude saving every life. Thus, the value of statistical life is used, determined by considering the risk/reward trade-offs that people make with regard to their health. The labor market is commonly used, correlating higher wages

JEL classification – C2, C6, D7, H56

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with higher death risks. These studies are referred to as revealed preference studies based on people's choices. The notion of statistical life is mainly used related to saving lives as opposed to taking or producing lives, used in disciplines including economics, health care, adoption, political economy, insurance, worker safety, environmental impact assessment and globalization.

The cost benefit analysis can be considered from several perspectives: politicians, governments, soldiers, communities, subpopulations, various intelligence communities, taxpayers, independent observers, people on each side of the war, stakeholders, third parties, etc. Assigning weights to stakeholders, values, gains, losses, etc., depends not only on the actor assigning but also on the institutional setting within which the weighting process unfolds. Perceived information asymmetry matters, as does public (and elected representatives') participation in the weighting process. Risk averse and risk seeking behavior is allowed for, and contexts in which irrationality or bounded rationality arises. Also enabled are different decision makers to weigh the three different kinds of values differently, to follow positive economics or impose value judgments, be subjective and allow for anchor bias, optimism and so forth. A static model is presented, together with a dynamic model summing over periods with time discounting. If the benefits outweigh the costs, war is recommended, otherwise not.

Benefits and costs can be assessed narrowly economically by some decision makers, and broadly by other decision makers to account, for example, for welfare aspects (e.g. issues of compensation and distribution). For example, one democratically inclined decision maker may be more concerned about the distribution of gains and losses rather than the overall balance and may degrade the benefits if the distribution is unfair. Other decision makers may be more concerned about the perceived or socially constructed interpretation of costs and benefits than about the objective costs and benefits (if the latter could somehow be established). For example, media reporting arguably tilted public opinion against the 1956-1975 Vietnam War. Objectively, the weights of the three kinds of losses may have remained unchanged, but the decision makers in charge interpreted the losses differently after intense media scrutiny.

The paper accounts not only for human lives saved versus lost (i.e. killed) but also for injuries which can be physical (amputations, diseases, etc). and psychological (traumas, posttraumatic stress disorders, etc.). For example, The Vietnam War caused 58,286 killed in action or non-combat deaths (including the missing and deaths in captivity, see http://aad.archives.gov/aad/series-list.jsp?cat=WR28, retrieved 1 May, 2015). Economic value is defined as monetarily quantifiable. It includes war budgets, i.e. military equipment, salaries, food, accommodation, etc., costs of rebuilding destroyed infrastructure, access to new markets, e.g. if winning a war means gaining access to a coast line, etc. For example, the Gulf War was initiated by Saddam Hussein partly motivated by gaining access to Kuwait's oil. Influence value is defined as political, economic and symbolic prestige, power, the ability to determine subsequent developments and priorities in world affairs, etc. For example, winning the Second World War enabled five countries to gain permanent seats in the United Nations Security Council. The paper allows subcategories for each kind of value. For example, the value of human lives can be divided into nationality, soldier/civilian and disability status. Economic value can be divided into direct costs, indirect costs (stimulus benefits, economic benefits of providing young soldiers with marketable skills, etc.), resources (territory, oil, long-term leases on military bases, etc.), etc. Influence value can be divided

into influence in different subject areas (technology, space exploration, innovation, etc.), influence in different world regions (Middle East, Africa, etc). and influence upon certain demographic groups, professions, interest groups, species, etc. Accounting for different kinds of value can be interpreted so that costs and benefits have different attributes. For multi-attribute utility theory, see Keeney and Raiffa (1976) and Borcherding *et al.* (1991).

1.2 The literature

The war literature has a long history. Early contributions were by Tzu (-320) (1971) and Clausewitz (1832). Lanchester (1916) provided early formulations as differential equations. Hausken and Moxnes (2002) analyzed stochastic versions of the differential equations. Epstein (1985) conducted dynamic analysis without Lanchester theory, Lepingwell (1987) considered laws of combat, and Usher (1989) evaluated the dynastic cycle and the stationary state. Cederman (2003) modeled the size of wars, and Findlay (1996) determined territorial expansion and the limits of an empire. Jervis (1976) assessed deterrence, spiraling and intentions, and Kuran (1989) considered unanticipated political revolution. Further, Richardson (1939) analyzed armament, Intriligator and Brito (1984) assessed whether arms races can lead to the outbreak of war, Gunderson (1974) evaluated the origin of the American Civil War, and Wittman (1979) assessed how a war ends. Fearon (2003) and Fearon and Laitin (2003) considered the role of ethnicity in war, and Wolfson *et al.* (1992) assessed competing optima in the Gulf War.

Yakovlev (2007) considered 28 countries during 1965-2000 and found that higher military spending and net arms exports separately lead to lower economic growth, but higher military spending is less detrimental to growth when a country is a net arms exporter. Higgs (2012) assessed the impact of war on the economy and civil liberties, arguing that the US government exploits national crises and limits the rights and liberties of all citizens for the benefit of the few, especially political leaders and industrialists.

Cost benefit analyses of war are somewhat missing in the literature. Historically, Pigou (1921) provided a political economy of war, Robbins (1939) considered the economic causes of war and Dolfsma and Kesting (2013) considered the late Kenneth E. Boulding's interdisciplinary economics where costs and benefits played a role, see e.g. Boulding (1989). In contrast, rationalist explanations of war are more common. Bueno de Mesquita (1980, 1981, 1988, 1989) developed expected utility theories of international conflict. McGuire (1992) specified economic factors in the future of nuclear defense, Hausken (2016) conducted cost benefit analysis of terrorist attacks, and Collier and Sambanis (2002) edited a special issue on the economics of civil war. Burton and Azar (1986) considered cost and benefits of violence and war from a need-based perspective. For economic modeling of the 2003-2011 Iraq War, see Berman *et al.* (2011). They developed a three-way contest between rebels, government and civilians, where counterinsurgency economics indicates the importance of governance issues.

1.3 Cost benefit analysis as utilitarianism and consequentialism

The cost benefit analysis in this paper contributes to public policy by offering a heuristic device, as a way of thinking about one dimension of the moral appraisal of a prospective war. Establishing cost benefit reasoning for starting wars means using the moral theory of utilitarianism, which informs a huge body of theoretical and applied economic

analysis. Bentham (1789), considered to be the founder of modern utilitarianism, proposed that the measure of right and wrong is the greatest happiness of the greatest number of people. Utilitarianism is often aligned with consequentialism and teleological reasoning, and opposed to, for example, deontology which especially Kant (1785) favored. Deontology holds that moral rules ought not to be broken, even when breaking the rules may yield better consequences in a utilitarian sense. Moral rules may place limits both on the pursuit of one's own narrow (or even other-regarding) interests and on the pursuit of the aggregative general good. Some of the actors in this paper's framework may respect and assign benefits and costs to honoring such rules. Even in a rule-utilitarian framework, utilitarian arguments can always be deployed to justify deviations from rules (and to trump individuals' rights). See Hausken (1996b) for a theory of maximizing a weighted sum of self-interest and sympathy, and Hausken (1996a) regarding accounting for ethics in economic theory. The approach is based on utilitarianism, but implicitly accounts for a variety of alternative moral theories if actors assign benefits and costs to such theories. Although utilitarianism allows comparing gains and losses, some disadvantages should be pointed out. Taken to the extreme, utilitarianism may be used to justify theft and murder. For instance, one could argue that if my 80-year-old neighbor without dependents has something that my family of five needs to survive, I could steal from that neighbor or even kill him for the greater good. Five lives minus one really old life would yield net positive economic benefits. However, if the 80-year-old neighbor is assigned a sufficiently high human value, and the weight assigned to human life is sufficiently high, and the five lives can somehow be saved without murder, then murder is not justified according to utilitarianism.

1.4 Alternative perspectives on war

Alternatives to empirical economic analysis of war exist. Allison (1971) used the 1962 Cuban Missile Crisis to illustrate three models of decision-making, i.e. the rational actor model which is closest related to this paper's approach, the organizational process model accounting for bounded rationality and the governmental politics model accounting for court politics.

Sturm (2012) assessed the psychology of human reasoning, with evidence supporting the use of heuristics and biases, bounded rationality and formal norms. Christie and Montiel (2013) identified how American psychologists impacted changes in US interests and perceptions of national security threats related to war and peace for the First and Second World Wars and, the Cold War and the Global War on Terror. They argued that since the 1960s, reacting to the threat of nuclear war, peace psychology has grown focusing on policies that promote peace, social justice and human well-being. McDonald *et al.* (2012) described how male coalitional aggression in intergroup conflict impacts the social psychologies of men and women differently, supporting a male warrior hypothesis. Kanazawa (2009) considered the evolutionary psychological foundations of civil wars, arguing that available reproductive women impact intergroup conflict.

Malesevic (2008) analyzed the macro sociological accounts of the purpose and causes of recent wars. Sharman (2015) criticized competitive selection as determining adapted sovereign states and argued that units secure social acceptance through conformity to promote legitimacy. Roxborough (1999) criticized that modernization theory cannot explain the persistence of war and argued that cognitive frameworks, organizational decision-making and cartelized political systems make war likely. Malesevic (2014)

observed consensus that warfare has changed over the past three decades, but questioned views of the direction and causes of this change, such as wars becoming more brutal, chaotic and decentralized, or wars becoming fewer, less lethal, more localized and shorter. Malesevic (2014) argued for organizational continuity, that warfare is not becoming obsolete, and "that new wars' are unlikely to completely replace inter-state warfare."

From an ethical perspective, it can be assessed whether wars should be initiated on moral grounds. Walzer (1977) applied medieval Just War Theory to consider reasons that can justify the jus ad bellum (right to go to war), and jus in bello (the right conduct within war). He attempted to develop a modern, secular theory of just war. Jus ad bellum contemplates issues such as just cause, comparative justice, competent authority, right intention, probability of success last resort and proportionality. Jus in bello contemplates issues such as distinction (e.g. between combatants and non-combatants), proportionality, military necessity, fair treatment of prisoners of war and no means malum in se (e.g. not using weapons or methods of warfare considered evil. Kovac (2013) presented a pacifist's perspective on science, ethics and war.

1.5 Alternatives to war versus no war

Although this paper presents an either/or type of analysis, i.e. war versus no war, alternatives exist. Such alternatives may be especially relevant if costs and benefits are similar but may apply dependent on the nature of the conflict regardless of costs and benefits. The most prominent alternatives are mediation and negotiation. Overviews of international mediation have been provided by Wall *et al.* (2001), Duursma (2014) and Vukovic (2014). Wall *et al.* (2001) reviewed six areas, i.e. determinants of mediation, mediation *per se*, mediation approaches, determinants of the mediation approaches, mediation outcomes and determinants of the mediation outcomes. The research is mostly descriptive. Wall *et al.* (2001) argued that the research involving determinants has potential for theory development. Duursma (2014) reviewed the antecedents of mediation, possible mediation approaches and the outcomes, to enable peacemakers to prevent and resolve armed conflict. He found that how mediation impacts the likelihood of reaching agreement has been extensively studied, in contrast to other outcomes. He thus requested further research on mediation not causing peace, the accumulative effect of peace agreements, how mediation affects positive peace and on the interlinkages between the different phases of the mediation process. Vukovic (2014) reviewed how mediators' characteristics, contextual and behavioral factors, and types of mediators impact outcomes. Negotiations are also powerful alternatives to war. Caputo (2013) reviewed 21 cognitive biases in negotiation processes, considering the literatures of judgment and decision-making, conflict management, psychology and management. Hausken (1997) integrated game-theoretic and behavioral negotiation theory, observing how the former is based on concepts such as extensive form, payoff and information structure and equilibrium concepts, whereas the latter is based on psychology, organization theory, sociology and related fields. Future research should link such alternative approaches to the type of research presented in this paper.

1.6 This paper's approach

Science advances by moving back and forth between the theoretical domain (domain of justification) and the empirical domain (domain of discovery). This paper operates

mainly in the theoretical domain but delves into the empirical domain by sketching how the model can be used to determine whether the US government should initiate war in Iraq.

Section 2 presents the model. Section 3 sketches procedures for estimating the parameter values. Section 4 applies empirics from the 2003-2011 Iraq War to illustrate how to use the model. Section 5 concludes.

2. The model

This section considers the decision of whether to initiate war from the perspective of actor *i*. Actor *i* is most prominently thought of as a government, but actor *i* can be a political party, politicians, various intelligence communities, soldiers, taxpayers, independent observers, people on each side of the war, stakeholders, third parties or any actor or group of actors.

The model accounts for three kinds of value. For the value of human lives, the value of statistical life (Viscusi, 1993; Viscusi and Aldy, 2003) is used when death occurs, and the insurance values are used for non-death injuries. Although laws in industrial nations assign infinite value to human life, e.g. illegalizing slavery, scarce resources preclude saving every life. The value of statistical life is determined by considering the risk/reward trade-offs that people make with regard to their health. The labor market is commonly used, correlating higher wages with higher death risks. These so-called revealed preference studies are based on people's choices. Although the notion of statistical life is mainly used related to saving lives as opposed to taking lives, this paper assumes the same value for both gained and lost lives. The notion of producing lives is outside the scope of this paper. The value of statistical life is used in disciplines such as economics, health care, adoption, political economy, insurance, worker safety, environmental impact assessment and globalization. Common estimates are US$6.1-US$9.1m (Appelbaum, 2011). Common values for one year of human life are US$50,000-US$129,000 (Kingsbury, 2008).

The parameters H_G and H_L are defined as the value of human lives gained versus lost, E_G and E_L are defined as the economic value gained versus economic value lost and I_G and I_L are defined as the influence value gained versus influence value lost, where subscript G means "gained" and subscript L means "lost". Gains and losses are determined relative to some agreed upon baseline. Assigning weight α_H to the value of human lives, weight α_E to economic value, $0 \leq \alpha_H, \alpha_E \leq 1$ and the remaining weight $1 - \alpha_H - \alpha_E$ to influence value, the utility from war for actor i is:

$$u_i = \alpha_H(H_G - H_L) + \alpha_E(E_G - E_L) + (1 - \alpha_H - \alpha_E)(I_G - I_L) \quad (1)$$

The α_H parameter varies substantially. A dictator may set $\alpha_H = 0$ (valuing only his own life), while a socially inclined actor may set α_H substantially higher at $\alpha_H = 1/3$, and $\alpha_H = 1$ if only the value of human lives matters.

Generalizing the static model in equation (1) to account for the three kinds of values gained and lost in each period t, $t = 1, \ldots, T$, where T is finite or infinite, the six values are expressed as $H_{Gt}, H_{Lt}, E_{Gt}, E_{Lt}, I_{Gt}, I_{Lt}$, where subscript t means time. Summing over T periods, the war utility is:

$$U_i(T) = \left(\sum_{t=1}^{T} \delta^{t-1} [\alpha_H (H_{Gt} - H_{Lt}) + \alpha_E (E_{Gt} - E_{Lt}) + (1 - \alpha_H - \alpha_E)(I_{Gt} - I_{Lt})] \right)^{1-\beta} \tag{2}$$

where δ, $0 < \delta \leq 1$, is the time discount factor and β is the risk parameter. That is, $\delta = 1$ means that the future and present are equally important, whereas $\delta < 1$ assigns lower weight to the future. Further, $\beta < 0$ means risk seeking, $\beta = 0$ means risk neutrality and $\beta > 0$ means risk avoidance.

Next, it is assumed that actor i accounts for the views of N different stakeholders or decision makers when determining the war utility. This is relevant for example for a government seeking high approval by appeasing disparate interests among its concerned stakeholders. Actor i assigns weight γ_j to stakeholder j, $\Sigma_{j=1}^{N} \gamma_j$, and stakeholder j assigns the weights α_{Hj}, α_{Ej} and $1 - \alpha_{Hj} - \alpha_{Ej}$ to the value of human lives, economic value and influence value, respectively. Actor i's war utility is then:

$$U_i(T) = \left(\sum_{t=1}^{T} \delta^{t-1} \left[\frac{\sum_{j=1}^{N} \gamma_j \alpha_{Hj}}{N} (H_{Gt} - H_{Lt}) + \frac{\sum_{j=1}^{N} \gamma_j \alpha_{Ej}}{N} (E_{Gt} - E_{Lt}) + \frac{\sum_{j=1}^{N} \gamma_j (1 - \alpha_{Hj} - \alpha_{Ej})}{N} (I_{Gt} - I_{Lt}) \right] \right)^{1-\beta} \tag{3}$$

The next generalization is to consider M mutually exclusive and jointly exhaustive subcategories for the three kinds of value. Subcategory k for the six values is labeled as H_{Gkt}, H_{Lkt}, E_{Gkt}, E_{Lkt}, I_{Gkt} and I_{Lkt}. Summing the value difference for each kind of value over all the M subcategories, equation (3) generalizes to:

$$U_i(T) = \left(\sum_{t=1}^{T} \delta^{t-1} \left[\frac{\sum_{j=1}^{N} \gamma_j \alpha_{Hj}}{N} \sum_{k=1}^{M} (H_{Gkt} - H_{Lkt}) + \frac{\sum_{j=1}^{N} \gamma_j \alpha_{Ej}}{N} \sum_{k=1}^{M} (E_{Gkt} - E_{Lkt}) + \frac{\sum_{j=1}^{N} \gamma_j (1 - \alpha_{Hj} - \alpha_{Ej})}{N} \sum_{k=1}^{M} (I_{Gkt} - I_{Lkt}) \right] \right)^{1-\beta} \tag{4}$$

The parameters in equation (4) can furthermore account for anchor bias, optimism and so forth.

The next generalization is to sequential decision-making about when to pull out of a war, given that war has been initiated. Assume that the current period is τ, $1 < \tau \leq T$, with accumulated utility $U_i(\tau)$. Actor i estimates $U_i(\tau + 1)$, $U_i(\tau + 2)$, …, $U_i(T - 1)$, $U_i(T)$ to determine whether to continue or cease warfare. If $U_i(t)$ increases or decreases monotonically as t increases beyond τ, warfare is continued or ceased, respectively. If $U_i(t)$ is inverse U-shaped, warfare proceeds until maximum $U_i(t)$ is reached, upon which

a new decision is made. If $U_i(t)$ is U-shaped, the challenging decision is whether to accept the early losses to possibly obtain future gains. Considerations like these were relevant, e.g., for the 1956-1975 Vietnam War.

The final generalization is to Q actors in a game, i.e. engaged in war against each other, who maximize their utilities $U_1(t)$, $U_2(t)$, …, $U_{Q-1}(t)$, $U_Q(t)$, $1 \leq \tau \leq t \leq T$. That is, each actor i, $i = 1, \ldots, Q$, maximizes his utility $U_i(t)$ taking the other actors' utilities $U_1(t)$, …, $U_{i-1}(t)$, $U_{i+1}(t)$, …, $U_Q(t)$ as given. This analysis can either be made before the war starts in period 1, or in any period t, $1 \leq \tau \leq t \leq T$. Actor i can assume that its own time horizon is $t = T_i$, and that the other actors' time horizons are T_1, …, T_{i-1}, T_{i+1}, …, T_Q, respectively, additionally assessing whether the other actors will continue or cease warfare. Alternatively, the analysis can be made in period τ, $1 < \tau < T$, applying past knowledge and estimating future development.

Although actor i is most prominently thought of as a government, actor i can be any actor or group. Different actors differ mainly in how they assess the weights α_H, α_E, and $1 - \alpha_H - \alpha_E$ for the value of human life, economic value and influence value, respectively. For example, human rights groups place especially high value on the weight α_H of human life, possibly even setting $\alpha_H = 1$ so that war is excluded unless the first term in each of the equations (1)-(4) is positive. Corporations benefiting from war place especially high value on the weight α_E of economic value. Various interest groups and perhaps even some political parties concerned about the USA's status in the world as a super power place especially high value on the weight $1 - \alpha_H - \alpha_E$ of influence value. Regular citizens can be expected to spread out across various weights for α_H and α_E. Conscientious citizens may place a high value on α_H, and citizens concerned about their tax bill may place a high value on α_E.

Actors second differ in their assessment of the time discount factor δ. Actors concerned about the present estimate low δ, and actors concerned about the future estimate high δ. Actors third differ in their attitudes towards risk. Risk seeking actors estimate $\beta < 0$, and risk averse actors estimate $\beta > 0$. Actors fourth differ in how they assign weights γ_j to the various stakeholders j in equation (3). Democratically inclined actors can be expected to distribute weights across all stakeholders, while non-democratic actors can be expected to distribute weights only to themselves or stakeholders aligned with their own interests. Actors furthermore estimate parameters differently dependent on their value systems, especially for uncertain parameter values within ranges where different estimates may impact decisions on war initiation. For parameter values estimated or determined by available records, less leeway exists and all actors may estimate the same values.

3. Estimating the parameters in the model

Benefits, costs, weights and the various parameters in the model are challenging to measure in practice. This section sketches broadly how to go about estimating the parameters. Thorough estimation is a good starting point to support the model empirically using real world cases. One may start with cases that have occurred and where decisions were made either to go to war or not go to war. For each case, one works to break each decision into sub-decisions to determine which factors were judged to be relevant, which factors counted for versus against going to war and how each factor was weighted by the various actors and stakeholders. Thereafter, one proceeds with cases likely to occur in the future, and cases where a decision actually has to be made.

Many of the parameter values in the model, especially those associated with economic gains and losses, are either publicly available or can be accessed from various budgets. Confidential parameter values can be accessed by those with security clearance. Unknown parameter values for a country potentially subject to invasion can sometimes be accessed by using informants from that country, or by using covert agents and spying, or by paying someone to provide the information. Other methods are to use experts and knowledgeable persons, and through interviewing, reasoning and assessment try to establish reasonable estimates. When uncertainties exist one can establish plausible ranges for the parameter values, and worst case and best case parameters as judged by the invader, and the country potentially being invaded. One can also estimate probability distributions over these ranges. Further estimation techniques are to let people, office holders and elected officials estimate parameter values, exploring statements and interviewing sympathizers, opponents, spies and others, and applying expert judgments.

Thereafter, the estimated parameter values, with their associated uncertainties, ranges and probability distributions, are inserted into equations (1)-(4) to get a feel for how the model operates, and how the decision of whether to initiate war depends on changes in the parameter values. Moving back and forth between the theoretical domain and the empirical domain enables one to retune the parameter values and assess the consequences of such retuning. The parameter values can also be estimated experimentally applying the methods common in decision theory.

4. Empirics: The 2003-2011 Iraq War

This section illustrates the model by delineating how equation (1) can be used to determine whether war should be initiated. The analysis is from the perspective of the US government as actor *i*. Most baselines relative to which to estimate gains and losses are controversial. Saddam Hussein invaded Kuwait in 1990, was subject to sanctions and military strikes causing Iraqi deaths (Roberts *et al.*, 2004; Burnham *et al.*, 2006) and violated UN ceasefire conditions. One plausible baseline is the 2003 status quo of UN sponsored sanctions and limited military strikes.

Applying Smith's (2013) numbers, taken from available sources, lost value of human lives, H_L, is estimated as 200,000 Iraqis killed (see Roberts *et al.* (2004) for an attempt to assess the mortality before and after the 2003 Iraq invasion), 4,400 Americans killed, 32,000 Americans injured and 1,000,000 Iraqis injured. Additionally, as of December 2011, 3,258 civilian contract workers had been killed or died in Iraq, and another 90,000 had reported injuries (www.propublica.org/article/war-contractor-fined-for-late-reports-of-30-deaths, retrieved 1 May, 2015). Assuming US$9m for the value of a statistical life and US$0.9m for the cost of being injured, $H_{L,US} = (4{,}400 + 3258) \times$ US$9m + (32,000 + 90,000) $\times$ US$0.9m $\approx$ US$179bn is the estimation for the lost value of American lives. Assuming that the US government values Iraq's deaths and injuries at one-tenth of the American deaths and injuries, $H_{L,Iraq} = 200{,}000 \times$ US$0.9m + 1,000,000 $\times$ US$0.09m = US$270bn is the estimation for the lost value of Iraqi lives. Such valuations are of course controversial. History shows that countries initiating war are especially concerned about the survival of their own citizens. One alternative to assigning different values of statistical life to different nationalities is to distinguish between the value of human lives under freedom and tyranny, accounting for the quality of life that people can lead post war.

Gained value of human lives, H_G, means estimating how much value of human lives was saved by the war. Roberts *et al.* (2004) estimated the risk of death to be 2.5 times higher during the 17.8 months after the 2003 invasion compared with the 14.6 months before, and the risk of death from violence to be 58 times higher after compared with before the invasion. This suggests no gained value of human lives over this short term. Over the longer term, one may assess whether the removal of the Hussein family from power, to be replaced with various alternatives, may cause gained value of human lives. Some evidence exists that the Iraqi Kurds were subject to poison gas in Halabja in March 1988, an event that could be repeated in the future with Hussein's presence, but could also be repeated with other leaders' presence. Some probability existed that Hussein could develop weapons of mass destruction (WMDs), and a smaller probability that Hussein might proceed to nuclear weapons. Regime change in Iraq caused different dynamics between Sunnis and Shias, for terrorist groups, immigration and emigration, etc., complicating the assessment of gained versus lost value of human lives. The absence of war would have caused no American deaths and injuries, i.e. $H_{G,US} = 0$. Given this challenge of estimating hypothetical numbers, the hypothesis is that without the war, the Hussein regime would have caused 50,000 Iraqis killed and 250,000 Iraqis injured, i.e. $H_{G,Iraq}$ = US$68bn.

Lutz and Crawford (2013), Trotta (2013) and Smith (2013) estimated that the US government invested US$6trillion into the Iraq War, acknowledging that the war was debt financed. (This exceeds Stiglitz and Bilmes', 2010 estimation of the total direct and indirect costs of the 2003-2011 Iraq War to be over US$3trillion.) Lost economic value is thus estimated as E_L = US$6trillion. Lost economic value from the Iraqi perspective was destroyed infrastructure and costs of defending against the invasion. Under lost economic value can possibly also be listed the lost opportunity cost of fighting Islamic terrorism. Fighting wars simultaneously in Afghanistan and Iraq dilutes the effort, decreasing the success probability.

Gained economic value, E_G, is extremely challenging to estimate. One good starting point is the Keynesian argument (Markwell, 2006) that war is justified to the extent that it provides jobs and economic activity above that which would have occurred without the war. Thus, a hired soldier or contract worker is not indicative of greater economic activity unless this worker would have been otherwise unemployed. Complicating opportunity costs exist as investment in military expenditure has alternative uses. [Military (as with civilian use) public expenditures are subject to crowding out Ricardian equivalence where increased government borrowing may have no impact on consumer spending because consumers predict that tax cuts or higher spending will lead to future tax increases to pay back the debt. Weingast *et al.* (1981) argued that the distributional aspects of government expenditure have been linked to the geography of political representation, so overall public spending (including public expenditures connected to warfare) may be highly inefficient.] The comparative problem is that history has to be run again without the war to determine whether the absence of war causes more or less economic activity. Wars cause economic activity due to the military expenditure of producing, maintaining and deploying war equipment and soldiers, providing jobs, contracts for companies and ripple effects throughout the global economy. Winning wars may even boost the stock market, witnessed by the Dow Jones Industrial Average reaching 200 points in 1946, which was the highest since the Great Depression (Ho, 2014). Removing the Iraq dictatorship caused an initial boost to inward investment and

increased exports, causing increased gross domestic product (GDP). Smith (2013) estimated that Iraq's GDP, low due to sanctions before the war, grew robustly every year after 2006, benefitting from high oil prices. Ho (2014) argued that genuine progress indicator (GPI) is a better indicator than GDP, as it removes the impact of military spending. GPI more generally accounts for people's well-being, incorporates environmental and social factors, counts resource depletion as a loss and avoids some double counting. [For example, for GDP war damage, crime and pollution are counted as gains as side-effects of other processes, and thereafter as second gains when the war damage, consequences of crime and pollution are rectified and cleaned up. The US GPI has been relatively constant since 1970 (Raymond, 2008).] Wars benefit some more than others. Although countries do not go to war primarily by considering the economic benefits to the countries they invade, for the Iraq War economic benefits to Iraq were assessed to cause economic benefits also for the invading country. For example, US defense contractors benefitted substantially from the Iraq War. Lockheed Martin recorded net profits of US$2.7bn in 2011 (Ho, 2014). Former Republican politician, Ron Paul, argued that "war is never economically beneficial except for those in position to profit from war expenditures" (Ho, 2014). Tzu (-320) (1971) similarly observed that "where the army is, prices are high; when prices rise the wealth of the people is exhausted". However, ripple effects are also substantial. Soldiers have to be fed and thus farmers are needed. The Iraq War caused more free movement of Iraq's oil. Wars usually increase oil prices. For the Iraq War, the USA assessed the long-term impact of stabilizing a country, ensuring stable flow of oil, hoping for decreased oil prices which could benefit the US economy. Decision makers interpret differently. To illustrate the method, and show how the Iraq War could be justified, gained economic value is hypothetically estimated as E_G = US$7trillion.

Lost influence value, I_L, consists of some lost influence in Europe (where opposition to the war was larger), and some lost influence in the Islamic world and elsewhere. From the US perspective, the Iraqi War caused some solidification of the Russia–China alliance, counteracting the US influence globally. Special for the Iraq War was US Secretary of State Colin Powell's presentation of the role of WMD to the United Nations 5 February 2003. As subsequent WMD facts emerged, some degradation of the perception of the quality of US intelligence and public discourse occurred. The Iraq War partly removed Iraq as Iran's enemy, thus increasing Iran's strength and possibly accelerating its nuclear program, challenging US influence. The Iraq War caused some shift of power from Sunnis to Shias which caused some increase in the Iraqi population's support of some aspects of terrorism, and recruitment of some terrorist groups to Iraq, which can be counted as some lost influence with respect to fighting terrorism in the Middle East. The 2014 ISIS insurrection seeks to regain power for the Sunnis. Placing a value on lost influence is extremely challenging, as assessments diverge. Let us here, to illustrate the method and generate a number, estimate lost influence value as I_L = US$1trillion.

Gained influence value, I_G, from the US perspective consists of demonstrating willingness to engage militarily even when the United Nations recommends against it, which is perceived positively by some and negatively by others. Those that view it positively argue that the Iraq War followed from Iraq's failing to abide by the treaty that ended the first Iraq War (1990-1991). Consequently, the US regains world wide credibility by demonstrating that if treaties are ignored, consequences follow. The Iraq

War shifted some attention away from the 9/11 focus of US vulnerability, perceived positively by some. The USA experienced some larger influence in Iraq in 2013 compared to before 2003, thus obtaining some foothold geopolitically in the Middle East. Freedom House (www.freedomhouse.org) estimated Iraq to be slightly more free in 2013 compared to before 2003. Placing a value on gained influence is also extremely challenging. One may be inclined to believe that the US government estimates the gained influence value, and especially the desire for increased geopolitical control, to be larger than the lost influence value, and estimate gained influence value as I_G = US$3trillion.

Many wars have unintended consequences which can be costs or benefits. For example, The Second World War led to the creation of the United Nations, the Holocoust led to condemnation of genocide and the oil price can be moved up or down dependent on initiating versus not initiating war. One should be reluctant to count such unintended consequences, although they may be intended by some, as costs and benefits. Finally, the intelligence services possess information, not available to the public, that can alter the estimates of costs and benefits.

Inserting the values above, in US$trillion, into equation (1) gives:

$$u_i = \alpha_H(0 + 0.068 - 0.179 - 0.27) + \alpha_E(7 - 6) + (1 - \alpha_H - \alpha_E)(3 - 1) \quad (5)$$

Intuitively, equation (5) shows that war occurs if only economic values ($\alpha_E = 1$) or only influence values ($\alpha_H = \alpha_E = 0$) matter, and does not occur if only the values of human lives matter ($\alpha_H = 1$). With equal weight to these three kinds of value, $\alpha_H = \alpha_E = 1/3$, $u_i = 0.873$, and war occurs. If economic values and influence values are assigned equal weights, $\alpha_E = 1 - \alpha_H - \alpha_E$, war occurs if the values of human lives are weighted below $\alpha_H = 0.8$, and otherwise does not occur. Future research should compile more extensive empirics and use equations (2)-(4) to illustrate the model more thoroughly.

5. Conclusion

A cost benefit analysis of war is provided. Three kinds of value are distinguished, i.e. human, economic and influence, which can be gained or lost by initiating war. The three kinds of value are assigned different weights as assessed by various actors, e.g. politicians, governments, soldiers, communities, subpopulations, intelligence communities, taxpayers, independent observers, multiple warring sides, stakeholders and third parties.

Six models with gradually increasing sophistication are presented. The first subtracts losses from gains with relative weights for the three kinds of value for a given actor. The second generalizes to multiple periods, time discounting and attitude towards risk. The third accounts for the views of multiple stakeholders, assigned different weights, where each stakeholder assigns his own relative weights to the three kinds of value. The fourth generalizes to multiple mutually exclusive and jointly exhaustive subcategories for the three kinds of value. The fifth generalization is to sequential decision-making about when to withdraw from war. The sixth model is game theoretic with multiple actors in war with each other, maximizing their respective utilities accounting for costs and benefits. The cost benefit analysis is briefly and empirically illustrated with the 2003-2011 Iraq War.

This paper illustrates how different actors conduct cost benefit analysis differently. Examples of actors are governments, political parties, various interest groups, politicians, intelligence communities, soldiers, taxpayers, independent observers, people on each side of the war, stakeholders and third parties. These actors assign different weights to human life, economic value and influence value. Furthermore, different actors have different time discount factors, which determine, e.g., the extent to which a war can be debt financed, and different attitudes towards risk, which impact whether a war with for example uncertain economic gains should be initiated. Finally, actors assign different weights to stakeholders impacting whether war should be initiated. Future research should expand the empirical analysis by estimating several of the parameter values empirically and consider other wars. For example, for the 1956-1975 Vietnam War, lost value of human lives, H_L, was 58,220 US dead service members, 800,000 - 3.1 million Vietnamese service members and civilians killed, 200,000-300,000 Cambodians killed, and 20,000-200,000 Laotians killed, http://en.wikipedia.org/wiki/Vietnam_War, retrieved 1 May, 2015.

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