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The costs of conflict: A choice-theoretic, equilibrium analysis

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HIGHLIGHTS

- Conflict may never be chosen in a model with exogenously-destructive arms.
- Parties self-regulate by reducing arms allocations as unit arms-destructiveness rises.
- Endogenously-destructive conflict may be dominated by cooperation.

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ABSTRACT

In models of (destructive) armed conflict, it is standard to account for the *endogeneity* of arming allocations made by incumbent government and rebel parties. Indeed, standard contest-theoretic (microeconomic) models of behavior recognize that allocations change with shifts in marginal benefit or marginal cost. Taking governments and rebels as responsive to such shifts, the present study applies standard, contest-theoretic, equilibrium analysis to the Smith et al. (2014) model of conflict and cooperation. This alternative solution methodology yields starkly different results. Within the present analysis, there does not exist greater scope for cooperation given endogenously-destructive arming rather than exogenously-destructive arming.

1. Introduction

Destruction via arms allocation is a central aspect of conflict. Collier (2006) estimates that – upon the completion of a typical conflict – an economy is 15% poorer than it would have been had the conflict not taken place. Hoeffler and Reynal-Querol (2003) find that, "…the main economic losses from civil war arise not from the waste constituted by diverting resources from production, but from the damage that the diverted resources do when they are used for violence". Collier et al. (2004) find evidence of substantial financial capital flight during civil conflict and attribute this movement mainly to (anticipated) destruction of physical capital.

Early contest-theoretic models of armed conflict largely ignore the destructive nature of armed conflict. In a survey article, Hirshleifer (1989, 1995) does not mention destruction as a key feature of the conflict-theoretic literature. Subsequently, Grossman and Kim (1995), and Garfinkel and Skaperdas (2000, 2007), among others, consider a case of conflict that is exogenously-destructive of contested prize valuation. This oversight has recently been addressed in three notable studies that treat input allocations as endogenously destructive of conflict prize. Notably, Shaffer (2006), Chang and Luo (2013), and Sanders and Walia (2014) each depart from the early literature in treating arming as endogenously destructive of conflict prize.

A standard approach in the conflict-theoretic literature has been to consider two or more parties in the shadow of conflict who choose private arms allocations to maximize expected payoff.

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Without offering an alternative modeling approach, the aforementioned literature surveys by Hirshleifer (1995) and Garfinkel and Skaperdas (2007) detail this framework for the characterization of conflict. Among many others, this framework is also employed by Hirshleifer (1989, 1995), Skaperdas (2002), Gershenson and Grossman (2000), Garfinkel and Skaperdas (2000), Siqueira (2003), Garfinkel (2004a,b,c), Amegashie and Kutsoati (2007), Chang et al. (2007a,b), Chang and Sanders (2009), and Caruso (2010). More broadly, the same framework is standard in the analysis of Tullock (1980) contests (see, e.g., Baik, 1993). Despite addressing different questions within the study of conflict, the studies share a common modeling methodology. Specifically, these studies – and the economic approach at large – incorporate allocative choice that allows for *optimizing behavior* and *equilibrium* (see, e.g., Lazear (2000) for a detailed discussion of the economic approach).

In a recent article, Smith et al. (2014) use a distinct modeling methodology in analyzing the costs of armed conflict. As in studies by Shaffer (2006), Chang and Luo (2013) and Sanders and Walia (2014), the authors examine not only the explicit cost of conflict arming but also the (endogenous) prize-destructive cost of arms use. They subsequently compare private welfare levels resulting from endogenously-destructive conflict to those resulting from a cooperative outcome, in which parties arm and divide gains from a resource according to relative arming levels. From a social welfare perspective, the cooperative outcome is of great potential appeal because it avoids endogenous destruction of conflict prize. Of central importance, the authors find conditions under which the cooperative outcome is preferred to the conflictual outcome.

In summarizing the contributions of their paper, Smith et al. (2014) state, "Unlike conventional models of conflict whose arms-independent destruction costs assumption, in Grossman and Kim's (1995: 1279) words, precludes 'an internal explanation for violence and destruction,' our model of conflict with arms-dependent destruction costs provides one". Their article is also unconventional in its analysis. The authors establish a contest-theoretic setting but subsequently treat arms allocations as exogenous and invariant to shifts in the marginal benefit and marginal cost of arming from cooperative to conflictual setting. The authors *impose* an equivalence of arms allocations in the cooperative and conflictual cases. It is stated in footnote 5 of Smith et al. (2014) that "the chosen arming level is the same whether the parties choose to cooperate or engage in conflict" (63). If arming levels are chosen, how could it be that they are necessarily equal in environments featuring different marginal benefit and marginal cost of arming? Such a solution methodology lacks foundation in that the objective functions for conflict and cooperation, respectively, possess different prize valuations and different cost functions across the two cases. In a model of endogenously-destructive arming, the authors do not consider the endogeneity of arming itself. As Shaffer (2006) writes, "When prizes change with effort, contestants adjust effort to mitigate that change (250). Simple observations of military drafts and authorizations to appropriate funds for conflict provide evidence that arms allocations often vary given a change in setting. The endogeneity of arms allocation is a central component of conflict-theoretic equilibrium analysis. Said analysis describes the extent to which parties arm to win a conflict prize (i.e., to the point where the marginal benefit of arming just equals the marginal cost).

The present study applies standard, contest-theoretic, equilibrium analysis to the Smith et al. (2014) model and yields starkly different results. Namely, there does not exist greater scope for cooperation under endogenous destruction than under exogenous destruction within the present analysis of their model. In the standard analysis, rather, endogenous destruction discourages arms escalation such that it does not present more compelling grounds for cooperation (than does exogenous destruction). Given variation in both prize destructibility and arms destructiveness across conflict, it is of great importance – in terms of prediction and policy-orientation – to properly characterize the effect of endogenously-destructive arms upon conflict outcomes in an *equilibrium* analysis.

2. The case of exogenously-destructive conflict

Parties engage in conflict (cooperatively settle) as a means of resource allocation in the first of n rounds if such a choice renders a greater expected payoff. The choice of allocative means in the first round is taken to dictate expected resource value for each party in subsequent rounds (2 through n). Smith et al. (2014) depict exogenously-destructive conflict and cooperative settlement payoffs, respectively, in the following two objective functions for Party i against Party j:

$$\mathrm{EV}_{i,j}^{\mathrm{Coop}} = n\left[Y\left(\frac{a_{i,j}}{a_{i,j}+a_{j,i}}\right) - a_{i,j}\right] \quad \text{for } n\epsilon\ (1,\infty),$$

$$\mathrm{EV}_{i,j}^{\mathrm{Con}} = n\left[Y\left[1-\phi\right]\left(\frac{a_{i,j}}{a_{i,j}+a_{j,i}}\right)\right] - a_{i,j} \quad \text{for } n\epsilon\ (1,\infty),$$

where $a_{i,j}$ represents arms allocation, Y stands for original conflict prize valuation, and ϕ ($0 < \phi < 1$) represents the proportion of conflict prize valuation (exogenously) lost in the event of armed conflict. Smith et al. conclude that parties cooperate when:

$$n\left[Y\left(\frac{a_{i,j}}{a_{i,j}+a_{j,i}}\right) - a_{i,j}\right] > n\left[Y\left[1-\phi\right]\left(\frac{a_{i,j}}{a_{i,j}+a_{j,i}}\right)\right] - a_{i,j},$$

$$\text{or when } Y > \frac{(n-1)\left(a_{i,j}+a_{j,i}\right)}{n}\phi.$$

As the authors state, the game is symmetric across player. The game is not, however, symmetric from cooperative case to conflictual case. Note that the conflict prize valuation is distinct from the cooperative prize valuation, and the conflict cost function is distinct from the cooperative cost function. Therefore, it is not correct to assume that $a_{i,j}^{\mathrm{Con}} = a_{i,j}^{\mathrm{Coop}} = a_{i,j}^{*}$ (that equilibrium arms allocations in the conflictual and cooperative cases are equal). Rather, the optimal values of $a_{i,j}^{\mathrm{Con}}$ and $a_{i,j}^{\mathrm{Coop}}$ must be solved for independently. Without such a solution methodology, the comparison of (non-equilibrium) payoff values from cooperative case to conflictual case is meaningless. We are not interested in comparing $\mathrm{EV}_{i,j}^{\mathrm{Coop}}\left(\bar{a}_{i,j},\bar{a}_{j,i}\right)$ and $\mathrm{EV}_{i,j}^{\mathrm{Con}}\left(\bar{a}_{i,j},\bar{a}_{j,i}\right)$ Rather, we are interested in comparing $\mathrm{EV}_{i,j}^{\mathrm{Coop}}\left(a_{i,j}^{\mathrm{Coop}},a_{j,i}^{\mathrm{Coop}}\right)$ and $\mathrm{EV}_{i,j}^{\mathrm{Con}}\left(a_{i,j}^{\mathrm{Con}},a_{j,i}^{\mathrm{Con}}\right)$. Toward this end, we consider the following objective functions:

$$\mathrm{Max}_{\{a_{i,j}^{\mathrm{Coop}}\}}\mathrm{EV}_{i,j}^{\mathrm{Coop}} = n\left[Y\left(\frac{a_{i,j}^{\mathrm{Coop}}}{a_{i,j}^{\mathrm{Coop}}+a_{j,i}^{\mathrm{Coop}}}\right) - a_{i,j}^{\mathrm{Coop}}\right]$$
$$\text{for } n\epsilon\ (1,\infty),$$

$$\mathrm{Max}_{\{a_{i,j}^{\mathrm{Con}}\}}\mathrm{EV}_{i,j}^{\mathrm{Con}} = n\left[Y\left[1-\phi\right]\left(\frac{a_{i,j}^{\mathrm{Con}}}{a_{i,j}^{\mathrm{Con}}+a_{j,i}^{\mathrm{Con}}}\right)\right] - a_{i,j}^{\mathrm{Con}}$$
$$\text{for } n\epsilon\ (1,\infty).$$

By deriving first order condition and solving for optimal arms allocations, we find that

$$\frac{a_{j,i}^{\mathrm{Coop}}}{(a_{i,j}^{\mathrm{Coop}}+a_{j,i}^{\mathrm{Coop}})^2}Y = 1; \qquad \frac{a_{j,i}^{\mathrm{Con}}}{(a_{i,j}^{\mathrm{Con}}+a_{j,i}^{\mathrm{Con}})^2}nY(1-\phi) = 1;$$

$$a_{i,j}^{*\mathrm{Coop}} = a_{j,i}^{*Coop} = \frac{Y}{4}; \qquad a_{i,j}^{*\mathrm{Con}} = a_{j,i}^{*Con} = \frac{nY(1-\phi)}{4}.$$

Recall that n is an integer greater than 1. Therefore, arms expenditures are greater in the conflict case than in the cooperative case if $(1-\phi) > \frac{1}{n}$. If $(1-\phi) > \frac{1}{2}$ (i.e., first-round conflict destroys less than half of the resource value), then arms expenditures are greater in the conflict case for all possible values of n. Equilibrium arms allocations are equal across case only when $n = \frac{1}{(1-\phi)}$(i.e., only for a severe (equality) restriction of model parameters). We