A MODEL OF CONFLICT WITH INSTITUTIONAL CONSTRAINT IN A TWO-PERIOD SETTING
WHAT IS A CREDIBLE GRANT?

by

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ABSTRACT

This paper extends the modelling and the results presented in Caruso (2005a) which elaborates an economic approach to conflict theory and tries to develop a theory of integrative behaviour. In particular, the aim of this paper is to deal in a simple way with the impact of a larger time horizon on the incentives to cooperate or to conflict of two rational risk-neutral agents that conflict over the appropriation of positive shares of a contestable joint-output. What it is stressed here is that the emergence of a feasible conflict management must be grounded also upon a ***credible grant****. Throughout the paper, the analysis highlighted the impact of a larger time horizon on the incentives to settle. It is showed that as the time horizon becomes larger, being constrained under a set of rules appears to become more 'suspect' In fact, rational parties taking into account ex-ante payoffs would settle and join an institution at a relatively low levels of 'institutional fee'*

INTRODUCTION

This paper extends the modelling and the results presented in Caruso (2005a), which elaborates an economic approach to conflict theory and tries to develop a theory of integrative action which takes the existence of conflict into account from the start. In particular, this paper aims at dealing in a simple way with the impact of a larger time horizon on the incentives to cooperate or to conflict of two rational risk-neutral agents that conflict over the appropriation of positive shares of a contestable joint-output.

There is a common belief in literature about the emergence of cooperation between different actors, namely that a repeated interaction between actors can enhance cooperation. The most famous reference is Axelrod (1984). However, a repeated interaction does not lead necessarily to an enhanced cooperation. Take marriages. A marriage can be considered as a repeated game in some sense. Unfortunately, many marriages break off.

Another common belief is that the opportunity cost of conflicts does constitute a powerful force favouring peaceful settlements This would mean that if we were able to raise the price of arms up to the infinity there would not be wars anymore. Unfortunately, poorer societies in the world seem to be those most affected by violence. Then, this analysis is also intended to relax partly the impact of such feature in order to focus specifically on the design of an integrative mechanism able to lead to a peaceful settlement. In such a vision, the concept of a **credible grant** in integrative interactions will be presented.

This paper clearly draws heavily from the economic literature on conflict. The pioneering work on modelling conflict in recent economic literature is by Jack Hirshleifer, whose foundations are in Hirshleifer (1987, 1988, 1989). The economic theory of conflict[1] rests to a large extent upon the assumption that agents involved in conflict interactions have to choose an optimal level of efforts or resources devoted to the unproductive activity of conflicts.

[1] In more recent years several studies extended Hirshleifer's basic model. See among others: Grossman (1991), Skaperdas (1992), Garfinkel (1994), Grossman and Kim (1995), Neary (1997), Anderton and Carter (1999), Garfinkel and Skaperdas (2000).

Economic literature on conflict is akin to both rent-seeking and contest models. The main difference between the conflict models and the rent-seeking and contest models is that the former are generally general equilibrium models, whilst the latter are partial equilibrium models. This means that conflict models involve a trade-off between productive, say 'butter', and unproductive activities, say 'guns', and the contested prize (or the rent) is endogenous. That is, the stake of the conflict is interpreted as a joint production which depends upon the productive efforts of the agents. At the same time, the cost function is represented by the foregone production. In such a construction, the larger the number of the agents, the larger will be the 'pie' to be shared. Instead, in rent-seeking and contest models, the prize (or the rent) is given exogenously. In such a case, even if the number of contestants becomes larger, the rent does not change.[2]

However, conflicts, contests and rent-seeking can be considered directly unproductive activities (DUP) in the spirit of the definition provided by Bhagwati (1982), that proposes a general taxonomy for a broader range of economic activities which represent ways of making profit despite being directly unproductive. This is rationale behind the labelling *directly unproductive profit-seeking activities* (DUP). Their output is clearly zero in terms of the flow of goods and services entering a conventional utility function.

This paper is based on Garfinkel and Skaperdas (2000) and Caruso (2005a). Garfinkel and Skaperdas (2000) propose a model where the contestable joint-output can be disposed in one of two ways: through conflict, or through a peaceful and predefined division of the 'pie'. The exploitation of violence plays a role in both cases: in case of breakout of a violent conflict, 'guns' would determine directly the positive fraction, hence the attainable payoffs for each party; in case of a settlement, they constitute a credible threat and they influence each party's negotiating position, and therefore again the share of the 'pie' and the attainable payoffs of both agents. Thus, each agent's share of the 'pie' will be a weighted combination of two possible rules: (i) a Contest Success Function denoting the technology of conflict and (ii) a symmetric split-of-

[2] For a deep comparison of conflict and rent-seeking models see Hauken (2005).

surplus rule of division which is commonly indicated in the literature on bargaining as the appropriate axiomatic outcome. The relative weights are determined by a destruction parameter denoted by $\beta \in (0,1)$. According to this construction, when a settlement occurs, it does arise only *in the shadow of conflict* borrowing an expression from Anderton and Carter.

Caruso (2005a) extends the Garfinkel-Skaperdas model in order to consider the existence of an institution committed to conflict management and resolution. By institution I mean a set of 'rules of the game' affecting each agent's behaviour. The agents are assumed to join an institutional set of rules by giving up a certain amount of resources that would be spent for violent efforts. This behaviour is intended to modify the payoff functions of both agents. Throughout this paper, I will call h the *institutional fee*. For analytical simplicity, it is assumed to be exogenous and equal for both contestants. Being exogenous, the *institutional fee* does fit more with a scenario where an institution already does exist and third parties are allowed to join it. At the same time it could also be interpreted as an exogenous reciprocal concession fixed by a mediator. Anyway, by paying this *institutional fee*, agents also signal the intention to comply with obligations emerging under an institutional regime. The intuition behind the nature of such *institutional fee* relates to Boulding's idea of 'grants economics' in integrative systems.[3] The reduction of resources devoted to unproductive 'guns' is also a pillar of the contractarian approach as expounded in Skogh and Stuart (1982).

The paper proceeds as follows: in a first section the model expounded in Caruso (2005a) is presented. In a second section the model is extended in a two-period setting. The last section presents some concluding remarks introducing in a simple way the concept of **credible grant**.

I. THE ONE-PERIOD MODEL

There are two risk-neutral agents indexed by $i = 1,2$. Each one is endowed with an initial positive endowment of resources, $n_i \in (0,\infty), i = 1,2$. They conflict over

[3] Boulding expounded in a comprehensive manner the theory of 'grants economics' in Boulding et al. (1972) and in Boulding (1973).

to appropriate a share of a contested joint-producton and then they have to make simultaneous once-and-for-all choices about their own allocation of resources between 'butter' and 'guns'. At the same time, they divert a certain amount of resources to join an institutional setting. Let $h \in (0,\infty)$ denote the positive amount of resources given up in order to join an institutional framework, namely an *institutional fee*. Then, the resources endowment can be divided according to a resources partition equation defined by:

$$n_i = x_i + z_i + h_i \qquad (1)$$

Where $x_i \in (0,\infty)$ and $z_i = (0,\infty)$ denote 'butter' and 'guns' respectively. They conflict over a contestable joint-production, namely the 'pie', denoted by a simple linear additive production function:

$$Y(x_1, x_2) = x_1 + x_2 \qquad (2)$$

The agents of the model can either fight or find a settlement. Given the assumption of rationality, agents will choose whether to fight or to settle comparing the expected payoffs coming from pure conflict and institutional setting respectively. Therfore, through comparative statics it would be possible to determine what would be the optimal choice for both agents.

In case of pure conflict (with $h = 0$ by assumption) the utility functions for both agents are represented by:

$$U_i^{pc}(z_1, z_2, x_1, x_2, \beta) = p_i \beta Y = \beta \frac{z_i}{z_i + z_j}(x_1 + x_2) \quad \text{for } i = 1,2 \qquad (3)$$

where the superscripts '*pc*' denote 'pure conflict'. A paramater $\beta \in (0,1)$ captures the foregone fraction of the positive stake due to the violent activity. In other words, as β increases, the conflict becomes less and less destructive. The destruction parameter can be interpreted as an *ex-ante* perceived evaluation of conflict losses. Both agents share the same perception of expected destruction.

The cornerstone of equation (3) is represented by a Contest Success Function (hereafter CSF for brevity) determining the outcome of conflict.[4] The CSF summarizes the relevant aspects of what Hirshleifer defines the *technology* of conflict. In particular, even if the CSF can take different forms, I apply the *ratio* form of the CSF.[5]

$$p_i(z_i, z_j) = \frac{z_i}{z_i + z_j} \qquad \text{for } i = 1,2 \text{ and } j \neq i \qquad (4)$$

where, under the assumption of risk-neutrality p_i denotes the proportion of appropriation going to agent i for $i = 1,2$ and follows the conditions below:

$$\begin{cases} p(0,0) \equiv 1/2 \\ p_1 + p_2 = 1 \\ p(.,.) \text{ is twice differentiable} \\ \partial p_i / \partial z_i > 0 \qquad \partial p_i / \partial p_j < 0 \\ \partial^2 p_i / \partial z_i^2 \leq 0 \qquad \partial^2 p_i / \partial z_j^2 \geq 0 \end{cases} \qquad (4.1)$$

Hence, assuming a Nash-Cournot behaviour, each opponent will maximize its own payoff expecting that the opponent is choosing the similar maximization strategy. Through an ordinary maximization technique (under the resources constraint) it is possible to show each player's optimal choice of 'guns' given the corresponding choice of the contender. The interior Cournot solution is given by:

$$z_*^{pc} = z_1^{pc} = z_2^{pc} = (n_1 + n_2)/4 \qquad (5)$$

[4] The Contest Success Function is a mathematical relation that links the outcome of a contest and the efforts of the players. It is actually a founding pillar of many models. Selective seminal contributions are by Tullock (1980), O'Keeffe et al. (1984) and Rosen (1986). Dixit (1987) develops a general framework for contests using the general properties of logit functions. Hirshleifer (1989) focuses on a different form for the CSF: the ratio form and logit form. See also Skaperdas (1996) and Clark and Riis (1998) for a basic axiomatization.

[5] Hirshleifer (1989) analyses the different impact of two different function forms for CSF: the *ratio form* and the *logistic form*. In the first case, the contest outcome depends upon the ratio of the efforts applied, whilst in the second case it depends upon the difference between the resources committed.

where the stars subscripted denote the equibrium level. Indeed, whatever the amount of resources available for each player, the contenders allocate the same absolute value to fighting efforts. Therefore, the income generated through the aggregate production function is equally divided between the two contenders. Formally, we have:

$$U_*^{pc} = U_1^{pc} = U_2^{pc} = \frac{\beta}{4}\left(n_1 + n_2\right) \qquad (6)$$

The alternative strategy set for both agents is modelled as a weighted combination of two rules of division: (i) the CSF and (ii) a symmetric split-of-surplus rule of division Their relative weights are determined by the destruction parameter. The utility functions will have as a cornerstone a modified version of the CSF:

$$p_i\left(z_{i,} z_j, h\right) = \frac{z_i - h}{z_i + z_j - 2h} \qquad \text{for } i = 1,2 \text{ and } j \neq i \qquad (7)$$

which follows the condition presented in (4.1) and also:

$$\begin{cases} \dfrac{\partial p_i}{\partial h} > 0 \quad \Leftrightarrow \quad z_i > z_j \\ \dfrac{\partial^2 p_i}{\partial^2 h} > 0 \quad \Leftrightarrow \quad z_i > z_j \\ \lim\limits_{h \to \infty} \left(\dfrac{z_i - h}{z_i + z_j - 2h} \right) = \dfrac{1}{2} \end{cases} \qquad (7.1)$$

Then, the utility functions in their functional specification become:

$$U_i^{ins}\left(z_i, z_j, \beta, h, x_i, x_j\right) = [\beta \frac{z_i - h}{z_i + z_j - 2h} + (1-\beta)/2](n_i + n_j - z_i - z_j - 2h) \qquad (8)$$

where the superscript '*ins*' denotes 'institution'. In the CSF, h can be considered a constant vector that affects the ordinary outcome of the contests.

In the CSF, the *membership fee* decreases the amount of resources devoted to 'guns'[6] In this case, it would negatively affect the poorer participant. That is, given the resources constraint of each contestant, the poorer side is relatively more impoverished. The first order conditions for the maximization problem are:

$$\frac{\partial U_i^{ins}}{\partial z_i}=\left[\frac{\beta(z_j-h)}{(z_i+z_j-2h)^2}\right](n_i+n_j-z_i-z_j-2h)-\left[\frac{\beta(z_i-h)}{(z_i+z_j-2h)}+\frac{(1-\beta)}{2}\right]=0 \qquad (9)$$

The second order conditions for a maximum are given by:

$$\frac{\partial^2 U_i^{ins}}{\partial z_i}=\frac{2\beta\left[4h^2-h(n_i+n_j+4z_j)+z_j(n_i+n_j)\right]}{(2h-z_i-z_j)^3}<0 \qquad (10)$$

Expression (10) dictates the conditions $h<\lfloor (n_i+n_j)/2\rfloor$ and $z_i-h>0, i=1{,}2$ at the symmetric equilibrium. It is simple to demonstrate that a symmetric interior Nash equilibrium level of 'guns' with $z_*^{ins}=z_1^{ins}=z_2^{ins}$ is:

$$z_*^{ins}=z_1^{ins}=z_2^{ins}=\frac{\beta(n_1+n_2)-2h(\beta-1)}{2(\beta+1)}; \qquad (11)$$

In this symmetric equilibrium utilities of both agents are:

$$U_*^{ins}=U_1^{ins}=U_2^{ins}=\frac{\beta(n_1+n_2)}{2(\beta+1)}-\frac{2h}{\beta+1} \qquad (12)$$

since the agents are assumed to be rational, it is possible to apply comparative statics in order to verify whether a settlement under an institutional setting is always preferable for both agents. Then, let $U_i^{ins}>U_i^{pc}, i=1{,}2$ be the *settlement*

[6] To the best of my knowledge, such type of modification is a novelty in literature, whilst there are some examples with an additive form. See Amegashie (2005), Dasgupta and Nti (1998).

condition. Manipulating and rewriting (6) and (12), the settlement condition becomes:

$$h < \frac{(\beta + 2)(1 - \beta)(n_1 + n_2)}{8} \qquad (13)$$

Given $n_1 \in (0, \infty)$ and $n_2 \in (0, \infty)$ the settlement condition depends upon the value of β and h. Since $\beta \in (0,1)$, the settlement condition is satisfied if and only if $h < [(n_1 + n_2)/4]$. In other words, parties can retain a level of utility higher than in continuing conflict, when they perceive the conflict as being destructive and the level of *membership fee* lies in an interval whose upper bound is given by the level of 'guns' each side would choose optimally under pure conflict. To summarise, when $h \in \left(0, z_*^{pc}\right)$, the model shows that both parties are better off if they find a settlement under an institution.

II. A TWO-PERIOD MODEL

Up to this point, a one-period model has been considered. In this section the model will be extended in order to take into account the impact of the future on the choices of agents. Consider for sake of simplicity two periods and no future beyond them. Within this simple dynamic setting, the two rational parties take into account second period payoffs when making their own first period choices. Therefore, the model can be solved by backward induction, starting from the final period outcome.

Let n_{it} denote the initial endowment of resources of agent $i = 1,2$ at time $t = 1,2$ In the first period the resources partition equation is as in (1). Suppose second period resources depend upon the realised utility in the first period. In the simplest case the resources available to each agent equal exactly the utilities realized in the first period. No discount factor is considered. This means that later utility is evaluated as much as the earlier utility. The results of the model will be sensitive to these assumptions[7]. More formally:

[7] Note that through this assumption the idea of the 'opportunity cost' of the conflict is strongly relaxed. In fact, agents are able to retain exactly the outcome of the first

$$n_{i2} = U_{i1} \tag{14}$$

The maximization problem in the second period is the same as in the first period. Thus, by substituting (14) into (3) and (8), it is possible to write the second period utility in the different scenarios. Anyway, in the first period each party will look at the sum of the *ex-ante* payoffs it receives over the two periods. Therefore, the objective function is so described:

$$V_i^j\left(U_{i1}^j, U_{i2}^j\right) = U_{i1}^j + U_{i2}^j,\ j = pc, ins; i = 1,2 \tag{15}$$

Through the comparison between the two-period payoffs it is possible to determine the choices of both agents. For instance, if $V_i^{ins} > V_i^{cc}$ for both $i = 1,2$, it would be possible to say that both agents would be willing to settle under the umbrella of an institution instead of being involved in a pure conflict situation. In other words, this condition could be considered as a *settlement condition* within a dynamic setting.

Now, recall the expressions (6) and (12). They represent the payoffs for both agents under pure conflict and under institution respectively. The *institutional* fee due to join an institution is assumed to be unchanged in the second period for both parties ($h = h_{i1} = h_{i2}, i = 1,2$). For sake of simplicity, notations for the first period are unchanged: then $n_{i1} = n_i, U_{i1} = U_i, z_{i1} = z_i$. Therefore, using equation (6) it is possible to write:

$$V_1^{pc} = V_2^{pc} = \frac{\beta(n_1 + n_2)}{4} + \frac{\beta(U_{11}^{cc} + U_{12}^{cc})}{4} \tag{16}$$

$$V_1^{ins} = V_2^{ins} = \frac{n_1 + n_2}{2(\beta + 1)} - \frac{2h}{\beta + 1} + \frac{U_{11}^{ins} + U_{21}^{ins}}{2(\beta + 1)} - \frac{2h}{(\beta + 1)} \tag{17}$$

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period. However, under this assumption the model is clearly biased towards conflict. Compare again Garfinkel and Skaperdas (2000), that assume $n_{i2} = \gamma U_{i1}, \gamma > 0$. Discussion on this point will be presented in the concluding remarks

Where (16) and (17) denote the two-periods payoff function for the continuing conflict and the institutional scenario respectively. Equations (16)[8] and (17) can be re-written as:

$$V_1^{pc} = V_2^{pc} = \frac{\beta(n_1+n_2)(\beta+2)}{8} \tag{18}$$

$$V_1^{ins} = V_2^{ins} = \frac{(n_1+n_2)(\beta+2)-4h(2\beta+3)}{2(\beta+1)^2} \tag{19}$$

Also in this case parties will settle in the first period and join an institution if and only if $V_i^{ins} > V_i^{cc}, i = 1,2$. That is, if and only if:

$$\frac{(n_1+n_2)(\beta+2)-4h(2\beta+3)}{2(\beta+1)^2} > \frac{\beta(n_1+n_2)(\beta+2)}{8} \tag{20}$$

Such settlement condition holds if and only if:

$$h^{**} < \frac{(n_1+n_2)(\beta+2)[4-\beta(\beta+1)^2]}{16(2\beta+3)} \tag{21}$$

Where h^{**} denotes the critical value of the membership fee over the two periods.

Such critical value for the institutional fee can be interpreted as a proxy of the willingness to settle for both parties. The higher is the critical value of h, the higher is the willingness to settle. In order to highlight a special feature of the two-periods model, recall the critical value h^*, captured by (13) for the membership fee in the basic model. Through a simple comparison it is possible to verify that:

$$h^{**} < h^* \tag{22}$$

[8] see appendix for complete algebra.

That is, **the critical value of the institutional fee in the two-period model is strictly lower than in the one-period model.** This result suggests that conflicting parties are not willing to give up a too high amount of resources when the time-horizon enlarges.

CONCLUDING REMARKS

The analysis presented here is grounded on Caruso (2005a) which is intended to be a contribution to integrative theory based upon the theory of 'grants economics' as developed and expounded by Kenneth Boulding. Albeit simple, the analysis in this section does shed light on a particular aspect. The point of interest is that parties will be willing to settle and join an institution if and only if the amount of resources devoted to join an institution is relatively low. This finding shows an interesting implication. It is commonly recognized the relevance of a credible threat in conflict interactions. What I would stress here is that the emergence of a feasible conflict management must be grounded also upon a **credible grant**

This statement clearly poses new problems on the definition of what does constitute a credible grant. Throughout this paper, the analysis highlighted the impact of a larger time horizon on the incentives to settle. It has been showed that as the time horizon becomes larger and larger, being constrained under a set of rules appears to become more and more 'suspect'. In fact, rational parties taking into account *ex-ante* payoffs would settle and join an institution at relatively low levels of 'institutional fee' In other words, it also would be possible to say that the willingness to settle decreases as the future becomes too far.

Recall also that according to the modelling presented here, the institutional fee is exogenously fixed. As expounded above, this does fit more with a scenario where agents commit themselves to an existing 'set of rules'. But, this also does fit with a scenario where a third party, say a mediator, makes a proposal to solve a conflict between two contestants. What this analysis shows is that such proposal must be credible and feasible for both parties. That is, whenever the grant is intended to be a reciprocal concession, a mediator ought to propose a reciprocal concession that is perceived as bearable by both contestants. Throughout the paper, symmetric equilibria emerged, but in reality it is clearly less probable that no disparities occur between conflicting parties. A credible grant would also take into account this aspect.

This result partly contrasts with the famous idea due to Axelrod (1984) according to which contenders in a long-term relationship are more willing to cooperate. At the same time, it also partly contrasts with Skaperdas and Syropulos (1996), and Garfinkel and Skaperdas (2000), that show that time dependence can intensify conflict. By contrast, this paper showed that a larger time horizon does not necessarily intensify conlict. It also suggests that under some conditions a settlement is feasible and such choice would not depend upon the opportunity cost of conflict. In fact, under a peculiar mechanism, namely the integrative relationship, the incentives to fight could be overcome.

Note that the models quoted above are biased in overestimating the opportunity cost of conflict, given the existence of a positive relationship between the outcome of the first period and the resources endowment at the beginning of a second period. More formally, equation (14) is a special case of $n_{i2} = \gamma U_{i1}, \gamma > 0$ as assumed by Garfinkel and Skaperdas (2000). The existence of a positive growth parameter leads to the conclusion that parties would prefer a war under some conditions. Using their words[9], *"the greater is the value of tomorrow's resources R_{i2} given today's payoffs U_{i1}, as indicated by the magnitude of γ, the larger is the set of values for ϕ that would be consistent with a preference for war over settlement. That is, a greater spillover effect means that each party has a greater tolerance for destruction of war"*. This result is clearly biased towards pure conflict because of the positive value of γ. Then, according to this line of reasoning, with $\gamma = 1$ as it is assumed in equation (14), the preference for waging a war would be stronger. But the point of worth interest is that the existence of an integrative mechanism is able to modify the incentives for both agents.

However, what I wanted to stress here is that the existence of an effective conflict management mechanism, as an integrative relationship, can be

[9] Garfinkel and Skaperdas (2000) p. 14. Note that in this paper the notations are: $\beta = \phi, R_{i2} = n_{i2}$

designed. What I would claim as a novel contribution is the idea that only by means of a **credible grant** conflict management is feasible. The findings of the model show that a credible grant is sensitive to the time horizon. The larger is the time horizon, the lower must be the value of the grant exogenously fixed, namely the amount of resources given up in order to solve the conflict.

REFERENCES

Amegashie A. J., (2005), A contest Success Function with a Tractable Noise Parameter, *Public Choice*, (forthcoming).

Anderson J. E., Marcouiller D., (2002), Insecurity and the Pattern of Trade: An Empirical Investigation, *The Review of Economics and Statistics*, vol. 84, no.2, pp. 342-352.

Anderton C. (2000), An Insecure Economy under Ratio and Logistic Conflict Technologies, *Journal of Conflict Resolution*, vol. 44, no. 6, pp. 823-838.

Anderton, C. H., Anderton R. A., Carter J., (1999), Economic Activity in the Shadow of Conflict. *Economic Inquiry*, vol. 17, n. 1, 166-17.

Baldwin D. A., (1973), The Power of Positive Sanctions, *World Politics*, vol. 24, no.1, pp. 19-38.

Baldwin, D.A. (1985), *Economic Statecraft*, Princeton University Press, Princeton.

Boulding, K. E., (1962), *Conflict and Defense: A General Theory*, Harper & Brothers, New York.

Boulding, K. E., (1963), Towards a Pure Theory of Threat Systems, *The American Economic Review, Papers and Proceedings*, vol. 53, no. 2, pp. 424-434.

Boulding, K. E., Pfaff M., Horvath J., (1972), Grants Economics: A Simple Introduction, *American Economist*, vol. 16, no.1, pp.19-28.

Boulding, K. E., (1973), *The Economy of Love and Fear*, Wadsworth Publishing Company, Belmont.

Caruso R., (2005a), A Trade Institution as a Peaceful Institution? A contribution to Integrative Theory, *Conflict Management and Peace Science*, (forthcoming).

Caruso R., (2005), A very simple model of Conflict with Asymmetric Evaluations and Institutional Constraint, mimeo.

Caruso, R., (2003), The Impact of Economic International Sanctions, *Peace Economics, Peace Science and Public Policy*, vol. 9, no. 2, pp. 1-34.

Cipolla, C. M., (1965), *Guns and Sails in the Early Phase of European Expansion 1400-1700*, Collins Sons & Co., London.

Clark, Derek J., Riis C. (1998), Contest Success Functions: An Extension, *Economic Theory*, vol. 11, pp. 201-204.

Cooper R. N., (1972), Trade Policy is Foreign Policy, *Foreign Policy*, no. 9, pp. 18-36.

Cooper R. N., (1973), (ed.), *A Reordered World, Emerging International Economic Problems*, Potomac Associates, Washington D.C.

Cooper R. N., (1987), Trade Policy as Foreign Policy, in Stern R.M. (ed.), *US Trade Policies in a Changing World Economy*, MIT press, Cambridge.

Dasgupta, A., and Nti, K.O. (1998), Designing an Optimal Contest, *European Journal of Political Economy*, vol. 14, pp. 587-603.

Dixit A. (1987), Strategic Behaviour in Contests, *The American Economic Review*, vol. 77, no.5, pp. 891-898.

Dixit A., (2004), *Lawlessness and Economics, Alternative Modes of Governance*, Princeton University Press, Princeton.

Garfinkel M. R., (1994), Domestic Politics and International Conflict, *The American Economic Review*, vol. 84, no.5, pp. 1294-1309.

Garfinkel, M. R., Skaperdas S., (2000), Conflict without Misperceptions or Incomplete Information: How the Future Matters, *Journal of Conflict Resolution*, vol. 44, no. 6, pp. 793-807.

Garfinkel, M. .R., Skaperdas S., (2001), Contract or War? On the Consequences of a Broader View of Self-Interest in Economics, *The American Economist*, vol. 44, no.1, pp. 5-16.

Garoupa Nuno R., Gata Joao E., (2002), A Theory of International Conflict Management and Sanctioning, *Public Choice*, vol. 110, pp. 41-65

Grossman H. I., (1991), A General Equilibrium Model of Insurrections, *The American Economic Review*, vol. 81, no.4, pp. 912-921.

Grossman, H. I., (1998), Producers and Predators, *Pacific Economic Review*, vol. 3, no. 3, pp.169-187.

Grossman, H. I., Kim M., (1995), Swords or Plowshares? A Theory of the Security of Claims to Property, *The Journal of Political Economy*, vol. 103, no. 6, pp. 1275-1288.

Hamilton, E. J., (1948), The Role of Monopoly in the Overseas Expansion and Colonial Trade of Europe before 1800, *The American Economic Review, papers and proceedings*, vol. 38, no. 2, , pp. 33- 53.

Hausken, K., (2005), Production and Conflict Models Versus Rent-Seeking Models, *Public Choice*, vol. 123, pp. 59-93.

Hirschman, A.O., (1945/1980), *National Power and the Structure of Foreign Trade*, University of California Press, Berkeley.

Hirshleifer, J., (1987), *Economic Behaviour in Adversity*, Wheatsheaf Books Ltd, Brighton.

Hirshleifer, J., (1988), The Analytics of Continuing Conflict, *Synthese*, vol. 76, no. 2, pp. 201-233. reprinted by Center for International and Strategic Affairs, CISA.

Hirshleifer, J., (1989), Conflict and Rent-Seeking Success Functions, Ratio vs. Difference Models of Relative Success, *Public Choice*, no. 63, pp.101-112, re-printed in Hirshleifer (2001), pp. 89-101.

Hirshleifer, J., (1991), The Paradox of Power, *Economics and Politics*, vol. 3, pp. 177-200, re-printed in Hirshleifer (2001), pp. 43-67.

Hirshleifer, J., (1994), The Dark Side of the Force, *Economic Inquiry*, vol. 32, 1-10.

Hirshleifer, J., (2001), *The Dark Side of the Force, Economic Foundations of Conflict Theory*, Cambridge University Press.

Isard, W., (1988), *Arms Races, Arms Control, and Conflict Analysis, Contribution from Peace Science and Peace Economics*, Cambridge University Press, New York.

Landes, D.S., (1999), *The Wealth and Poverty of Nations, Why some Are so Rich and Some so Poor*, Abacus, London.

Mansfield E.D., Pevehouse J.C., (2000), Trade Blocs, Trade Flows, and International Conflict, *International Organization*, vol. 54, pp. 775-808.

Neary H. M., (1997), Equilibrium Structure in an Economic Model of Conflict, *Economic Inquiry*, vol. 35, no. 3, pp.480-494.

Noh, S. J., (1999), A General Equilibrium Model of Two Group Conflict with Endogenous Intra-Group Sharing Rules, *Public Choice*, vol. 98, pp.251-267.

O'Keeffe M., Kip V. W., Zeckhauser R. J. (1984), Economic Contests: Comparative Reward Schemes, *Journal of Labor Economics*, vol.2, no.1, pp. 27-56.

Padoan P.C. (1997), *Integrazione e Sicurezza nel Mediterraneo, Le Opzioni dell'Occidente*, Franco Angeli, Milano.

Perroni C., Whalley J., (1994), The New Regionalism: Trade Liberalization or Insurance?, NBER working paper no. 4626.

Polachek, S. W., (1980), Conflict and Trade, *Journal of Conflict Resolution*, vol. 24, no.1, pp. 55-78.

Polachek, S. W., (1992), Conflict and Trade: An Economics Approach to Political Interactions, in Isard W., Anderton C.H., (eds.), *Economics of Arms Reduction and the Peace Process,* North Holland, Amsterdam.

Polachek, S. W. (1994), Peace Economics: A Trade Theory Perspective, *Peace Economics, Peace Science and Public Policy*, Vol. 1, no. 2, pp. 12-15.

Polachek, S.W., (1997), Why Democracies Cooperate More and Fight Less: The Relationship Between International Trade and Cooperation, *Review of International Economics*, vol. 5, no. 3, pp. 295-309.

Polachek, S. W. (1999), Conflict and Trade: An Economics Approach to Political International Interactions, *Peace Economics, Peace Science and Public Policy*, Vol. 5, no. 2.

Polachek, S. W., Robst J., Yuan C. C., (1999), Liberalism, interdependence: Extending the trade conflict model, *Journal of Peace Researc*h, vol. 36, no. 4, pp. 463-79.

Reuveny R., (2000), The Trade and Conflict Debate: A Survey of Theory, Evidence and Future Research, *Peace Economics, Peace Science and Public Policy*, vol.6, no.1.

Rosen S., (1986), Prizes and Incentives in Elimination Tournaments, *The American Economic Review*, vol. 76, no.4, pp. 701-715.

Schelling T. C., (1960), *The Strategy of Conflict*, Harvard.

Schiff M., Winters A. L., (1997), Regional Integration as Diplomacy, World Bank working paper.

Skaperdas, S., (1992), Cooperation, Conflict, and Power in the Absence of Property Rights, *The American Economic Review*, vol. 82, no.4, pp.720-739.

Skaperdas, S., (1996), Contest Success Functions, *Economic Theory*, vol. 7, pp. 283-290.

Skaperdas, S., Syropoulos C., (1996), Can the Shadow of Future Harm Cooperation?, *Journal of Economic Behavior and Organization*, vol. 29, pp. 355-372.

Smith A., (1776), *An Inquiry into the Nature and Causes of the Wealth of Nations*, re-printed (1993), edited with an introduction and notes by Kathryn Sutherland, Oxford University Press, Oxford.

Skogh G., Stuart C., (1982), A Contractarian Theory of Property Rights and Crime, *Scandinavian Journal of Economics*, vol. 84, no.1, pp. 27-40.

Stauvermann P., (2002), Why is there so much peace?, *Defence and Peace Economics*, vol. 13, no. 1, pp.61-75.

Tullock, G., (1980), Efficient Rent Seeking, in Buchanan, J. M., Tollison R., D., Tullock G., (eds.), *Toward a Theory of the Rent-seeking Society*, Texas A&M University, College Station, pp. 97-112.

APPENDIX

Payoffs for both players over the two periods in a continuing conflict scenario.

$$V_1^{cc} = V_2^{cc} = \frac{\beta(n_1+n_2)}{4} + \frac{\beta(U_{11}^{cc}+U_{12}^{cc})}{4} =$$

$$= \frac{\beta(n_1+n_2)}{4} + \frac{\beta\left[\frac{\beta(n_1+n_2)}{4} + \frac{\beta(n_1+n_2)}{4}\right]}{4} =$$

$$= \frac{\beta(n_1+n_2)}{4} + \frac{\beta\left[\frac{2\beta(n_1+n_2)}{4}\right]}{4} =$$

$$= \frac{\beta(n_1+n_2)}{4} + \left[\frac{\beta^2(n_1+n_2)}{2} \times \frac{1}{4}\right] =$$

$$= \frac{\beta(n_1+n_2)}{4} + \frac{\beta^2(n_1+n_2)}{8} =$$

$$= \frac{2\beta(n_1+n_2) + \beta^2(n_1+n_2)}{8} =$$

$$= \frac{\beta(n_1+n_2)(\beta+2)}{8}$$

Payoffs for both players over the two periods under an institution

$$V_1^{ins} = V_2^{ins} = \frac{n_1+n_2}{2(\beta+1)} - \frac{2h}{\beta+1} + \frac{U_{11}^{ins}+U_{21}^{ins}}{2(\beta+1)} - \frac{2h}{(\beta+1)}$$

$$\frac{n_1+n_2}{2(\beta+1)}-\frac{2h}{\beta+1}+\frac{\left(\frac{n_1+n_2}{2(\beta+1)}-\frac{2h}{\beta+1}+\frac{n_1+n_2}{2(\beta+1)}-\frac{2h}{\beta+1}\right)}{2(\beta+1)}-\frac{2h}{(\beta+1)}=$$

$$=\frac{n_1+n_2}{2(\beta+1)}-\frac{2h}{\beta+1}+\frac{\left(\frac{n_1+n_2}{2(\beta+1)}+\frac{n_1+n_2}{2(\beta+1)}-\frac{4h}{\beta+1}\right)}{2(\beta+1)}-\frac{2h}{(\beta+1)}=$$

$$=\frac{n_1+n_2}{2(\beta+1)}-\frac{2h}{\beta+1}+\frac{2\left(\frac{n_1+n_2}{2(\beta+1)}\right)-\frac{4h}{\beta+1}}{2(\beta+1)}-\frac{2h}{(\beta+1)}=$$

$$=\frac{n_1+n_2}{2(\beta+1)}-\frac{2h}{\beta+1}+\frac{\left(\frac{n_1+n_2}{(\beta+1)}\right)-\frac{4h}{\beta+1}}{2(\beta+1)}-\frac{2h}{(\beta+1)}=$$

$$=\frac{n_1+n_2}{2(\beta+1)}-\frac{2h}{\beta+1}+\frac{\frac{(n_1+n_2)-4h}{(\beta+1)}}{2(\beta+1)}-\frac{2h}{(\beta+1)}=$$

$$=\frac{n_1+n_2}{2(\beta+1)}+\left(\frac{(n_1+n_2)-4h}{(\beta+1)}\frac{1}{2(\beta+1)}\right)-\frac{4h}{(\beta+1)}=$$

$$=\frac{n_1+n_2}{2(\beta+1)}+\left(\frac{(n_1+n_2)-4h}{2(\beta+1)^2}\right)-\frac{4h}{(\beta+1)}=$$

$$=\frac{(n_1+n_2)(\beta+1)+(n_1+n_2)-4h-8h(\beta+1)}{2(\beta+1)^2}=$$

$$=\frac{(n_1+n_2)(\beta+2)-4h[1+2(\beta+1)]}{2(\beta+1)^2}=$$

$$=\frac{(n_1+n_2)(\beta+2)-4h(2\beta+3)}{2(\beta+1)^2}$$