Specific Institutional Aspects of International Cooperation – A GAME Theoretic Account –

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Abstract

If one abstracts from specially organized markets like stock or commodity exchanges, (international) trade relies on bargaining between the interested parties. Whereas earlier the results of bargaining were seen as unpredictable or determined by an at most vaguely defined concept of (relative) bargaining power, it is simply a field of application in view of game theory. Our discussion tries to elaborate the specific institutional aspects of international bargaining with interacting parties from different countries. Especially, we concentrate on the problem when contracts resulting from international bargaining are unenforceable.

1. Introduction

Traditionally the theory of international trade has been dominated by extending general equilibrium analysis, i.e. by assuming competitive markets in all countries without international factor mobility, but more or less international mobility of products. This led to well-known reasons for international trade like comparative cost advantages, elaborated by the pure theory of international trade. Notice, however, that international trade can already be triggered by different market organization in different countries. An extreme case would be a centrally planned economy facing a market economy. Here the centrally planned economy would choose its optimal point on the offer curve of the market economy and thereby induce international trade even when the two countries are otherwise completely identical (Güth, 1976).

Recently we experience quite a change in the theory of international trade: Instead by general equilibrium analysis it is now dominated by the theory of industrial organization which, in turn, is dominated by the use of (non-)cooperative game theory. In essence, the new models of international trade are oligopoly markets with sellers and customers from different countries. The advantages of this change are institutionally richer models of international trade, its pitfalls are those of neglecting general equilibrium effects. Clearly, the latter are relatively harmless when considering special products whose shares in the national gross product are relatively low. If not partial analysis may neglect some of the most crucial consequences.

Especially in view of this recent development one can ask which role game theory plays or can play when studying international cooperation, e.g. in the form of international trade. To avoid reviewing all the recent literature which often can be interpreted as a game theoretic analysis of international markets with agents from different countries we discuss merely the bargaining aspects which arise in such international cooperation.

There are rare market institutions like stock or commodity exchanges where one can engage in trade without having to bargain about the terms of trade. Given such institutions there also do not exist specific problems of international trade. Here we do not consider such highly organized markets, but concentrate on markets where the terms of trade are the result of international negotiations.

In view of game theory bargaining is an application of game theoretic methods. Whereas in cooperative game theory the model abstracts from individual behavior, non-cooperative models of bargaining rely on highly specific rules concerning the bargaining process and the information conditions of the interacting parties. Since we do not simply review bargaining theory (see, for instance, Bester, 1989, Güth, 1995, Osborne and Rubinstein, 1990), but try to focus on the specific institutional aspects of international negotiations, we rely on the latter approach. Whereas cooperative game theory simply assumes, for instance, perfect contract enforcement, we think that international cooperation often cannot rely on contract enforcement.

2. Problems when cooperating across borders

If the cooperating parties who bargain about the details of their cooperative venture live in different countries, certain institutional aspects will become more crucial, if not be new. There is, of course, the problem of being able to **communicate** at all which, in modern times, has become more negligible although in international affairs one often struggles about what certain contract clauses imply, e.g. legally. The sender-receiver-game can be used to illustrate that cooperation requires some basic kind of language.

Sender-Receiver-Games: Let $\Omega = \{w_1, ..., w_T\}$ denote the finite set of states $w \in \Omega$ of the world with $T \geq 2$. Whereas the sender S observes the true state $w \in \Omega$ of the world, the receiver R must choose the action $a \in A$ yielding the same (expected) utility $u(a, w)$ for both players R and S. Before choosing $a \in A$ player R receives a message $m \in M$ sent to him by S. For the sake of simplicity

let us assume that there are as many different messages as states of the world, i.e. $|\Omega| = |M| = T$, and that for every two different states $w', w'' \in \Omega$ of the world the optimal actions $a'(w'), a''(w'') \in A$ are different what implies $|A| \geq T$.

Effective Cooperation in Sender-Receiver-Games requires only a kind of language $m(w)$ in the sense that for all $w \in \Omega$ sender S can signal by m the actually prevailing state w. Given such a language receiver R will choose the optimal action $a(m^{-1}(m(w)))$ for all messages $m \in M$ by decoding it correctly according to $w = m^{-1}(m(w))$.

Clearly, one will not speak of bargaining if people are able to communicate in such an elementary way, i.e. cooperation per se does not lead to bargaining. Whether and how such an elementary language develops can be analysed in an evolutionary way (Blume, Kim, and Sobel, 1993, Wärneryd, 1993).

Although at least for Western Europe this will become less important in the next millennium, international cooperation often means that at least one party has to accept **foreign currency**. Of course, in modern times one can avoid the currency risks involved. But one has to pay a **risk premium** which is non-existent if all parties are living in the same currency region.

Similarly, international cooperation in the form of trade usually is burdened by **transportation costs** in the widest sense, e.g. those implied by customs controls etc. But again modern means of transportation have reduced the cost share of transportation considerably – for Germany it would be still much cheaper to import hard coal from the USA than to provide it nationally. But it is still true that certain products implying high transportation cost like sand or cement are mostly regionally, i.e. often nationally supplied whereas international trade concerns mainly products where the cost share of transportation is relatively low.

Game theoretic or experimental studies of bargaining can easily incorporate such institutional aspects and investigate their implications for the likelihood as well as for the profitability of international cooperation. One also needs **empirical field**

studies by which one tries to assess institutional obstacles, e.g. requirements in national law which mainly (are to) discourage foreign competitors, or to measure the additional cost of international cooperation econometrically.

An aspect where one con hardly expect much help from such studies is incomplete information as, for instance, implied by communicating at least partly in a foreign language or resulting from cultural differences (for an experimental analysis of cultural differences see, for instance, Roth et al., 1991).

Incomplete information essentially means that the negotiation rules are not commonly known. A party may not know the true incentives of its partners, their information conditions or even the time structure of the decision process. In his pioneering contribution John C. Harsanyi (1967/68) has shown that all these information deficiencies can be translated into uncertainties concerning the other parties' types, i.e. their (cardinal) utility functions and, more importantly, that such **type uncertainty** can be transformed into stochastic uncertainty by including fictitious chance moves whose results are only partially revealed as to capture the type uncertainty of certain players.

Güth and Selten (1989) have tried to elaborate how such type uncertainty can influence the bargaining process. A party which wants to appear as a superior type will try to gain such a **reputation** (see also Kreps, Milgrom, Roberts, and Wilson, 1982) by mimicing the superior type's behavior. Often the superior type will, however, be able to distinguish itself from inferior types by providing a **risk proof** of its superiority, e.g. by risking conflict with positive probability due to not conceding, a risk from which inferior types would shy away.

Clearly, **national identy** reduces the degree of uncertainty regarding the other parties' types. Cultural transfers and the, in modern times, much better knowledge of foreign cultures due to international exchanges via travelling abroad and via the modern mass media have, however, greatly reduced the degree of **uncertainty about foreign cultures**. Mostly it seems more important to find the right partners within a country than the right country for international cooperation, i.e. incomplete information is dominated by invidual differences rather than by cultural ones (that this may be task dependent is suggested by Roth et al., 1991).

3. Cooperation without contract enforcement

Let us now concentrate on a more dramatic aspect of international cooperation, at least in its early days, namely the non-existence or practical **impossibility of contract enforcement**. To demonstrate this let us refer to the most recent past when the Iron Curtain was still existent: If an Eastern European partner did not fulfill its obligations, its Western European partner would hardly engage in a legal dispute. It, much more likely, would have tried to exert pressure by political means, e.g. by trying to employ the foreign office. If also this is impossible or would not pay the effort, international cooperation appears similar to **cooperation in anarchy** to which we now turn our attention.

a) Interacting repeatedly

Game theory offers some possibilities to enable cooperation even when contracts are not enforceable. If the partners **interact repeatedly**, one way of inducing the agreed upon behavior is to terminate cooperation (the grim strategy) or at least to interrupt it sufficiently long. Due to the **Folk Theorem** players can cooperate efficiently by relying on such threats which are self-enforcing (e.g. Aumann, 1981). One can question the relevance of the Folk Theorem, which requires an infinite horizon and does not only justify efficient outcomes, but (nearly) every outcome which is individually rational, as well as its normative justification (Güth, Leininger, and Stephan, 1991).

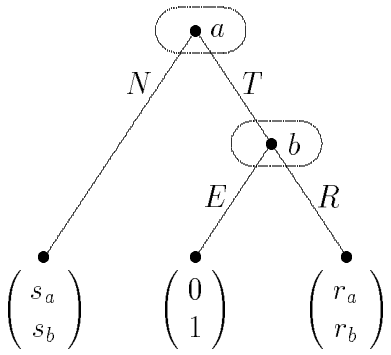
Empirically one does not need infinitely many rounds to engage in mutually profitable cooperation (see, for instance, the respective experimental results of Selten and Stöcker, 1986, for the case of 20 rounds). Inspired by such experimental results an alternative game theoretic justification of self-enforcing cooperation relies on a finite horizon, but introduces type uncertainty. If my partner expects me with positive probability to suffer from breeching contract – since it is not justified at all why my partner may think so, one often speaks of "**crazy perturbations**" –, I myself might try to appear like this strange alter ego although I am completely opportunistic. In essence this will mean that I will be cooperative with

high probability at the beginning and try to fool my partner when approaching the end of interaction.

Whoever has tried to actually compute such a **reputation equilibrium** (Kreps et al., 1982) will wonder how one can expect boundedly rational human decision makers to derive their behavioral plans in such a way (see, for instance, McKelvey and Palfrey, 1992). More importantly, certain aspects of the experimentally observed behavior are inconsistent with the qualitative properties of reputation equilibria which predict, for instance, continued conflict after a transient breakdown of cooperation whereas actual players engage in attempts to restore cooperation.

b) The case of no repetition or the game of trust

In general, international cooperation may not be repetitive at all since depending on changing world market prices it is often better to cooperate with somebody in country A today, but in country B tomorrow what may be, furthermore, rather unpredictable. Is there no chance of one shot-cooperative endeavors when contracts are unenforceable? In the following this will be discussed with the help of **the basic game of trust** as thoroughly discussed by Güth and Kliemt (1993, 1994, 1995).



The basic game of trust $(0 < s_a < r_a, s_b < r_b < 1 < r_a + r_b)$

Figure 1

In the basic game of trust two partners, player a from country A and player b from country B, can either not cooperate (if a chooses N) or cooperate with a

delivering first (his move T). When a has revealed trust (by choosing T), player b can either reward him (the move R) or exploit a (by choosing E). Since $r_i > s_i$ for $i = a, b$ cooperation in the sense of the play (T, R) is efficient and payoff dominates non-cooperation (N) which, however, is implied by the unique solution behavior (N, T) in the sense of subgame perfect equilibria (Selten, 1965 and 1975) or of strategies surviving once repeated elimination of dominated strategies. In this sense the basic game of trust paradigmatically illustrates the impossibility of cooperation when contracts are unenforceable.

c) On the evolution of morals in international trade

Güth and Kliemt (1992, 1994, 1995) interprete the basic game of trust as representing just the monetary incentives. But although money seems to rule the world, it is not the only thing we care for. Imagine player b who considers to exploit his trustful partner a after he has chosen T. Will b easily enjoy his exploitative profit of 1 or will he feel remorse? Instead of simply imposing such feelings of remorse or not Güth and Kliemt ask whether or not such feelings would evolve by employing ideas of **evolutionary game theory** (see Hammerstein and Selten, 1994, for a general survey). Unlike in evolutionary game theory they, however, do not study the evolution of strategies, i.e. behavior, but rather (the **indirect evolution**) of preference types like Güth and Yaari (1992).

Their simple means of doing so is to substitute player b's exploitation profit of 1 by his more complex payoff $1 + m$ where m stands for moral feelings of remorse if negative or for enjoyment of exploitation ("a sucker is born every day and I found him!") if positive. Unlike the other payoff parameters the payoff component m is completely immaterial, i.e. it motivates b's decision, but does not directly determine his material and therefore evolutionary success. Depending on m the solution is (T, R) in case of $m < r_b - 1 \, (< 0)$ and (N, E) in case of $m > r_b - 1$. Experimental evidence for the existence of prohibitive $\underline{m}$-parameters is mixed: Güth, Ockenfels, and Wendel (1997) observed only little trust, which was generally exploited, in an experiment granting entitlement and offering a very high monetary exploitation incentive $1 - r_b$; Keren and Snijders, 1994, observed considerably more trust and reward of trust but only for negligible monetary incentives.

Since parameter changes within the half-intervals $m < r_b - 1$ and $m > r_b - 1$ are obviously without consequence, let us assume that there are only two realizations possible for, namely $\underline{m}\,(< r_b - 1)$ and $\overline{m} = 0$. Which of the two values has to be expected to prevail in the long run when evolutionary success solely depends on monetary profit?

The result can be easily detected from the table specifying the expected success of $m_1 \in \{\underline{m}, \overline{m}\}$ for every m_1, m_2-constellation with $m_i \in \{\underline{m}, \overline{m}\}$ for $i = 1, 2$. The entries of this table are derived under the assumption that a type m_i assumes both roles (that of player a and that of player b) with equal probability. If, for instance, 1 is of type $m_1 = \overline{m}$ and 2 of type $m_2 = \underline{m}$, the play (T, R) results if $m_2 = \underline{m}$ becomes b whereas the play (N) occurs if $m_1 = \overline{m}$ becomes b so that $m_1 = \overline{m}$ earns the expected $(r_a + s_b)/2$. The other components of the table can be derived analogously.

	$m_2 = \overline{m}$	$m_2 = \underline{m}$
$m_1 = \overline{m}$	$(s_a + s_b)/2$	$(r_a + s_b)/2$
$m_1 = \underline{m}$	$(s_a + r_b)/2$	$(r_a + r_b)/2$

Since $r_i > s_i$ for $i = a, b$ the $m_1 = \underline{m}$-type always expects more than the $m_1 = \overline{m}$-type regardless whether he confronts a monomorphic $m_2 = \overline{m}$- or $m_2 = \underline{m}$-population from which m_2 is drawn. Thus $\underline{m}$-types are always more successful and will only survive in the long run. In other words: When the m-types are commonly known what has implicitly been assumed in our derivations, the only evolutionarily stable m-type is the one of prohibitive remorse feeling enabling mutually profitable international cooperation even without contract enforcement.

d) On possible generalizations

It has already been mentioned above that type information will usually be less reliable in international affairs. The assumption of commonly known m-types appears therefore rather questionable in this context. Unfortunately, if one assumes

m-types to be private information and beliefs concerning others' types to be governed by the true population composition, the above result is completely reversed (see Güth and Kliemt, 1993, 1994, 1995 for details): The only evolutionarily stable population composition is the $\overline{m}$-monomorphic one excluding any cooperation based on trust.

4. Prospects of international cooperation in case of costly type detection

Incomplete information must not be accepted. Güth and Kliemt (1994 and 1995) prove that in case of costly detection there may exist an evolutionarily stable bimorphism, i.e. a population containing both, $\underline{m}$- and $\overline{m}$-types in positive proportions. The basic intuition for this result is that there must be sufficient type uncertainty to render the investment in detection profitable and that in case of more or less reliable detection $\underline{m}$-types are more successful than $\overline{m}$-type like in the border case of commonly known m-types.

The results when type information can be obtained by investing in type detection are graphically illustrated in Figure 2 in the p, C-diagram where p is the share of $\underline{m}$-types in the population and C the cost of type detection.

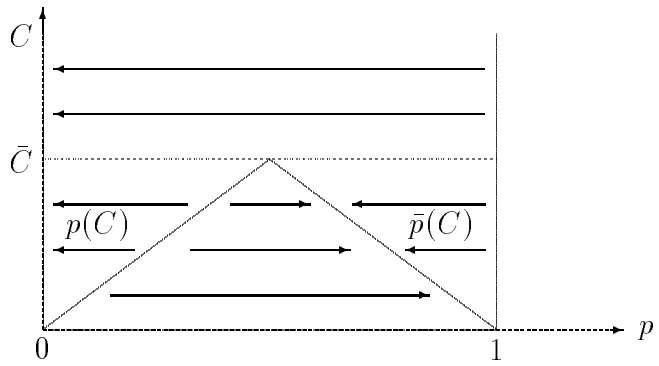


Figure 2

For cost levels $C \geq \overline{C}$ type detection is too costly. Thus m-types remain private information what implies that $\overline{m}$-types fare better than $\underline{m}$-types and that

p converges to $p^* = 0$, the only evolutionarily stable population composition for $C \geq \overline{C}$.

In case of $C < \overline{C}$ the final result depends on the starting point, i.e. what finally happens is **path dependent**. Within the triangle of Figure 2 one invests in type detection since its costs are non-prohibitive and since the population is sufficiently mixed to render type information sufficiently valuable. When type information is available, $\underline{m}$-types are more successful than $\underline{m}$-types what explains why the arrows within the triangle are pointing to the right, i.e. p increases over time.

To the left and to the right side of the triangle in Figure 2 one does not invest in type detection since there is not enough type uncertainty to render such an investment profitable. Thus one obtains similar consequences as for $C \geq \overline{C}$, i.e. p decreases over time.

So for cost levels $C < \overline{C}$ one has two evolutionarily stable p-configurations, namely the $\overline{m}$-monomorphic population with $p^* = 0$ or the bimorphic population $p^* = \overline{p}(C)$ whose population share $\overline{p}(C)$ of trustworthy partners increases when C decreases.

Whenever the starting point p° is to the left of $\underline{p}(C)$ or when $C \geq \overline{C}$, the process ends with $p^* = 0$, whereas it ends with $p^* = \overline{p}(C)$ for $C < \overline{C}$ and $p^\circ > \underline{p}(C)$. The **set of attraction** for the stable configurations $p^* = \overline{p}(C)$ is thus as illustrated in Figure 3 whereas $p^* = 0$ results if one starts outside of the $p^* = \overline{p}(C)$-attraction set.

If the type information from investing in type recognition is informative, but not certain, i.e. in case of **stochastic type signals**, the triangle in Figure 2 shrinks. In Figure 4 the larger triangle represents the case of more informative type detection. If type information becomes more reliable, this

- increases the share $p^* = \overline{p}(C)$ for a given cost level C of type detection,
- generates the new evolutionarily stable configuration $p^* = \overline{p}(C)$ for the generic interval from C' to C'' of cost levels C.

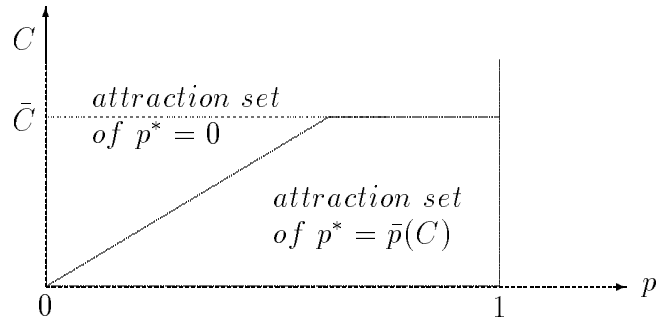


Figure 3

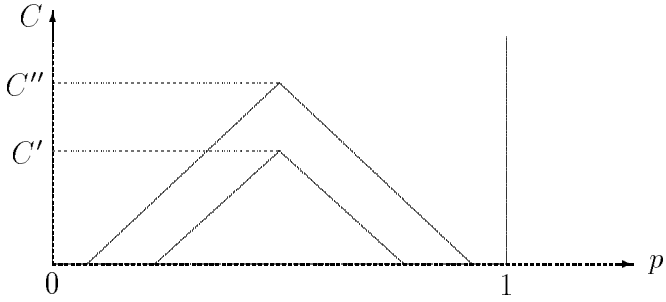


Figure 4

5. Policy measures improving the prospects of international cooperation

Based on our analysis in section 4 we want to analyse policy measures by which one can improve the prospects of international cooperation which is endangered by type uncertainty. Like in our discussion above uncertainty about the second mover's type in the game of trust may, however, be reduced by investing in costly type detection. In principle, policy could influence parameter values by

(i) measures which move the starting point p° into the attraction set of $p^* = \overline{p}\,(C)$ as illustrated in Figure 3,

(ii) lowering the cost C of type detection so that (p°, C) lies in the attraction set of $p^* = \overline{p}\,(C)$,

(iii) improving the reliability of type detection what increases the triangle as shown in Figure 4.

Measures of type (i) essentially require an increase of the initial proportion p° of trustworthy $\underline{m}$-types. In addition to well-known measures like education and punishing or stigmatizing exploiters it could mean to start international cooperation only when trustworthiness is sufficiently large.

The obvious means for (ii) are to provide type information freely, e.g. by the diplomatic services, or at least to subsidize all attempts to learn more about potential foreign partners. Also requirements for self-revelation, e.g. by asking to publish a firm's main characteristics like the amount of equity, present profits etc. can reduce the cost of type detection.

The reliability of type detection can be improved by means which allow to base a detective's type assessment on more reliable indicators, e.g. by granting access to a firm's accounts etc. It seems that generally all requirements for transparency in economic and political life could be viewed as policy measures in the sense of (iii).

A further policy measure would be to guarantee contract enforcement by **international courts** whose verdicts are binding, i.e. require supporting national law. This will certainly help to exclude major risks. But since contracts are mostly incomplete, even enforceable contracts will allow for opportunistic exploitation. Thus international courts may levy the obstacles of international cooperation, but cannot avoid them totally. Like in national cooperation one needs trustworthy partners since legal verdicts are often impossible, too costly, or too late in effect.

Actually Brennan, Güth, and Kliemt (1997a and 1997b) have introduced the possibility of litigation when a has been exploited. Interesting aspects of their analysis is that "judges are not better", i.e. they judge according their m-type so that the moral evolution also changes the reliability of the legal system, and their analysis whether legal enforcement will crowd out or crowd in **intrinsic motivation** in the sense of $\underline{m}$-types satisfying $\underline{m} < r_b - 1 \, (< 0)$.

6. Conclusions

Our modest aim was to discuss the most important institutional aspects which one encounters in international negotiations. Some of them were briefly discussed whereas the non-existence of contract enforcement has been explored more thoroughly by relying on the previous results of Güth and Kliemt (1993, 1994, and 1995). Another speciality of our analysis above is that we do not only explore the game theoretic solution behavior, but also discuss its predictive success, mainly by referring to appropriate experimental results.

Since bargaining and thus international bargaining is mostly an application of (cooperative or, like here, non-cooperative) game model there exists an abundance of bargaining models. Without empirical research trying to find out the actually used rules of international negotiations, in politics (see, for instance, Mautner-Markhof, 1989) or in business hardly anything specific can be said. The empirical, mainly experimental study of bargaining behavior for well-defined rules of negotiations has to be supplemented by empirical institutional research finding out the actually applied rules. Only with such empirical institutional evidence one can derive more specific conclusions about the prospects of international cooperation, either as implications of game theoretic rationality or by empirical, e.g. experimental studies.

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