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THE SUCCESS AND USE OF ECONOMIC SANCTIONS

ALASTAIR SMITH

Department of Political Science
Washington University,
St Louis MO 63130
asmith@wuecon.wustl.edu

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This paper explains the use and the success of economic sanctions. In the model, a sender, nation A, uses sanctions to force a target, nation B, to alter its current policy. I use a continuous time, one sided incomplete information game to show that the decision of the sender to sanction is related to the decision of the target to resist. I characterize the conditions under which sanctions occur, the conditions under which the sender threatens sanctions and the conditions under which sanctions are successful. The analysis reveals that the success of sanctions affects whether a nation chooses to sanction. I discuss how the implications of this result relates to the cases of sanctions that we empirically observe.

Keywords: sanctions, economic sanctions, Bayesian equilibria, war of attrition model.

This paper examines when sanctions occur and when sanctions succeed. A formal model relates one nation's decision to sanction with another nation's decision to resist sanctions. Substantively, the model demonstrates the interdependence of the occurrence of sanctions and the success of sanctions.

I use a stylized two nation game to model sanctions. In this game nation A, a potential sanctioner or sender, dislikes some particular policy pursued by another nation, B. In an attempt to make nation B, the target, change policies, nation A can apply sanctions. There are two main questions: 1) Under what conditions does nation A start sanctions, and 2) if sanctions are applied which nation prevails.

What constitutes sanctions? Hufbauer, Schott and Elliot (1985 & 1990) provide the most comprehensive data on sanctions. I use their definition of sanctions (1985); "economic sanctions [are] the deliberate government-inspired withdrawal, or threat of withdrawal, of "customary" trade or financial relations." For the purposes of this paper, I define sanctions as successful if the target nation, B, makes the policy concessions that the sender nation, A, demands. This is a more restrictive definition of success than that used by Hufbauer, Schott and Elliot.

Before introducing the model formally, I discuss its basic outline. First, I assume that both A and B care about the policies that nation B pursues. However, nation B unilaterally chooses its policy. Although nation A cares about B's policy it is unable to directly affect it unless it conquerors B militarily. There is a well developed literature that considers bargaining in the face of military conflict (Fearon 1994a & 1994b; Morrow 1989; Banks 1990). Instead of considering military options, I investigate how nation A can use sanctions, or the threat of sanctions, to encourage B to adopt a different policy. There are costs associated with sanctions. Whatever form the sanctions take there is an economic cost associated with them. Sanctions prevent trade and investment between countries. If without sanctions firms and individuals want to trade then preventing this trade has economic costs. However, just because sanctions impose economic costs, this does not mean that sanctions are costly politically. Political leaders care about political costs as well as economic costs. For example, if it is politically popular to impose sanctions on another nation then a leader may implement economically costly sanctions even when they know that the sanctions will be ineffective.

It is economically costly to be sanctioned. However, this does not necessarily mean that it is also politically costly. Sanctions have distributional effects. Sanctions lower the aggregate wealth of a nation. However, the economic effects of sanctions may fall disproportionately on political opposition rather than political leaders. Under these circumstances leaders may actually enjoy being sanctioned as it strengthens their position relative to domestic opposition.

Given that nation A decides to sanction nation B, which sanction should it use? This is a question that Eaton and Engers (1992) pursue. For the purposes of this paper, I assume the level of sanctions is discrete rather than continuous: For example nation A either trades with nation B or it does not. Similarly I assume that the target either complies or not. Eaton and Engers (1992) provide a comprehensive treatment of compliance levels.

For tractability I consider a two nation model: a sender, nation A, and a target, nation B. However an important factor in the success or failure of international sanctions is whether nations can collectively commit to sanctioning (Martin 1992). If other nations continue to trade with a target then this may considerably lower the impact of sanctions and hence the probability that they will succeed.

There are a variety of formal models of sanctions; although the majority of these model are either complete information or single shot games (Hayes 1995, Eaton and Engers 1992, Tsebelis 1990). I present a continuous time model with one sided incomplete information. The value that the target nation places on maintaining its current policy is private information (its type: Harsanyi 1967–68). The sanctioning game is similar to the standard war of attrition model. Fundenberg and Tirole (1992, p. 119–26, 216–219, 230–32, 239–40) provide a comprehensive summary of these games. In the classical war of attrition model two player fight for a prize. In is expensive to remain in the game. If either player drops out then the other player wins the prize. Although similar, this is not the same as the model of sanctions I present. Prevailing in the sanctions battle might be thought of as wining the prize. In the context of sanctions, B's prize is continuing to enjoy its desired policy sanction free; while the prize for A is a change in B's policy. In the war of attrition terms, nation B already holds the prize. Nation A sanctions in the hope of wrestling the prize away from B. However, B continues to enjoy the prize, in this case its desired policies, until the instant it complies.

THE MODEL

Nation A dislikes some policy, X, that is pursued by nation B. Nation A wants nation B to stop this policy. Nation A uses sanctions as a tool to stop B implementing policy X. Sanctions are modeled in continuous time. The game starts at time $t = 0$. At any time either nation can stop the sanctions: Nation A can decide not to continue sanctions any longer, nation B can comply with A's wishes which ends sanctions.

Nation B values continuing its current policy. Let B's value, per period, of its current policy, X, be $\theta \geq 0$. This means that for every time period in which B keeps this policy its payoff is θ. Although B receives payoffs in a stream rather than as a lump sum, we can calculate the present value of the income stream. If the interest rate is $(1 - \delta)$ then the value of the payoff stream from time $t = 0$ until time $t = t'$ is $\int_0^{t'} \theta\, e^{-(1-\delta)t}\, dt$. If B receives the income stream of θ forever then this has a present value of $\theta/(1 - \delta)$.

How much B values policy X is private information. Although A does not know the value of θ it has beliefs about B's type. Let $P(\theta)$ be A's cumulative beliefs about B's type. Thus, $P(y)$ is the probability that B's type is less than y: $P(y) = \text{Prob.}(\theta \leq y)$. Let $p(\theta)$ be the associated density. Assume that $P(\theta)$ is continuous, twice differentiable and bounded away from zero. θ ranges between 0 and θ_{max}. As I show later, the assumptions about A's beliefs have real bite. The model's predictions vary markedly with different distributional assumptions. The uniform distribution and the exponential distribution are considered in detail. In the uniform case θ ranges between 0 and 1. In the exponential case, which is commonly used in war of attrition models, the upper limit on the range of θ, θ_{max}, is $+\epsilon$.

Nation A is unhappy with B's current policy. A's per period payoff if B continues its current policy of X is normalized to 0. A prefers B to switch policies. If this happens then A receives payoffs at the rate of v per period. The present value of this income stream can be calculated. For example, if B were to changes policy at time t' then the value of this income stream evaluated today, at time $t = 0$, is $\int_{t'}^{+\infty} v e^{-(1-\delta)t} dt = \frac{v}{(1-\delta)} e^{-(1-\delta)t}$, where $(1 - \delta)$ is the interest rate. I assume that once B has stopped policy X it never reverts back to this policy. Once B complies with sanctions, A's income stream lasts forever.

Sanctions are costly. Sanctions have both political and economic costs. As long as sanctions continue nation A pays a per period cost of c_a. Although economically costly, sanctions are often domestically popular. In these circumstances, nations may actually benefit from symbolic sanctions. Thus, c_a can be either positive or negative. Sanctions impose costs, c_b, on nation B. To keep the problem interesting I assume that $c_b > 0$; otherwise nation B enjoys being sanctioned, in which case it never complies with sanctions.

The per period payoffs for each outcome are summarized in the table below.

Outcome	U_a per period	U_b per period
A stops sanctions	0	θ
B complies	v	0
Sanctions	$-c_a$	$\theta - c_b$

Where $v > 0$, $\theta \geq 0$ and $c_b > 0$.

The game assumes that sanctions start at time t=0. These sanctions continue until one nation stops them. Nation A stops sanctions by no longer sanctioning. Nation B stops sanctions by complying with A's wishes. Nations decide at which time, t, to stop sanctions, where $t \in T = \Re^+$.

A's strategy is a mapping from time into the unit interval: $s_a: T \rightarrow [0,1]$. Thus, $s_a(t)$, is the probability density with which A stops at time t. If A decides never to sanction, this is equivalent to stopping at time zero.

B's strategy is a mapping from type and time into the unit interval: $s_b: \Theta \times T \rightarrow [0,1]$. Thus, $s_b(\theta, t)$ is the probability density with which type θ stops at time t. For characterizing the equilibria, it is convenient to define $t_b(\theta)$ as the time at which type θ complies with sanctions. The inverse function of $t_b(\theta)$ is $\phi(t)$: $\phi(t)$ is the set of types that comply at time t. $t_b(\theta)$ and $\phi(t)$ are defined more rigorously later.

The solution concept is Bayesian equilibrium. This requires that each player is utility maximizing given the strategy of the other player and that A's beliefs about B's type are consistent with Bayes rule.

RESULTS

Before characterizing the equilibria I discuss some of the intuition behind the results. There is a big reward to winning the sanctions battle. Although the per period payoff might be quite small, nations receive this payoff for a long period of time. Even when the cost of sanctions dwarf the per period payoffs, nations have an incentive to fight and win the sanctions battle. Obviously, as the per period payoff from winning increases, the incentives to win the sanctions battle increase. If B's per period reward for continuing its policy of X is greater than the cost of sanctions, $\theta \geq c_b$, then B will never comply. Although nation B suffers the costs of sanctions it prefers to pay these costs and continue enjoying its current policy rather than comply with A's wishes. This is true even if B knew that sanctions would last forever.

If nation B really cares about its policy, $\theta \geq c_b$, then it will never comply with sanctions. This is not true for nation A. Even if A's per period payoff, v, is much greater than the cost of sanctions, c_a, A will not sanction indefinitely. Although nation A may care strongly about altering B's policy, if it has little chance of success then it will not sanction. If v is extremely high and B is unlikely to capitulate from sanctions alone, then a model which allows A some military option might be more appropriate. In general, if a nation thinks that it will lose the sanctions battle at some point it prefers to submit immediately. As long as sanctions continue then both nations pay the costs associated with sanctions.

Suppose both nations know that nation A will stop sanctions before B will comply. Nation A could sanction but it will be to no avail. Nation B will not comply knowing that A will stop first. Given that it can not win the sanctions battle nation A wants to minimize its costs. Therefore A does not start sanctions unless it anticipates that it can win. Alternatively, if nation B knows that A will sanction longer than it will resist, B complies immediately.

If one nation anticipates that the other nation will out last it then in stops sanctions. Thus, nation A does not sanction if it does not believe it can win. Similarly, nation B immediately complies with sanctions if it believes that A will continue sanctions indefinitely. There is an exception to the last statement. Although sanctions are economically costly, they can have domestic political benefits. If these domestic political benefits outweigh the economic costs of sanctions, $c_a < 0$, then A sanctions even when there is no chance of B complying. If B is not prepared to comply then sanctions are Pareto optimal.

Nations face mixed incentives. They want to win the sanctions battle, but if they are going to lose they want to lose immediately. There are two types of equilibria to this game. I describe them as time independent (TID) and time dependent (TD) equilibria. In the time independent equilibria, nations take the same actions at every point in time. In the time dependent equilibria the probability of nations ending sanctions is a function of time. In these later equilibria nations slowly drop out of the sanctions battle. These equilibria are more difficult to characterize than the simple time independent ones. For this reason, I characterize the time independent equilibria next before moving on to look at properties of the time dependent equilibria.

Time Independent Equilibria

The time independent equilibria are reminiscent of the equilibria in the chicken game. Nations either continue sanctions forever, or they stop immediately. With one exception, either nation A or nation B immediately stops sanctions. If sanctioning is costly for A, $c_a>0$, then either nation A never sanctions or nation B immediately complies.

In the first equilibrium, B's strategy is never to comply with sanctions. Given that nation B always resists, nation A has no incentive to sanction. The sanctions are costly to enforce and have no prospect of ever changing B's policy. Since nation B knows that A always stops it has no incentive to ever comply. In this equilibrium there are never any sanctions. More formally,

Equilibrium TID 1

If $c_a \geq 0$ then $s_a(t) = 1$ and $s_b(\theta, t) = 0$ for all t.

In the second equilibrium, A sanctions and B immediately complies. This equilibrium only exists if the highest type of B, θ_{max}, is less than B's cost of sanctions, c_b. Nation B always complies with sanctions. Given B's compliance, nation A always wants to sanction because sanctions result in B immediately changing policy. A instantly gets the policy concessions it wants without ever having to pay the cost of sanctions. Given that nation A sanctions forever, nation B never resists. Providing that $\theta < c_b$ for all B, resisting sanctions is never worth while. The cost of sanctions outweighs the value of continuing the current policy of X and there is no possibility of A ever stopping sanctions. This equilibrium only occurs if A believes that the cost of sanctions is so high that no type of nation B would ever prefer to suffer sanction to maintain its current policy: $\theta_{max} < c_b$. In this equilibrium sanctions are never observed; B immediately complies with A's threat. More formally,

Equilibrium TID 2

If $c_b \geq \theta_{max}$ then $s_a(t) = 0$ and $s_b(\theta, t) = 1$.

There is a third time independent equilibrium. It is closely related to the second. In this equilibrium nation A always sanctions and B resist only if the payoff from maintaining its current policy is greater than the cost of sanctions, $c_b < \theta$. If nation A benefits domestically from sanctions, $c_a \leq 0$, then it always sanctions. Those types of B which value their policy highly, $\theta \geq c_b$, do not comply. Of the three time independent equilibria, this is the only one in which sanctions occur with positive probability. Sanctions occur when A's political incentives to sanction outweigh its economic costs and when B's benefits of maintaining its current policy outweigh the cost of sanctions. More formally,

Equilibrium TID 3

Given that $c_a \leq 0$ and $\theta_{max} > c_b$, $s_a(t) = 0$. If $\theta < c_b$ then $s_b(\theta, t) = 1$, otherwise if $\theta \geq c_b$ then $s_b(\theta, t) = 0$.

There are three time independent equilibria. In only one of these equilibria can sanctions occur. In the other two either A does not sanction or B immediately complies. Two conditions are necessary to observe sanctions. First, A must benefit from sanctioning even if it never achieves any policy concessions from B: $c_a \leq 0$. Second, nation B must value its current policy more highly than avoiding the cost of sanctions: $\theta \geq c_b$. Sanctions only occur when the political benefits to nation A outweigh the economic costs of sanctions and when the cost of sanctions is low for B.

Time Dependent Equilibria

Before characterizing the time dependent equilibria, I want to outline some of the intuition behind the results. Suppose both nations are currently engaged in a sanctions battle. Both nations face similar incentives. They want to win the sanctions battle, but conditional on not winning they want to lose quickly. Consider the problem from nation B's perspective. It is contemplating complying with sanctions today, time t'. It wants to know that value of waiting some small, ϵ, time before complying. There is a potential benefit from waiting ϵ longer. During this time nation A may stop sanctions. If this occurs then B wins the sanctions battle which is worth $\theta/(1-\delta)$. The probability that A stops during this ϵ time depends upon A's strategy. The probability that A stops between time t' and $t' + \epsilon$ is $Q(t) = \int_{t'}^{t'+\epsilon} s_a(t)dt$. The benefit of waiting ϵ longer is therefore approximately $Q(t)\theta/(1-\delta)$. ϵ

There are also costs associated with waiting before complying. If nation A does not stop sanctions during this ϵ time period then nation B pays sanction costs at the rate of $(c_b - \theta)$. The cost of sanctions is c_b but, until compliance, nation B benefits from continuing its policy. Therefore, the net cost of non-compliance is $(c_b - \theta)$. The probability that A continues sanctions through $t' + \epsilon$ is $(1 - Q(t'))$.

Equating costs and benefits, the net expected payoff from waiting ϵ longer is approximately $E[U_b(\text{wait } \epsilon)] = Q(t)\theta/(1-\delta) - (1 - Q(t))(c_b - \theta)$. If this expected payoff is positive then B waits. If this expected payoff is negative then B complies. The expected utility of waiting is increasing in both $Q(t)$ and θ. This means that the more likely A is to stop, the less likely B is to comply. Since the expected payoff is increasing in θ, those types that value their policy highly wait longer than those types that do not value their policy highly. If $\theta \geq c_b$ then the expected value of waiting is always positive. Therefore those types that value their continued policy more highly than the cost of sanctions, $\theta \geq c_b$, will never comply.

Let $t_b(\theta)$ represent the optimal time for a type θ to comply with sanctions. The time B waits before complying with sanctions is an increasing monotone of its type; $t_b(\theta)$ is increasing in θ. In fact, $t_b(\theta)$ is strictly increasing in θ over the range 0 to c_b. To see why, suppose that this is not the case and that a range of types all stop at the same time, t'. As time t' approaches nation A never stops. A knows that if it waits until just after t' then a whole interval of types will have complied. A prefer to wait a short period of time until just after t' before stopping. However, since A does not stop for some time interval before t′ then B types that stop at t′ would prefer to stop earlier. Therefore, the optimal time for B to stop is strictly increasing in its type (for $\theta\epsilon[0, MIN\{c_b, \theta_{max}\}]$). Similar intuition shows that, in equilibrium, the optimal time for B to stop is continuous in types. The optimal time for B to stop, $t_b(\theta)$, is a strictly increasing continuous monotone over the range 0 to c_b. These properties are formally demonstrated in the appendix.

Before going on to consider the behavior of nation A it is worthwhile summarizing what we know about B's strategy. First, if B does not value maintaining its current policy, $\theta=0$, then B will immediately comply with any sanctions: $t_b(\theta = 0) = 0$. Those types that value their current policy more highly that the cost of sanctions will never comply with sanctions: $t_b(\theta \geq c_b) = +\infty$. For the types $\theta\epsilon[0,c_b]$ the optimal time to wait before complying with sanctions is a continuous, strictly increasing monotone. For this later group $t_b(\theta)$ is a one-to-one mapping. It is convenient to define the function $\phi(t)$ as the inverse function of $t_b(\theta)$. $\phi(t)$ is the type that complies with sanctions at time t.

If nation B, of type θ, complies with sanctions at time t_b then its expected payoff is $E[U_b(t_b, \theta, s_a(t))]$.

EQUATION 1

$$E[U_b(t_b, \theta, s_a(t))] = \int_0^{t_b} \frac{s_a(t)\theta_b e^{-(1-\delta)t}}{(1-\delta)} dt + \int_0^{t_b} (1 - s_a(t))(\theta_b - c_b)e^{-(1-\delta)t}dt$$

The first term represents the potential benefits that B receives from resisting sanctions until t_b. The first term is the product of the probability that A will stop sanctioning before time t_b and the value of winning the sanctions battle. Winning the sanctions battle immediately is more valuable than winning it after a period of time. To allow for this the term $e^{-(1-\delta)t}$ ensures that the payoffs are properly discounted. The second term represents the costs of sanctions. Provided that A has not stopped sanctions, B pays a net cost of $(c_b - \theta)$ for noncompliance with sanctions.

Nation A can stop sanctions at any time. It nation A stops at time t_a then its expected payoff is a function of t_a and B's strategy.

EQUATION 2

$$E[U_a(t_a, t_b(\theta))] = \int_0^{t_a} p(\phi(t)) \cdot \frac{d\phi(t)}{dt} \frac{v_a}{(1-\delta)} e^{-(1-\delta)t}dt$$

$$- c_a \int_0^{t_a} (1 - P(\phi(t))) \cdot e^{-(1-\delta)t}dt$$

The first term represents the potential benefits of sanctioning until time t_a. The rate at which nation B complies with sanctions is $p(\phi(t))d\phi(t)/dt$.[1] If B complies then the payoff stream for A is worth $v/(1 - \delta)$. The term $e^{-(1-\delta)t}$ ensures that the payoffs are correctly discounted; receiving the payoff $v/(1-\delta)$ immediately is worth more than waiting before receiving the payoff stream of v per period.

The second term represents the costs that A pays in continuing sanctions until time t_a. The probability of B complying by time t is $P(\phi(t))$. Unless B complies, A pays the per period cost of c_a associated with sanctions. Again the term $e^{-(1-\delta)t}$ ensures that the payoffs are correctly discounted.

The Optimal Time to Stop Sanctions

Given equation 1 we can calculate the optimal time for nation B to comply with sanctions. Equation 1 is maximized with respect to t_b.

EQUATION 3[2]

$$\frac{dE[U_b(t_b, \theta, s_a(t))]}{dt_b} = e^{-(1-\delta)t_b}((\theta - c_b)) + s_a(t_b)(c_b + \delta\theta/(1-\delta))) = 0$$

Rearranging equation 3 and substituting $\phi(t)$ for θ yields

EQUATION 4

$$\phi(t) = (1-\delta)(1-s_a(t))/(\delta s_a(t) + 1 - \delta) \text{ or}$$

$$s_a(t) = -(\phi(t) - c_b)(1-\delta)/((1-\delta)c_b + \delta\,\phi(t)).$$

Similarly given equation 2 we can calculate the optimal time for nation A to comply with sanctions. Maximizing equation 2 with respect to t_a yields

EQUATION 5

Rearranging equation 5 yields equation 6.

$$\frac{dE[U_a(t_a, \phi, (t))]}{dt_a} = e^{-(1-\delta)t_a}\left[\frac{v}{(1-\delta)} \cdot p(\phi(t))\frac{d\phi(t)}{dt} - c_a(1 - p(\phi(t)))\right] = 0$$

EQUATION 6

$$\frac{d\phi(T)}{dt} = \frac{c_a(1-\delta)}{v}\,\frac{1 - P(\phi(t)))}{p(\phi(T))}$$

Evaluating the second order conditions given equation 6 yields that $\dfrac{d^2E[U_a(t_a, \phi(t))]}{dt_a^2} = 0$ Thus, if equation 6 is satisfied then nation A is indifferent between all stopping times.

Conditions for Time Dependent Equilibria

The section above has characterized several properties of time dependent equilibria. In summary if $(s_a{}^*(t), s_b{}^*(t))$ is a time dependent equilibrium strategy profile then the following properties are true.

1) The optimal stopping time, $t_b(\theta)$ is a strictly increasing continuous monotone that maps the types $[0, \text{MIN}\{\theta_{max}, c_b\}]$ into time interval $[0, +\infty]$.

2) The optimal stopping time for a type that does not value its policy is zero: $t_b(\theta=0)=0$. Types that value their policy more highly than the cost of sanctions never comply: $t_b(\theta \geq c_b) = +\infty$.

3) For the range $[0, \text{MIN}\{\theta_{max}, c_b\}]$, B's optimal stopping time satisfies equation 6:
$$\frac{d\phi(t)}{dt} = \frac{c_a(1-\delta)}{v}\frac{1-P(\phi(t))}{p(\phi(T))}$$

4) The rate at which nation A stops sanctions is given by equation 4: $s_a(t) = -(\phi(t) - c_b)(1-\delta)/((1-\delta)c_b + \delta\phi(t))$.

CHARACTERIZING TIME DEPENDENT EQUILIBRIA

Equilibrium strategies are found by integrating equation 6 and substituting $\phi(t)$ into equation 4. The existence of time dependent equilibria depends upon A's beliefs about B's type. I consider two different distributional assumptions. If A's beliefs are uniform then time dependent equilibria exist. However, for other distributions, such as the exponential distribution, there are no time dependent equilibria. I characterize the equilibria assuming uniform beliefs. Having shown that the exponential distribution rules out time dependent equilibria, I discuss general distributional requirements for the existence of time dependent equilibria.

Uniform Distribution of Types

Assuming that A's beliefs about B's type are uniform implies that equation 6 reduces to
$$\frac{d\phi(t)}{dt} = \frac{c_a(1-\delta)}{v_a}(1-\phi(t)).$$

Case 1: $c_b \geq \theta_{max} = 1$.

Integrating equation 6 reveals that the type that stops at time t is $\phi(t) = 1 - e^{\frac{-(1-\delta)c_a t}{v}}$.

This implies that B's optimal stopping time $t_b(\theta) = -\frac{v}{(1-\delta)c_a}\ln(1-\theta)$.

The probability with which A stop is $s_a(t) = \frac{(1-\delta)(\phi(t)-c_b)}{(1-\delta)(\phi(t)-c_b)-c_b}$.

Proof: First, consider B's strategy. $t_b(\theta)$ is a strictly increasing continuous monotone where $t_b(0)=0$ and $t_b(1)=+\infty$. Given $s_a(t)$, then $t_b(\theta)$ maximizes B expected utility (equation 1). Therefore $t_b(\theta)$ is a best response for B given $s_a(t)$.

Now show that A's strategy is a best response given $t_b(\theta)$. Since $t_b(\theta)$ satisfies equation 6 then A is indifference between stopping at all times and A's beliefs about B are consistent with Bayes rule. Therefore, $s_a(t)$ is a best response given $t_b(\theta)$. QED

Case 2: $c_b < \theta_{max}$.

The equilibrium is similar to case 1, except that those types $\theta \geq c_b$ never comply with sanctions. The type that stops at time t is $\phi(t) = c_b - e^{\frac{-(1-\delta)c_a t}{v}}$.

B's optimal stopping time is $t_b(\theta) = -\frac{v}{(1-\delta)c_a}\ln(c_b - \theta)$ for types in the interval $\theta \in [0, c_b)$. If $\theta \geq c_b$ then B never stops.

The probability with which A stop is $s_a(t) = \frac{(1-\delta)(\phi(t) - c_b)}{(1-\delta)(\phi(t) - c_b) - c_b}$.

Proof: As for case 1

In these equilibria, nation A randomizes its stopping time. The rate at which A stops declines the longer sanctions last. Since the rate at which A stops declines, nation B finds compliance more attractive as sanctions continue. Eventually, only the highest types of B continue to resist sanctions. Sanctions occur in these equilibria. Unfortunately, these time dependent equilibria do not always exist. Their existence is sensitive to A's beliefs about B's type.

Exponential Distribution of Types

In war of attrition models it is a common to assume that types are distributed exponentially: $P(\theta) = 1 - e^{-\theta}$, and $p(\theta) = e^{-\theta}$.

If types are distributed exponentially then no time dependent equilibria exist.

Proof: Suppose not then there exists a time dependent equilibria.
If a time dependent equilibria exists then, given the discussion above, $\phi(t)$ must satisfy equation 6: $\frac{d\phi(t)}{dt} = \frac{c_a(1-\delta)}{v_a}$. Integrating equation 6 reveals that $\phi(t) = c_a(1-\delta)t/v$. But this contradicts $t_b(\theta) \rightarrow +\infty$ as $\theta \rightarrow c_b$. Therefore there are no time dependent equilibria if A's beliefs are exponential. QED.

Distributional Requirements for the Existence of Time Dependent Equilibria: A Discussion

Time dependent equilibria exist if B's type is distributed uniformly but not if B's type is distributed exponentially. The existence of equilibria depends upon distributional assumptions. In general there are two constraints that effect whether time dependent equilibria exist. First, $t_b(\theta)$, the optimal stopping time for B, must be continuous and tend to infinity over a finite interval; as θ tends to c_b or θ_{max}, $t_b(\theta)$ must tend to infinity. If all types stop at some finite time then an equilibrium can not exist. Second, $t_b(\theta)$ is constrained by equation 6. In order that A is indifferent to stopping at any time the rate at which B complies must satisfy equation 6. Only beliefs that satisfy both these requirements lead to time dependent equilibria.

A necessary condition to satisfy these distributional requirements is $\frac{dp(\theta)}{d\theta} > -\frac{p(\theta)^2}{1 - p(\theta)}$ for all θ. This condition, which is derived in the appendix, rules out the existence of time dependent equilibria if the probability density of types declines sharply at any point. In particular, as θ approaches is upper bound then either $p(\theta)$ must tend to zero or the probability density must be non-decreasing. This means that the right hand tail of the distribution must be (weakly) increasing. Although, this condition must be satisfied for time dependent equilibria to exist, it does not guarantee their existence: It is only a necessary condition.

Time dependent equilibria only occur for a limited set of beliefs. Unfortunately, theory can not tell us whether these distributional requirements are met in the real world. This is an empirical question. Without knowing the distribution of beliefs it is not possible to predict whether these equilibria occur.

IMPLICATIONS.

In this section I look at several aspects of sanctions. First, I examine the conditions under which sanctions occur. Second, I consider when A threats B with sanctions. Third, I examine when sanctions are successful. Finally, sampling effects complicate the estimation of sanctions' success. I examine these sampling problems.

Conditions Under Which Sanctions Occur

There are two equilibria in which sanctions occur: Time dependent equilibria and equilibrium TID3. Sanctions do not occur in other equilibria. The analysis suggests that sanctions can not occur under all conditions. Sanctions only occur in those circumstances where either a TD or TID3 equilibrium exists. Under other circumstances sanctions do not occur.

Sanctions require that either the belief requirements discussed above are satisfied or nation A benefits politically from sanctions and the cost of sanctions is small compared to the value of the policy ($c_a \leq 0$ and $c_b < \theta_{max}$). In equilibrium TID3, sanctions occur because neither side as an incentive to stop the sanctions battle. For nation A the political benefits of sanctions outweigh the economic costs ($c_a \leq 0$). For nation B the cost of complying with sanctions is greater than the damage inflicted by sanctions ($\theta \geq c_b$).

The time dependent equilibria resemble the equilibria that Tsebelis (1990) characterizes in a single shot sanctioning situation. Hayes (1995) also predicts that nations randomize when to quit the sanctions battle. Observationally this is similar to war of attrition models with incomplete information. In these models nations drop out of the sanctions battle according to their type. Fundenberg and Tirole (1992 p.230–32) discuss the close relationship between mixed strategy and Bayesian equilibria. However, in this model time dependent Bayesian equilibria only exist for a restrictive set of beliefs.

Nation A always sanctions if the domestic political benefits outweigh economic costs ($c_a \leq 0$). Under these conditions A sanctions even though it knows that the sanctions will never succeed. Under these conditions, nation B knows that sanctions will continue indefinitely. If the cost of resisting sanctions is high compared to A's demands then nation B complies immediately. However, if nation B values its current policy highly then it resists sanctions ($c_b \leq \theta$). Under these circumstances sanctions continue indefinitely. Neither side wants to end the sanctions battle even though they know that their competitor will never comply.

This later situation is common in sanctioning. Lindsay (1986) observes that nations typically use sanctions as domestic and international symbols rather than as serious attempts to bring about policy concessions. Political leaders often sanction to satisfy domestic constituents. In fact, in those cases where the size of the sanctions is small compared to the concession demanded, this is the only reason to sanction. If the costs imposed on the target nation are small then the target never acquiesces to the sender's demands. Suppose a sender imposes small sanctions on a target nation. These sanctions are designed to appease domestic groups or international partners rather than bring about serious policy concessions from the target.

In summary, sanctions occur under two circumstances. First, given restrictive beliefs, sanctions can occur in a time dependent process. Second, sanctions occur when the political benefits of sanctioning outweigh any economic cost for the sender nation. Under this condition, A sanctions whether or not it believes sanctions will produce policy concessions. When the concessions demanded are large and the cost of sanctions small then the target resists. If prolonged sanctions occur then either A's beliefs about B satisfy the distributional requirements discussed above or sanctions are low cost and politically motivated.

Conditions Under Which a Sanctions

There are three sets of condition under which A sanctions. A sanctions in the time dependent equilibria. These time dependent equilibria only occur for certain distributions of types. Since these equilibria were discussed above, I will concentrate on the other circumstances in which A sanctions.

Nation A sanctions B in the time independent equilibria TID2 and TID3. Nation A sanctions if either B immediately complies with A's demands (TID2) or sanctions are politically popular (TID3). In TID 2, the cost of sanctions on nation B is high compared to the value of the concessions demanded ($c_b > \theta_{max}$). Under these circumstances nation B immediately complies with sanctions. Thus, nation A imposes sanctions when its demands are small but the cost of the sanctions on the target is high. In TID 3, both nations, A and B, continue sanctions even though they know that they can not win the sanctions battle ($c_a \leq 0$ and $c_b \leq \theta$).

Substantively, A threatens sanctions when it is either politically beneficial to do so or when B is likely to comply with sanctions. In this second case, the length of sanctions will be short. In fact, we may never actually see the sanction at all. Particularly if it is costly to back down in the face of sanctions, B may preempt sanctions and unilaterally change its policy. Nations threaten sanctions when it is politically beneficial or when if they expect to be successful. Next I want to look at the circumstances in which A is likely to be successful.

Conditions Under Which Sanctions are Successful

The analysis reveals two conditions under which sanctions are successful. B complies with sanctions in time dependent equilibria and in time independent equilibrium TID 2. The time independent equilibrium TID 2 requires that sanctions impose large costs on the target relative to the concessions sought ($c_b > \theta_{max}$).

Hufbauer, Schott and Elliot (1985) summarize those conditions that are likely to lead to successful sanctions. I consider some of their results and show that the predictions of the model are consistent with their findings. Hufbauer, Schott and Elliot claim that sanctions are likely to be successful if they impose only small costs at home but have large costs on the target. The only time independent equilibrium in which sanctions are successful is TID

2. This equilibrium requires that, for the target nation, sanctions are costly compared to the concessions demanded. Indeed, Galtung (1967) describes the ideal situation in which to sanction as one in which the costs to you are low but the costs for the target are high.[3]

Hufbauer, Schott and Elliot (1985) claim that sanctions against allies are more successful than those against enemies. Allies are likely to share similar policy desires. Therefore, nations are likely to demand smaller concessions from their allies than from their enemies. In addition, allies have closer commercial and financial interactions than enemies. This implies that the cost of sanctions is larger for allies than enemies. Equilibrium TID2 predicts that high costs and small concessions are a recipe for successful sanctions.

The incremental imposition of sanctions does not tend to be successful. Hufbauer, Schott and Elliot claim that nations that gradually increase the level of sanction rarely obtain significant policy concessions. To understand why, suppose that the large sanctions eventually imposed would succeed in bring about concession. In these circumstances the sender should apply the large sanction straight away. By doing so they immediately achieve policy concessions and do not bear the cost of sanctions because the target immediately complies. Nations that increase sanctions progressively do so, not to win policy concessions, but rather in response to domestic political demands. If a nation seeks policy concessions it should immediately use the most powerful sanction at its disposal. It is likely that leaders gradually increase sanctions in response to increasing domestic pressure rather than as a serious attempt to bring about policy concessions.

Sampling Effects

The equilibria predict when sanctions occur and when sanctions succeed. The analysis reveals that the occurrence and success of sanctions are interdependent. The probability of B complying with sanctions affects whether A sanctions in the first place. A only sanctions when it believes it can win or when it is responding to domestic pressures. Therefore, the sanctions we observe contain events in which A is likely to win or events in which sanctions are domestically popular for A. However, we should rarely observe A imposing sanctions that are domestically unpopular and that have little chance of success. In this section, I demonstrate how this selection effect complicates any assessment of sanctions.

As researchers, we only observe sanctions when A decides to sanction and B decides to resist. This only occurs in time dependent equilibria or in TID3. Thus, the set of sanctions that we observe is generated via either TID3 or TD equilibria. Therefore, Hufbauer, Schott and Elliot's data contains many events that satisfy the conditions for TID3 or TD equilibria but contain few events that correspond to TID1 or TID2.[4]

To demonstrate the selection effect consider the following examples. Suppose that nation A asks B for some small scale concessions and threaten costly sanctions if B does not comply. Since the demands are low and the costs are high, B immediately complies (TID2). Although we never observe the sanctions they are responsible for B's change in policy. This argument is analogous to the effect of Presidential veto on congressional legislation. The anticipation of the President's veto is sufficient to ensure that Congress modifies its policy to avoid the veto. Even if a bill is not vetoed by the President, it would be wrong to conclude that the veto is unimportant in shaping the bill (Matthews 1989).

These sampling effects make it extremely difficult to assess the success of sanctions by simple induction. Sanctions are applied if A thinks sanctions will be effective or if sanctions are domestically popular. These events do not constitute a random sample from all the possible sanctioning event that could have occurred. Unfortunately, the selection of the event, whether sanctions occur, already contains most of the information about the probable success of the sanctions. Therefore, it is extremely hard to draw conclusions about the success of sanctions, without considering why the sanctions were applied in the first place. Presumably, in events of successful sanctions at least part of the reason for applying sanctions was that the sender nation anticipated that the sanction would be successful.

CONCLUSIONS

This paper models the incentives of a sender nation to use sanctions to extract policy concessions from a target nation. The equilibria of the game outline the conditions under which sanctions occur and the conditions under which these sanctions are successful. The model's crucial substantive finding is that the decision to sanction and the success of sanctions are interdependent. Therefore, it is not possible to consistently estimate the success of sanctions by looking only at sanctions. Inductive studies alone are insufficient assess the success of sanctions. To study the success of sanctions it is necessary to control for the decision to sanction in the first place. In order to study this decision it is essential to consider events where nations could have potentially sanctioned but did not.

This paper has not explicitly considered the domestic effects of sanctions. However, sometimes nations sanction for domestic political reasons (Kaempfer and Lowenberg 1992). An understanding of the incentives of domestic leaders would help explain the decision to sanction. Using domestic factors to identify the decision to sanction would enables us to examine the success of sanctions.

The domestic effects of sanctions is important in the target nation as well as the sender nation. Hufbauer, Schott and Elliot show that many sanctions are implemented to destabilize the target's political system rather than to obtain policy concessions. The target's domestic political situation affects whether sanctions are applied and whether they are effective. The domestic effects of sanctions are essential in explaining the occurrence of sanctions.

In conclusion, this paper is a preliminary attempt to examine the selection effects of sanctions. A formal model demonstrates the relationship between the application of sanctions and the success of sanctions. Domestic political pressures and the likelihood of success affect whether a nation decides to sanction. Unfortunately, as researcher, we only observe the success of sanctions if sanctions occur. The success of sanctions affects whether sanctions are observable. Thus, using sanctions to study their success involves selecting on the dependent variable: This results in misleading conclusions.

APPENDIX

Properties of time dependent equilibrium strategies.

(i) The optimal time for B to comply with sanctions is non-decreasing: $t_b(\theta)$ is non-decreasing in θ_b.

In equilibrium, suppose types θ and θ' stops at times $t_b(\theta)$ and $t_b'(\theta')$, respectively.

By the definition of a Bayesian equilibrium, $E[U_b(t_b, \theta)] \geq E[U_b(t_{b'}, \theta)]$ and $E[U_b(t_{b'}, \theta')] \geq E[U_b(t_b, \theta')]$.

The expected utility of stopping at t_b is,

$$E[U_b(t_b, \theta)] = \int_0^{t_b} \frac{s_a(t)\theta_b e^{-(1-\delta)t}}{(1-\delta)} dt + \int_0^{t_b} (1 - s_a(t))(\theta_b - c_b)e^{-(1-\delta)t}dt$$

Therefore,

$$E[U_b(t_b, \theta)] - E[U_b(t_b, \theta')] + E[U_b(t_{b'}, \theta)] - E[U_b(t_{b'}, \theta')] \geq 0.$$

This implies that .

$$\frac{(\theta_b - \theta_b')}{(1-\delta)} \left[e^{-(1-\delta)t_b'} - e^{-(1-\delta)t_b} + \delta \int_0^{+\infty} s_a(t)e^{-(1-\delta)t_b}dt - \delta \int_0^{+\infty} s_a(t)e^{-(1-\delta)t_b'}dt \right] \geq 0 .$$

Thus if $\theta > \theta'$ then $t_b \geq t_{b'}$.#

(ii) The optimal time for B to comply with sanctions is strictly increasing for $\theta < c_b$: $t_b(\theta)$ is strictly increasing in θ for $\theta < c_b$.

Suppose not. Then there exists some $t^\wedge > 0$ such that for the interval $[\underline{\theta}, \overline{\theta}]$, $t(\theta_b) = t^\wedge$. Define $Diff = E[U_a(\text{stop at } t+\xi)] - EU_a(\text{stop at } t-\xi)] = [P(\overline{\theta}) - P(\underline{\theta})]v_a/(1-\delta) - 2\xi c_a$. As $\xi \to 0$ then $Diff \to [P(\overline{\theta}) - P(\underline{\theta}_b)]v_a/(1-\delta) > 0$. Therefore, if $t \in [t^\wedge - \xi, t^\wedge]$ then $s_a(t) = 0$. Just before time $t^\wedge$ nation A does not stop.

Given that A does not stop just before $t^\wedge$ then B does not wait until time $t^\wedge$ before stopping. If $\theta < c_b$ then $E[U_b(t^\wedge - \xi, \theta)] > E[U_b(t^\wedge, \theta)]$, which contradicts $t(\theta_b) = t^\wedge$. Therefore, the optimal time for B to stop is strictly increasing in type for all types $\theta < c_b$.#

(iii) The optimal time for nation B to comply with sanctions is a continuous function in type: $t_b(\theta)$ is continuous.

Suppose not. Then there exists some interval $t'' > t' > 0$ such that $Prob(t(\theta) \in [t', t'']$ for some $\theta) = 0$. A does strictly better by stopping at t' than for stopping at any time in the interval $(t', t'']$. Thus for the interval $(t', t'']$, $s_a(t) = 0$. Given that A does not stop in the interval $(t', t'']$, B's expected utility for waiting until time t'' is

$E[U_b(t'', \theta)] = E[U_b(t', \theta)] + \int_{t'}^{t''} (\theta - c_b)e^{-(1-\delta)t}dt$. For all $\theta < c_b$, t' is a strictly better strategy than t''. If $\theta \geq c_b$ then $t_b(\theta) = +\infty$. But this contradicts $t'' = t_b(\theta)$ for some θ. #

(iv) In equilibrium, as $\theta \rightarrow \min\{c_b, \theta_{max}\}$ then $t_b(\theta) \rightarrow +\infty$.
From the previous results $t_b(\theta)$ is a strictly increasing continuous monotone. First consider the case where $c_b \leq \theta_{max}$. If $t_b(\theta)$ does not tend to infinity as θ tends to c_b then $t_b(\theta)$ tends to some finite constant k. As time approaches k then consider the incentives facing A. If A waits until time k it wins with probability one. At the time $k-\epsilon$ the cost of waiting ϵ longer is less than $\epsilon . c_a$. For an arbitrary small ϵ the cost of waiting is zero and the potential benefit is winning, which is worth $v/(1-\delta)$. Therefore, A does not stop in the interval $[k-\epsilon, k]$.

Given that A does not stop just before k all types θ, such that $\theta < c_b$, prefer to stop earlier: $E[U_b(t'', \theta)] > E[U_b(k, \theta)]$ for all $t'' \in [k-\epsilon, k]$, for all $\theta < c_b$. But this contradicts $t_b(\theta)$ being a continuous strictly increasing function tending to k. Therefore, as θ tends to c_b, the optimal stopping time tends to infinity.

Exactly the same arguments hold if $\theta_{max} < c_b$. As $\theta \rightarrow \theta_{max}$ then $t_b(\theta) \rightarrow +\infty$. #

Distributional Restrictions and the Existence of Time Dependent Equilibria. Differentiating equation 6 yields,

$$\frac{d^2\phi(t)}{dt^2} = k\frac{d\theta}{dt}\left[1 - \frac{p(\phi))}{p(\phi)^2}\,\frac{dp(\phi)}{d\phi}\right], \text{ where } k = (1-\delta)c_a/v.$$

Given that $t(\theta)$ tends to $+\infty$, $\frac{d^2\phi(t)}{dt^2} < 0$. This implies that $\frac{dp(\theta)}{d\theta} > -\frac{p(\theta)^2}{1-p(\theta)}$, for all $\theta \leq \mathrm{MIN}\{c_b, \theta_{max}\}$.

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NOTES

1. The probability $p(\phi(t)).d\phi(t)/dt$ is obtained via the change of density formula.
2. The second order conditions evaluated at this point are

$$e^{-(1-\delta)t_b}\left(c_b + \delta\phi(t)/(1-\delta)\right) . ds_a(\phi(t))/d\phi(t) . d\phi(t)/dt < 0 .$$

3. Galtung phases this statement in terms of proportion of trade between states rather than using the term cost.
4. Hufbauer, Schott and Elliot include cases of threat in their data set. These events are likely to correspond to TID2.

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CONTRIBUTOR

Alastair Smith is a Lecturer in the department of Political Science and department of Social Thought and Analysis at Washington University in St. Louis. His research interests include the effect of international alliances on the occurrence of conflict, diversionary war theory, the effect of domestic politics on foreign policy, endogenous tariff theory and endogenous election timing in parliamentary systems.