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Management of Whales as Mixed Good and Shared Resource

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Abstract

In this essay, the issue of whaling is discussed by addressing the international management of whale species as an economic mixed good, having both private consumptive values and private/public non consumptive ones. We want to stress why and how it is important to take account of both features when we cope with international environmental agreements (IEA) on whales - or similar resources. In fact international bargaining should be based on total value in order to lead to an optimum level of steady state stock and eventual harvest. We use the Kaldor Hicks criteria to value bargaining welfare implications.

Bargaining is analysed both by using Nash co-operative theory of two agents behaviour and coalitional analysis (3 agents). By means of that we try to model what we think it is the current IWC (International Whaling Commission) situation under the ban voted in 1982. We underline the weakness, instability and possible inefficiency of the current IEA, then we highlight how the situation under IWC could be enhanced if transfers may be allowed.

We claim a IWC reform is necessary, by changing the convention goals from being consumptive value oriented to total value oriented. Then we think it is necessary to introduce side payments into the bargaining process to approach an economic optimum so enhancing the current inefficient situation. Finally, bargaining should be as decentralised as possible, that is each species (and maybe unit stocks within species) should be managed by separated bargaining processes, creating separated markets within the convention, instead of considering whales as one single homogeneous species.

Keywords: Whales total value, bargaining, side payments, International agreements, mixed good, shared natural resource, IWC reform

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0. Introduction

Whaling is one of the oldest industry ever existed, as whales were caught by men since the appearance of the human race. But the issue of whaling has been evolving and changing, mostly during the last century. The problem was once one of open access over fishing, dealing with slow growth species. Things could maybe have been worse without the International Whaling Convention (IWC) advice, but IWC could not prevent whalers from depleting stocks of all species toward extinction.

A new turning point can be the year 1972: following decades of depleting stocks many species were almost extinct and a new international position was born, mainly stemming from ecologist movements and campaigns within western societies (where whale assumed the role of a focal species). In 1972 there were the United Nations Conference on the Human Environment in Stockholm and the ratification of the Marine Mammal act in the US; both stated that whales were not only a "fish" but a species worth conserving because of other values. The struggle between whalers, who considered the whale just a fish to harvest, and the conservationist/animal welfare lobby began, ending in 1982 with the total ban (moratorium) on whaling[1], voted by the necessary 2/3 majority to amend IWC schedule. The ban was the ending point of an increasing support for the "non consumptive use" of whales and marine mammals in general, which allowed the formation of an anti whaling majority within IWC.

What I have described so far is the rationale of addressing the problem of managing whale resources today. In the past natural resource economics dealt with the problem mainly in terms of managing an optimal harvest and assuring a sustainable industry. It is not a case that whales were so studied within fishery economics. Today we deal with a resource which has attached not only consumptive values, but a bundle of non consumptive values.

1. Whale as a mixed good

1.1 The nature of whale resource

The main difference between IWC goals until the 70's and the whale issue since then is the nature of the whale resource. During the 70's new values, non consumptive ones, begin to appear: the whale watching industry starts its life in the US, before spreading all around the world; whales are chosen as focal species by the young environmental movements, some moral philosophers argue superior mammals - so whales- have rights to be defended and attached intrinsic values.

When IWC was set up in 1946 as a consequence of the International Convention for the Regulation of Whaling (ICRW), organised to enable whaler countries to conserve the great whales and the associated industry, the only interest toward whales was concerned to oil and meat. Whales had been regarded as fish, and the IWC was born on that cultural background. The issue was to manage co-operatively the resource in order to prevent the industry from collapsing following a huge and irreversible depletion of the stock.

During the '70s Whales began to be considered not just as a big fish but a sentient living mammal. But the non consumptive values attached to whales, aside from whale watching/touristic activities, are defined as pure global goods. This fact raises new issues and new problems: on one hand we have the necessity of recognising a market failure if these non consumptive values are not taken into account, o the other hand we need to measure the new values- under the well known problems related to public goods revelation of preferences. The mixed good nature of whales makes things more difficult as far as economic theory and policy enforcement is concerned, because whales represent different values to different people and the arguments are concerned with economics, biology, politics and ethics.. We face both market failures due to an open access management and market failures caused by the public good characteristics of the asset resource.

1.2 Total Economic Value

Total economic value as far as whales are concerned can be divided into use and non use values. Then use values can be further split into consumptive use values, non consumptive use values- both direct values- and indirect use values; non use values can be defined as such values characterised by public good features (global public good). Table 1 sum up in brief what values we face when dealing with whales.

(Table 1)

2. IWC and other international conventions

The management of whales by IWC is influenced and connected to other international conventions and national policies concerning marine mammals and endangered species. The links are important as far as the reciprocal consistency of policies is concerned, and because they influence the bargaining process within IWC.

The most important international conventions and national acts concerned with whales are the followings.

1. 1973. Convention on International Trade in Endangered Species (CITES). This convention is important because whale, as an endangered species, can be listed either on appendix 1 or appendix 2 in order to prevent exploitation by international trade.
2. 1982 UN Convention on the Law of the Sea (LOSC). Under this convention (article 56) an exclusive economic zone of 200 miles was adopted to allow states the management of living and non living natural resources. Since 1982 many countries has enforced it and many developing countries are sympathetic because it strengthen their bargaining power. The issue becomes more complicated when migratory species as cetaceans are examined. Article 65-following 63 and 64 concerned with fish- deals with it by stating that states must cooperate in conserving marine mammals and that in the case of cetaceans a particular work by international organisations is needed for management[2].
3. GATT (General Agreements on Tariffs and Trade). GATT rules are worth considering while analysing the whale issue because trade unilateral policies (i.e. US trade policies) aimed at enforcing by threats specific IEA (International Environmental Agreements) must be consistent with GATT (given the involved states are GATT members) . This could be the case of US commercial threats to Norway and Iceland in case of a resumption of whaling.

   Article XI(1) of GATT prohibits members from imposing restrictions on imports and exports. Moreover no exceptions exists as far as a better conservation of natural resources. Articles XX(b) and (g) allows governments to impose trade measures that are necessary to protect human, animal or plant life or health and to take measures relating o conservation of exhaustible natural resources if such measures are made effective in conjunction with restrictions on domestic production and consumption.

   It seems that the only cases where such a threat is plausible and consistent are: a) where another international treaty permits the use of trade measures to protect species (i.e. CITES); in this case we could argue a priority over GATT; b) when trade measures are established by the convention concerned with the resource under analysis; c) obviously when the resource is under the jurisdiction of the damaged agent. So it seems that IWC should contemplate trade sanctions in order to avoid GATT inconsistency.

4. 1972 US Marine Mammal Protection Act. The basic scheme is unchanged although it has gone through several amendments. The central feature is a moratorium on all taking of all marine mammals and a ban on imports.
5. 1976 Magnuson Fishery Conservation and Management Act. The act applies within the US EEZ zone. The relevant fact for whales is the Packwood amendment to the act in 1979, which provides for an automatic 50% reduction in fishing allocations within EEZ those countries undermining conservation programmes under international convention;
6. 1976 Fishery Conservation and Management Act and Pelly amendment in 1979. The amendment provides that US president may restrict import into the USA fish products from a country which undermines conservation programmes under international conventions.

As we have seen so far the international institution dealing with whale management should cope with other involved institutions so that consistency issues arise. Even if global commons require a multilateral bargaining to achieve or approach the optimum, the role of unilateral trade sanctions (effectiveness, credibility, secondary effects, long term effects) must be carefully analysed. This is necessary to see if the problem in trade and environment conflicts is due to GATT vague consideration of environmental global issues or the weakness of actual international environmental obligations.

2.1 Sharing global oceanic resources

The big challenge is to reform international institution managing whales while attracting the memberships of all whaling and anti whaling countries (recall unanimity is needed). A great bargaining effort is needed to achieve such an agreement.

As stressed by Swanson (1991) the main problems in reaching an agreement on a global oceanic resource are free riderism and non compliance dealing with joint management resources and multilateral parties. Free riderism is caused by opportunistic behaviour (incentive to cheat when the other co-operates), non compliance follows the heterogeneity we face dealing with international issues. Countries being different, the payoffs they face are different. Moreover the interaction between the two problems makes things more complex to solve.

As far as whales are concerned, both issues are involved although in a new framework. Interested parties have conflicting interests and values on the use of the resource. Non compliance follows the clear trade off in goals; the role of side payments and threats to ensure and achieve a potential global optimum will be explored below. Then we face free riderism within each “party”: free

riderism within whalers in order to get higher shares while the other is co-operating for a sustainable use, free riderism within anti whaling countries caused by the global public nature of non consumptive values.

3. Bargaining

As stressed in last sections, the issue is currently one of dealing with a joint managed resource- enforcing the 200 miles means that whales are not longer strictly an open access resource- by multilateral agreements. It is worth noting two points:

i) The costliness of bargaining between interested parties may be not very high if marine property rights will be enforced. Even if diversification between countries remain strong, property rights definition can be an useful framework for bargaining and joint management.
This could allow a "coasian" bargaining between parties in order to achieve the most valuable use of the resource. Moreover a property rights enforcement should allow a decentralised approach which I argue is necessary. I mean the bargaining process (and related valuation) should deal with each species and unit stocks separatelyand not with the global use of the resource. The costs of property rights enforcement and decentralisation must obviously be taken into account in order to ensure the cost of decentralisation are lower than the benefits.

ii) the ban under enforcement is a form of *ex post bargaining process* (without redistributions), and some countries (Norway, Japan, Iceland) are not accepting it because the costs for them are higher then benefits. It has already been stressed it is clearly not stable in the long run and I argue it is the main reason. The aim of the following sections is to show that an ex ante bargaining process with redistributions is a better framework to manage the resource. The costliness of the ex ante approach- definition of individual shares, total global/regional quotas and monitoring may be reduced by using recurrent short term contracts instead of either incomplete long term contract or once and for all ones (Williamson, 1993). By means of short term agreements (i.e. expiring every 6-8 years) reciprocity could be increased and opportunistic behaviour disincentived; changing values and new situations could be dealt with.

It is similar to "franchising" international commons thus reciprocal incentive to cheat exist. Once a payment is done, the resource could be exploited against the donor will, while the donor could try to reduce the payment when the resource is being conserved. Both behaviour should be

disincentived if the agents play in a long run scenario, knowing that losing credibility means losing the power to enforce the deal.

4. Bargaining Models

In this section a dynamic model, which bring together optimal management and bargaining on whale values will be presented.

4.1 Two agents bargaining

A dynamic model of whale management taking account for total value is presented in combination of Nash theory of two agents co-operative games (Binmore, 1991; Myerson, 1991; Raiffa, 1982). It will be considered either the case when side payments are allowed or not.

We face conflict of interests between the two interested in the resource, a whaling agent and an anti whaling one concerned with non consumptive values.

The two objectives can be incorporated into a single present value maximisation [3]where we take into account of both, that is:

$PVH = \beta PV1 + (1-\beta)\, PV2,$

Where:

$PV1 \text{ (whaling)} = \int e^{-rt} (p-c(x))h(t)\, dt,$

where t goes from 0 to T or ∞

$PV2 = \int V(x),$

or defining function V(x)

$PV2 = \int e^{-rt} \tau x,$

we define e^{-rt} as the discount factor where r is the continuos discount rate. We start by analysing a unique discount rate, then differentiating between the two agents.

P is the market price of whale meat, c(x) the cost of harvesting (that we will assume sometimes constant for simplicity), h(t) the harvest rate. X(t) is the population biomass: the underlying biological model is the well known Schaefer model, where F(x)= gx(1-x/k), k the maximum biomass size and g the intrinsic growth rate.

Population dynamics is defined by dx/dt = F(x) - h(t), and h(t) = q E x(t), with q the catchability coefficient, E the fishing effort.

Now we turn to the management agreement. Let such an agreement be one where we maximise a weighted sum of the objectives of the two agents, with x as a state variable and h as a control variable.

So we have:

$\max \int [(p-c)\, h(t) + \tau x(t)]\, dt,$
w.r.t. $dx/dt = F(x) - h(t)$.

$X(0)=X_0$ and h(t) satisfies $0< h(t) < hmax$ where hmax is a feasible maximum harvest rate.

The present value Hamiltonian is:

$PVH= [\beta(p-c)h(t) + (1-\beta)\, \tau x(t)\,]\, e^{-rt} + \lambda\, [\, F(x) -h(t)],$

where lambda is the costate variable or the PV shadow price of a unit of resource stock (equates with resource rent in equilibrium).

Having defined the relevant parameters, the FOCs are:

(1) $\partial\lambda/\partial t = - \partial H/ \partial x = - (1-\beta)\, \tau\, e^{-rt} - \lambda F'(x)$ adjoint equation

(2) $\partial H/\partial h = 0 = e^{-rt}\, \beta(p-c) - \lambda(t)$ maximum condition.

We note the adjoint equation, defining the optimal path of the multiplier, involves the marginal non use value.

The problem we face is that the hamiltonian is linear in h; h ≥0 should be chosen to maximise H. This implies h(t)=0 if $\lambda > e^{-rt}\beta(p-c)$ and h(t) = hmax if $\lambda < e^{-rt}\beta(p-c)$. In this case the condition is adjusted by weight β- is positive.

In order to approach a steady state other than 0 or K for X* we assume that (2) equals zero over some time. So that we face the most important case where

$\lambda = e^{-rt}\beta(p-c)$

Differentiating (2) with respect to time and using (1), we get the revised fundamental equation[4]:

(3) $F'(x) + \tau (1-\beta)/(p-c)\beta = r$ (assuming c as a constant).

so the optimal stock at a steady state must be given by (3) and it depends on the non use value and on the relative weights. Other things being equal, the optimal stock would be higher than in the classic case with use values alone.

The optimal steady state stock would be defined by:

(4) $x^* = k/2[\ 1 + \tau (1-\beta)/\beta\ (p-c)g - r\beta/g]$.

Having determined the optimal stock, let analyse the optimal harvest. Being unlikely a situation where $X_0 = x^*$, some adjustment is necessary. The policy is described by a so called "most rapid approach path" (MRAP), where:

h(t) =	0	whenever	x(t) < x*	(a)
	h max	whenever	x(t) > x*	(b)
	F(x*)	whenever	x(t) =x*	(c).

So we should get to x* as soon as possible (finite time T) by (a) or (b) and then retaining it by an equilibrium harvest (c).[5]

We note how the solution is in a feedback form, being optimal harvest an explicit function of the state variable x (Conrad and Clark, 1987).

Let analyse some interesting cases by changing values to the parameters:

1. by putting r=0 we are in a static case, and extinction is never possible even if tau (τ) was zero and β=1.
2. If beta was 1 we are back into a situation where the only goal accounted for is the whaling one. Extinction is more likely the more the ratio p/c is high, the growth rate low and r high. R tends to infinity when we face an open access situation and the rents are swept away (p-c=0).
3. Recalling that $0<\beta<1$, we see that as β approaches zero, the optimal stock is characterised by x*= K, the carrying capacity steady state. Clearly the anti whaling goal prevails. A very high value of tau as the same effect on x*. So τ can act as a counter balance to the bargaining power of whalers, in terms of optimality.
4. We rule out as unlikely the situation where tau and beta are both zero. The existence of non use value should be associated to some bargaining power.
5. When the weights are equal to 1/2, we face a maximisation of total present value. This is like a situation where a social optimise maximise a function as U(x, h) taking into account for non use values. Obviously the optimal stock depends on the relevant parameters but not on the bargaining powers.

We will see later how the actual size of β arises from the solution to the Nash co-operative game.

At this point we can introduce a new variable, representing the externality associated to harvesting itself. If not considering the non use value of the stock can result in a suboptimal provision of the stock itself, nonetheless we may face an externality even when the stock is optimised following the previous analysis, and some "optimal level of harvest" is carried out.

This is the "animal welfare" externality, that is the loss perceived simply when harvesting happens, more or less cruelty.

In order to take into account such a factor, we think it is useful to introduce a coefficient $\alpha h(t)$, where Alfa represents the loss suffered by anti whaling agents. In this case we introduce the factor as a cost to whalers, a cost that should be borne (like a tax on harvest) if we want to achieve an optimum stock/harvest steady state.

So we have $PV2 = \int U(x,h) = \int \lambda x - \alpha h$,

clearly if anti whaling should manage the resource, x=K and h=0 would be the optimal vector.

As this enters the model like a cost, we do not write down the new optimal equation for x* and the new fundamental equation. We stress that taking into account an externality associated to harvesting itself leads to an higher optimal stock than before, and a lower equilibrium harvest.

I mean that we face two externalities suffered by non whalers: the first is a stock externality and the second a pure animal welfare consideration related to harvesting itself.

This is clearly seen within the IWC debate over the last years: while some anti whaling agents are concerned with the stock value alone, other agents are concerned with the stock value and the harvesting level and cruelty. It is so worth considering the effects of those two externalities in a separate way.

As far as policy considerations are concerned, we see how the MRAP could justify a temporary ban on whaling (see above harvest (a)) if the stock is to be reoptimised because sub optimal. Then some harvest is possible in equilibrium if h>0 is optimal. It is interesting to note how the "rapidity" of transition is influenced by the growth rate of the species. The more is slow the more a ban should be carried out.

4.1.1 Pareto frontier and equilibrium

Now, by varying β between 0 and 1 and determining for any case the policy which maximises the weighted PV, we can draw the relevant Pareto frontier. Then we need a Theory of bargaining in order to solve for the resulting weights. By means of a Nash game we could find which weight is most likely to arise from bargaining.

We assume a strictly convex pareto frontier. Then the Nash bargaining solution arises from maximising $(\pi^*-\pi^0)(\theta^*-\theta^0)$,where starred payoffs are the solution payoffs, and the other ones the "threat payoffs". From that we find which weights are more likely to arise out of negotiations.

We can draw a figure (figure 2) mapping out the possible threats associated to the whale bargaining arena.

We can imagine two kind of reciprocal threats: whalers threat to resume whaling, inside or outside IWC, which causes a loss-of availability on the resource- to the opposite lobby. On the other hand whalers can be threatened by commercial threats by anti whaling countries (i.e. US).

In figure 2 the frontier represents the pareto set of efficient points. Assuming reciprocal threats to be in favour of anti whalers lobby, a dotted line has been drawn to show how commercial threats may be correlated to the intensity of whaling (the more they whale, the more the threat is high). So the dotted line is a vector of possible non co-operative conflict points $(\theta^0 - \pi^0)$. We note how, given the potential

commercial threats, a ban or a very limited harvest is inside the bargaining feasible set. A solution to the game as represented by the tangency 'a' in figure 2 is feasible, leading to a strong bias toward non whaling lobby preferences. This could mirror the past and current situation within IWC, characterised by a ratio $1-\beta/\beta$ equal to 0.85/0.15, following the ratio of whaling nations which is roughly 6-7/ 40.

(Figures 1, 2)

We argue the ban was enforced during the 80's given the powerful external economic trade sanctions the US threatened to adopt.[6] The exit of Iceland out of IWC and the Norwegian resumption of whaling maybe shows how agreements based on threats can lack of credibility and so stability in the long run. The political (see GATT consistency) credibility of threats has faded away over time, so that the conflict point may shift from a 'threat' one to a disagreement point (Binmore, 1991) associated to non credibility of anti whaling lobby threats. We then claim that the current solution associated to the Nash bargaining game (a) cannot be sustained in the long run. Whalers may have incentives to resume whaling either within or outside IWC. We represent it in figure 2 by the arrow which shifts the "threat vector" and so Nash solutions toward the whaling goal (tangency b). What we want to show is that a ban is, under current premises, an unstable solution to the bargaining game.

So the *credible* "threat" is the one against non whaling agents, the threat of pursuing whaling without co-operating to shared management. Given the strict trade off between goals, it means a movement along the Pareto set toward the maximisation of whalers goal occurs (bargaining power=1). It can be a realistic interpretation of the current situation, where the instability of the 1982 ban is leading year by year to a unilateral resumption of whaling and defections by exit (Iceland) or loopholes (Japan), decreasing anti whaler welfare.

Summing up so far, if threats had been credible and legally enforceable, a ban of whaling could have been sustained and within the frontier of feasible bargaining points, and it could have approached a possible Nash bargaining solution associated to a strong anti whalers bargaining power[7].

Having anti whalers no credible threats, a ban is not enforceable and not efficient being outside the potential bargaining Pareto set -. So the situation is not stable, because as time goes by the unstable equilibrium point could shift more an more to the left along the frontier, as whaling countries

resume whaling or leave IWC to set up their own organisation (as represented by the arrow). Then the Nash bargaining solution moves more and more toward the whaling lobby optimum (tangency at b).

We have intuitively shown that the current situation is not stable, being ex ante commitment on threats not credible. In order to ensure a self enforcing and committed agreement, new instruments are necessary.

4.1.2 Side payments

So far we have assumed payoffs were not transferable.

We now analyse the situation by introducing into the picture the possibility of transferring money (utility in some cases) between parties involved. Side payments enter agent's utility functions by a unitary marginal utility; when transfers are allowed, the relevant frontier becomes a straight 45^0 line. It is worth noting (Munro, 1979) that the objective is now total return maximisation (i.e. it means giving equal weights, so it is like $\beta=1/2$), then bargaining is confined to division of total value of the "fishery".

This means that by dealing with side payments we can move along a straight line: any point on the line can be achieved. The compelling fact is that by means of transfers maximisation of total benefit is feasible and any party may be better off in the end (satisfying Kaldor Hicks criteria[8]).

Parties are allowed to transfer money until reciprocal marginal benefits are equalised so that any welfare improvement is exploited.

This is intuitively shown in figure 3.

(Figure 3)

What we see is that by means of side payments whalers may be compensated by the opposite lobby and being so at least as well off. On the other hand pro whale conservation would be better off if they pay until marginal benefits from the resource are equalised at the optimum. This means that, if the initial situation was suboptimal (different marginal benefits), a net gain is possible by transfers.

What we have to carry on is the elicitation of willingness to pay associated to non use values, to capture it and to allow payments from agent 2 to agent 1. As WTP may be considered the (discounted)

value $\lambda x(t)$ associated to the stock, this is the maximum amount non whaling agents would pay in order to get a certain amount x(t) of the resource.

But this means that what we achieve by side payments is the enforcement of the case associated to equal weights. In fact the optimal stock x(t) in that case is the result of a maximisation taking into account of both values, so leading to an optimal solution. The higher non use values are, the higher WTP is, the higher the optimal steady state stock is as a result. What we need to define is the optimal transfer so that marginal benefits are equalised.

In figure 3 we see the case: the 45^0 lines starting from an hypothetical current situation represent side payments rationale. But is intuitive that a situation as the "current situation" zone (or a ban) is not enforceable as an efficient outcome, given the shape of the pareto frontier (depending on the relevant parameters). It means that WTP is not sufficiently high to assure that solution (at the margin) as an optimal equilibrium. Marginal benefits to whalers are higher than marginal WTP, so that transfers from whalers to non whalers may lead to pareto improvements for both. The reason why weights other than ½are not optimal is that we are not maximising total value and marginal- static and dynamic optimality is not reached.

In reality solutions with $\beta \neq 1/2$ are not enforceable (without threats) if we assume a first best bargaining leading to equalisation of values at the margin. As we will see later, this is not always a feasible approach. By auctioning the resource -to the highest bidder- second best outcomes are achieved, associated to unequal weights (i.e. β=0,1).

Looking back at figure 3, a non empty set of pareto dominating points appears if we consider lines 1 and 2. It can be seen graphically that points along the lines are not optimal. Optimality is instead defined by tangency between the side payment line 3 and the pareto frontier, that is the point at which total value (PV1+PV2) is maximised.

If under a Nash bargaining scheme we tried to maximise (PV1-C1)(PV2-C2) with respect to the pareto frontier (so searching for the tangency as a solution), under side payments we maximise PV1 + PV2 (45^0 line), with respect to the pareto frontier efficient payoffs. We search for the max total value given the pareto frontier we face, and the associated optimal transfer.

In other words, solutions associated to weights $\beta \neq 1/2$ are not enforceable because pareto dominated. When the optimal solution from max PV1 +PV2 is enforced by WTP elicitaton followed by transfers, whalers should have no incentive to cheat by harvesting more, because at the optimum marginal value of harvesting one more whale is equal to the marginal payment they receive.

So side payments allow maximisation of total value from the resource (max PV1 +PV2), leading to an *optimal and enforceable* bargaining solution. It is worth noting that points we could not achieve without allowing side payments are now within our range of feasible solutions. Without side payments sub optimal unstable equilibria are to be achieved.

Because side payments are based on WTP elicitation and capture, we have seen they lead to the solution maximising total value/total return. This means that even corner solutions (i.e. ban) or any other can be the solution of a side payment game, depending on the value of the parameters (relative/opposite values of the whale), that is on the shape of the pareto frontier.

For example, the more non consumptive values are high, the more the pareto frontier is skewed toward agent 2 PV. Figure 3 shows how even a ban can be (Kaldor Hicks) optimal and enforceable under side payments bargaining, given a very skewed pareto frontier.

In figure 4 it is shown what the optimal side payment should be.

(Figure 4)

4.1.3 Different discount rates

So far we have assumed one common discount rate for the 2 agents. Now we introduce two different discount rates[9]. In policy terms the situation is worth analysing because different policy prescription may arise.

Reformulating the problem in 4.1, the hamiltonian becomes:

$[e^{-r1t}\beta\ (p-c)h\ + e^{-r2t}\ (1-\beta)\tau x\ ] + \lambda(F(x) -h)$ (leaving out the 'harvest externality').

After some calculations and rearranging we get a new fundamental equation:

$r_1 = F'(x) + e^{t(r1\ -\ r2)}(1-\beta)\tau/\beta\ (p-c)$,

and an optimal steady state:

$x^*= k/2[\ 1+ e^{t(\ r1\ -\ r2)}\ (1-\beta)\tau\ /\ g\ \beta\ (p-c)\ -\ r_1\ /\ g]$,

noting that both are dependent on time. Note further that as t goes to infinity, the limit of the new fundamental rule is:

$r_1 = F'(x)$ if $r_2 > r_1$

$r_1 = F'(x) + \infty$ if $r_2 < r_1$

in case whalers have a lower rate, their goal prevails so that we face a golden rule as when $\beta=1$. When their rate is higher, even a very high r_1 is overwhelmed by anti whalers preferences, which should dominate more and more as we approach the medium and long term.

We can outlight the same point by analysing the equation defining x*, as t approaches infinity. Letting t go to infinity, we see that the limit of the compounded discount term depends on the relative value of r1 and r2. If r1 > r2 (as likely), the limit e^{-r2t}/ e^{-r1t} goes to infinity, leading x* toward the carrying capacity. If r2 > r1 the limit goes to zero even when tau is quantitevely relevant.

If we allow side payments and we consider the case with different discount rate, the optimal policy is for the low discount rate agent to buy out the other at the beginning of the program (defined period). This is so because any payment made at t>0 would have a smaller value for the high discount country.

Having described the rationale for setting side payments into the bargaining arena, it is worth noting some problematic points arising:

i) who has property rights on whales? That is, should we adopt a victim pay principle (VPP) or a polluter pay principle (PPP)?. Although economic efficiency is not affected by this, welfare distribution is. Have whalers rights to exploit the resource? Has the global community the rights to enjoy it?

   So should we elicit WTP (VPP) or WTA (PPP) from people, when we try to capture non consumptive values? This is clearly an open question. We argue that on policy ground the property rights should maybe be allowed to whaling agents, and a VPP chosen to enforce the bargain (Maler, 1995);

ii) from (i) we point out the problem of eliciting values for public global good, the well known free rider problem associated to public good revelation of preferences. This may lead to sub optimal side payments and so suboptimal provision of the whale stock as a public good;

iii) strategic behaviour by who receives compensation is to be studied. Whaling countries could exaggerate the level of whales caught off if they were free to maximise their goals. This would maybe raise WTP to avoid that harvest. The benchmark for whaling activities is to be defined carefully in order to reach optimality.

Non whalers could exaggerate their willingness to conserve and preserve whales (opposite to the free rider problem).

5. Conclusions

The essay tries to develop a new way of addressing the management of whales and marine mammals. Given the existence of non consumptive values, whales cannot be analysed neither by neo classical models used so far - because they do not include non harvesting values or stock values- nor the problem can be solved by the international institutions and by the related IEA as they are structured today. The literature- in some cases- as addressed and underlined the total economic value, the mixed good nature of the whale asset and the possible use of threats and side payments under IEA. What I have tried to stress is the necessity to bring together these issues in a common framework and the possibility of including it into the economic theory of bargaining.

The current IWC effort of enforcing a stable IEA has not been successful. Following some years of more or less stability after the ban, now the situation is one of polarisation and non compliance. Anti whaling countries -possessing a majority- continue to vote a total ban on whaling, while whaling countries have resumed small scale whaling and have threatened (starting to set up parallel convention like North Alliance) to leave IWC. A creation of a new IWC by whaling nations alone would not help the cause and would not solve the issue.

Agreement on what values IWC should manage and study has not been reached, so pro non consumptive countries have been using a 'whaling' framework (current IWC) to pursue their goals. The situation is clearly neither efficient in economic terms nor stable and self enforcing: a new institution is to be set up, from a "whaling" one to a "whale" one.

Analysing the issue by means of a game theoretical perspective and by looking at the international/institutional IEA scenario, I argue an *ex ante* agreement enforced by allowed side

payments (ex ante redistributions) is to be preferred to an ex-post sequential solution (and ex post redistributions) We can sum up the essay results by underlining that:

i) The introduction of side payments into the IEA game allows the achievement of a Pareto superior result, because it creates a "bargaining core" - by highlighting all values attached to whales. So the capture of WTP for whale conservation is necessary in order to lead to an efficient outcome.

   More important, WTP elicitation from non whaling agents gives a more realistic scenario than majority voting where every country has the same power (i.e. Japan vs St. Lucia). Quantitative powers are realistically assessed; we have seen how majority voting leads to efficient outcomes only by accident.

ii) We stress that most of the time a Kaldor Hicks approach is necessary, given no real Pareto exchange is likely. In this case a real Pareto improvement is necessary in order to ensure self enforcingness (so that compensation should be paid) ;

iii) The 2 agents model has shown how a ban could be optimal in a transition toward optimality. But optimality does not mean self enforcingness when we face heterogeneous parties. Moreover the transition to the equilibrium can be long for whale species, increasing the need to compensate losers.

iv) Side payments require the acceptance of a 'Victim pays principle' which is necessary, given the unilateral nature of the externality[10]. I argue that a victim pay principle is maybe preferred as far as stability of agreements are concerned. This for two reasons: first non consumptive values have to be captured and made visible to the international community, and a visible payment could better achieve the result. Secondly retaliatory power seems to be in favour of whaling countries.

   Monetary payments could be used both to compensate whalers and to fund research, conservation activities and monitoring. Monitoring is a crucial part of the ex ante approach to IEA (along with assesment of optimal total quota and individual share distribution).

v) Side payments facilitate self enforcingness, but "contracts" must be based on a short term basis and well specified. Long term deals cannot take into account changing factors (new information on stock level, new data on whale values, etc.) and are less easily enforceable. We claim that 5-10 years could be a good focal point to define a contract period.

vi) Bargaining should be as "decentralised" as possible, that is based on different species status and even different unit stocks within each species. An overall bargaining process on whales is inefficient given the differences between species and stocks. We face differences in population, growth, migration patterns, meat value, intelligence; so this is reflected in differences as far as total value and the composition of TV are concerned. For instance, some stocks can have lower existence values, other cannot be observed so they do not have direct non consumptive values, and so on. A careful analysis should specifically be carried out to evaluate the optimal level of stock and harvest.

At the moment the issue is covered by a cloud of uncertainty: consumptive values (due to the ban) are difficult to estimate, non consumptive values database are in their infancy. Further research is then strictly necessary;

vii) The drawbacks of an ex ante approach should not be underestimated. Reaching an agreement may be very costly, given the necessity to define an optimal aggregate and individual level, optimal side payments, monitoring the deal. If bargaining is too costly (significant bargaining and enforcement costs may lead to inapplicability of the deal) , we may opt for a second best solution represented by a sort of an *auction.* A solution less costly than bargaining on total value may be obtained by auctioning, so giving the right to the agent valuing the resource the most of managing it for a determined period of time. Marginal benefit equalisation is substituted by a corner solution, but some kind of economic (not only biological and/or political) approach would be introduced. As seen above, an auction could be the policy solution arising from the model (section 4.1.1) whenever the agents have different discount rates, so that who value the most the resource should manage it (obviously being the higher bidder). In other cases it should be viewed as a second best solution.

Two policy indications could be suggested. The first indicates that WTP for whale conservation is necessarily to be elicited (capture of value) in order to *define* an optimal solution. Moreover capture should be followed by payments in order to *enforce* the optimal solution.

Secondly, a "tax" on harvest could be suggested in order to take into account the externality suffered by who is concerned with whale welfare and cruel killing. A tax is proper because the external effect is related to the control variable harvest.

The two policies can be politically more acceptable because they together represent both *polluter pays principle and victim pays principle* applications.

We conclude by affirming that an institution (IEA) structured on the above considerations is what we argue is necessary. But a formal revision of the convention-by unanimity- is needed in order to reformulate IWC objectives and research fields.

In the past non decentralised approaches were used- the blue whale unit, the ban itself; now a decentralised approach is to be carried out- the Revised Management Procedure of IWC. But even the RMP does not take into account non consumptive values, so an inefficient result will be achieved in any case (even if it explicitly takes into account a precautionary approach given the high uncertainty related to stock size (IWC, 1996 p.54).

In such a situation any bargain outcome is the result of a balance of threats and majority voting, so it is economically efficient only by accident. We need IEA characterised by policies aimed at achieving social / economic efficiency.

Notes

[1] Which in reality is not a ban but an indefinite zero allocation of individual shares, given that IWC has not the power to vote on a ban.

[2]The Bonn convention on migratory species further stresses that whales are not to be considered as a fish. Cetaceans are an exception so all countries concerned (not only range states) should participate to agreements.

Nevertheless the issue is unsettles as coastal sates argue, in contrast with article 63-65, that they have the superior right and interest in managing shared resources within EEZ. They claim application of the consistency principle, that is that the management of shared resource should be consistent with the one chosen by the coastal state.

[3] One point is worth stressing at this stage. When goals are represented by PV maximisation, a clear trade off exists: the more PV1 is high, the lower PV2 is when we maximise.

It may be the case that whalers are not maximising PV but other goal, like employment (number of vessels). If it is true, whalers may be better off even if PV2 increases, provided we are operating on the side of growth function where $x < k/2$ (the higher the stock, the higher the harvest in equilibrium when $F'(x) > 0$).

This possibility is not included in our model, dealing only with PV maximisation.

[4] The fundamental equation, assuming c(x), is $F'(x) - c'(x)\, h(t)/ p-c(x) = r$

[5] The other approach is an asymptotic one, where $x \Rightarrow x^*$ as $x \Rightarrow \infty$.

[6] Under the Pelly amendment, US can totally restrict fish imports. In the case of Norway this amounts in 1997 to a value of 900 million NOK, 4% of total Norwegian exports, while Australia and New Zealand, the other two countries with Marine mammals act, would add nothing in case of ban. Remind that Norwegian whaling business was about 1 mil NOK over the period 1993-96. Instead a

restriction of Japanese fishing within US EEZ amounted to ten times Japanese whaling business. It is clear that even if whaling could be increased, the relative importance is meaningless. Boycott is another way of menacing. Conrad and Bjorndal (1993) estimates at about 10 Million NOK the per year economic damage. Even this threat fades away over time anyway.

[7] This may even be a corner Nash bargaining solution.

[8] Whenever we are on a situation where losses and gains are unavoidably related to each other, so that a strict Pareto improvement is not possible, we must use a Kaldor Hicks definition of pareto improvement (Pearce, 1983). By using a Kaldor Hicks approach we can see whether or not a given equilibrium is Kaldor Hicks optimal or not, that is if someone can compensate a loser and being better off. As we saw in a previous section (whale as a mixed good), the optimal point is where the marginal benefit of whalers equals the marginal benefit of anti whalers, determining a situation with an optimal level of externality.

[9] It is likely that whaling agents and non whaling possess different perception of time preferences. As far as whaling is concerned we can assume rates ranging from the private market interest rate to infinity (open access); anti whaling agents are likely to be associated to lower rates (Kuronuma and Tisdell, 1994), ranging from 1% to 2,5%, the latter found by analysing scientific precautionary IWC advises.

[10] We see that the acceptance of a VPP is far from being achieved. Anti whaling countries have been refusing to pay for monitoring and other activities, claiming whalers should pay.

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Figure 1. Nash bargaining solution

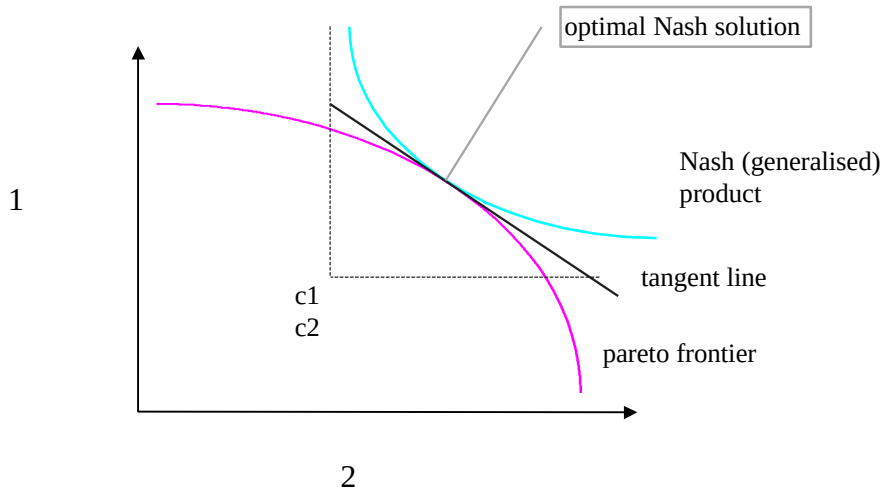

Figure 2. Nash bargaining solutions on whales

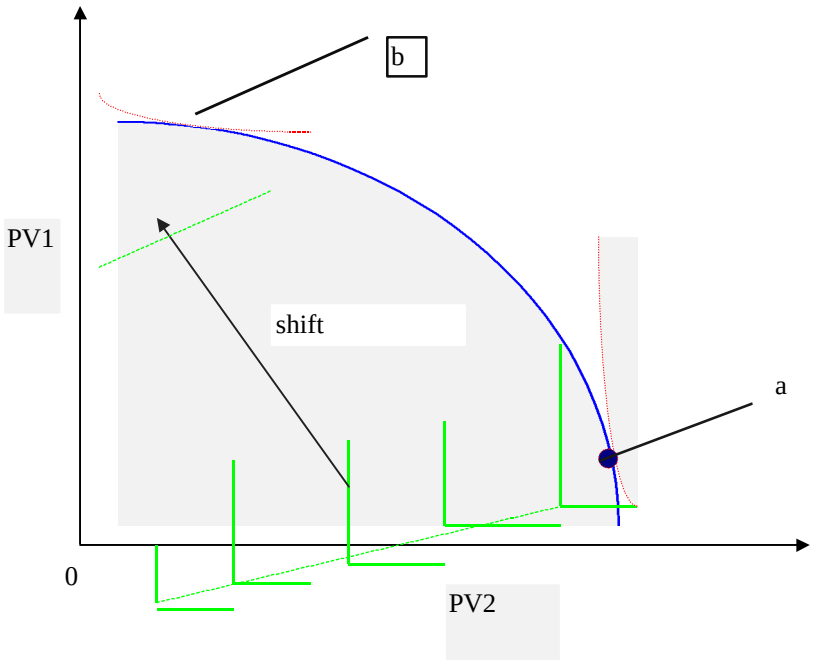

Figure 3. Two agents bargaining Pareto frontier and side payments

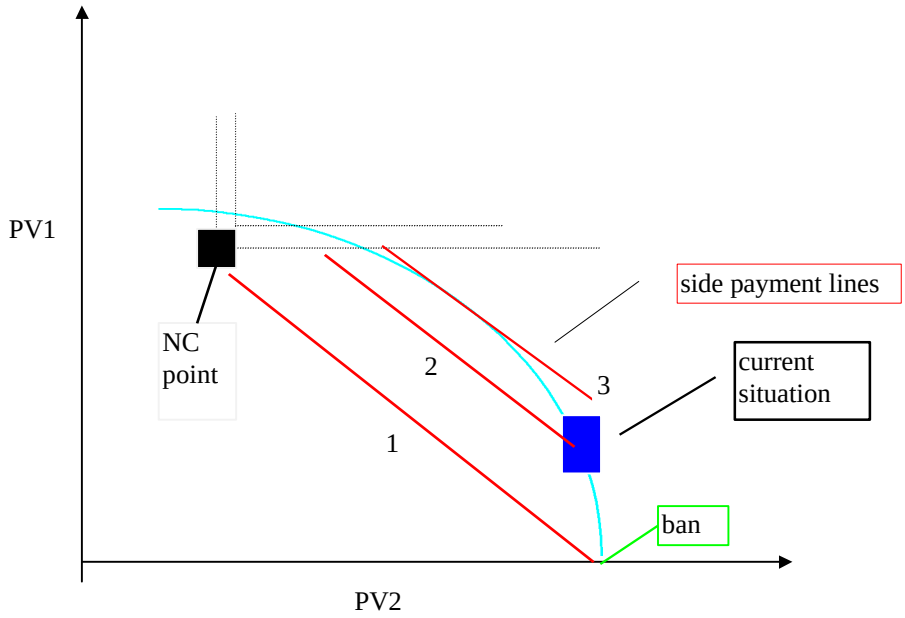

Figure 4. Different side payments solutions with different pareto frontiers

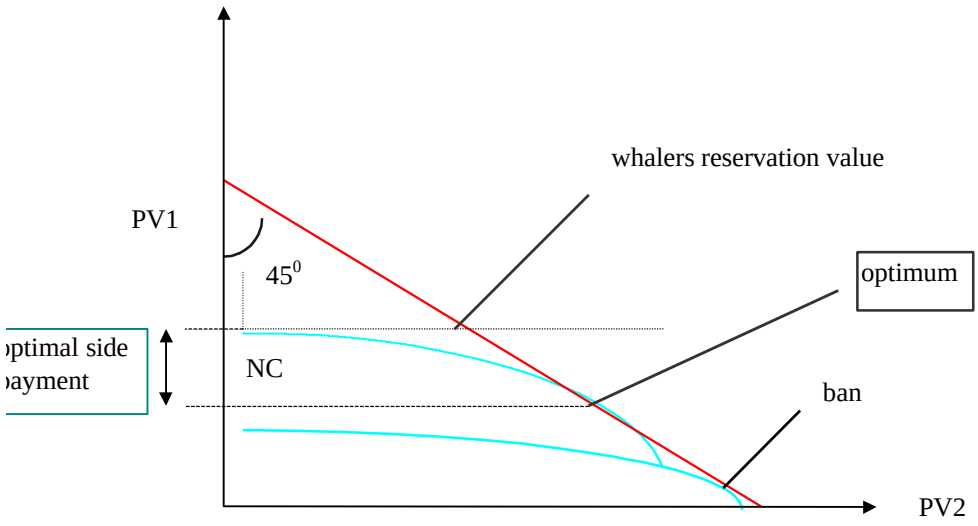

Table 1. Total Economic Value

Total Economic Value				
Use Value			Non Use Value	
Consumptive use	non consumptive use	Indirect use values	Option and quasi option value	Existence value
harvesting	whale watching ; research	ecological functions	future uses; new information on values	Symbolic value; animal welfare;