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THE IMPORTANCE OF ECONOMIC INCENTIVES IN FISHERIES MANAGEMENT

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1. Introduction

The aim of this study is to give an overview of the significance of economic incentives in fishery management under the *theory of agency*.

Fisheries management is primarily associated with monitoring, enforcement and control measures.The reason is that objective of society and fishermen do not converge and management authorithies react by introducing stricter and costlier control measures. This has raised, in the literature and in the fishery economic research, the need for a deeper knowledge of the rationale inducing fishermen to comply.In other words, the questions to be anwered concern what kind of incentives could be set in order to make fishermen to modify their behaviour meeting the management and society's objective. In the economic literature problems like that are often addressed in the theory of information economics and principal-agent methods.

The economic theory of *agency* characterises the contractual relationships between individuals in the economy in terms of a *principal* and one or more *agents*. The principal (in this case the fishery management authority) seeks to ensure that the aggregate of the choices of all the individual decision-making agents (fishing firms) is in the interest of the society. However, the (private) interests of the individual agents may not be the same as of the (public) interest of the principal. If perfect enforcement of desired behaviour on the part of all agents is not feasible, the principal must try to establish an *incentive scheme* that will align the interests of the agents with those of the principal.

Economic incentives can be used by the managing authority (*the principal*) to induce particular responses or behaviours from investors or actors (*the agents*) in the fishing industry, either by reducing profits (in the case of negative incentives) or by increasing profits (in the case of positive incentives). The determination of the correct value of the incentive which lets the principal (managers) to induce the agent (fisherman) to comply with the rules (e.g. fishing one target species rather than an other) requires managers to solve an optimisation problem with a number of economic constraints.

Only few analyses applying the principal-agent approach to economic incentives in fisheries management exist and among those are non-point pollution problems, of Segerson ([6] 1988) that have some resemblance to the infliction of fishing mortality to the fish stock from unknown

fishermen. The modelling of international fisheries relations (Clarke and Munro [1] 1987) should also be mentioned here.

Frost *et al.* ([2] 2001) has gone further on this subject by analysing the role and the meaning of different types of positive and negative incentives under various fishery management options (quota management, effort reduction and EU-decommissioning scheme).

2. Information assumptions

The solution to the economic incentive problem is very sensitive to the information assumptions. The economic theory make distinction among the cases of a) full information, b) asymmetric information and c) lack of information.

Economic analyses are often based on assumptions of perfect or full information on the market and models do not present any problem. In this case the principal always knows what is the real type of agent he has to relate to and what he is doing; therefore he is able to react precisely on that information and to define precisely the economic incentive in order to induce the agent to behave as he wishes.

In the case of the fishery the assumption of full information is clearly not relevant because the managers often lack information about fishermen's catches, fishermen's cost functions, fishermen's effort and of use of capacity after decommissioning or laying-up premiums.

The literature distinguishes between two types of information problems that are associated with the actions of the agents and with the identification of "true" types, viewed from the principal's perspective: the case of moral hazard and of adverse selection.

A mathematical description of moral hazard is to be found in Laffont and Tirole ([4] 1993) who characterise moral hazard as a situation where the endogenous variable is unobservable. Hanley *et al.* ([3] 1997) stated that *"moral hazard arises when the actions of one person are unobservable to a second person"*. For this reason Varian ([7] 1992, [8] 1996) defines moral hazard models those models with hidden actions.

Adverse selection as described also by Laffont and Tirole ([4] 1993) is a situation where exists asymmetric information about exogenous variables. while Hanley *et al* ([3] 1997) writes that *"adverse selection exists when one person cannot identify the type or character of the*

second person". For this reason Varian ([7] 1992, [8] 1996) calls adverse selection models as models with hidden information.

2.1 Moral Hazard models (hidden actions)

If the principal does not know what the agent will do after the contract (the incentive) has been signed, a moral hazard problem could arises. In such cases it is important to know how the risk-bearing scheme is designed. A classical example for a moral hazard situation is that of the land's owner and the tenant. The problem with a fixed salary to the tenant is that the tenant does not have an incentive to maximise the value of the crop in the interest of the owner. The tenant may have other interests, which imply that the action of the tenant is associated with some uncertainty. He can choose between different options associated with different types of risk. He could be risk adverse and value the risky alternatives (i.e. securing the harvest in bad weather, or selling part of it on the black market) lower than the possible wages he will get from that alternative. In such a case the agent will not bear any risk and choose the safer alternative. The principal has to bear the risk. An incentive scheme with risk sharing could solve the problem.

The case seems relevant in fisheries. A moral hazard behaviour can occur because after the fishermen have been allocated access (rights) to the fish resources, either in terms of catches or fishing days and/or a contract to withdraw has been agreed, there can be an incentive for the fishermen to change behaviour. The success of management is very dependent on the possibility to observe the action of the fishermen. It is therefore important to characterise the chosen management option (e.g. quota, effort management, fleet capacity adjustment) from the perspective of moral hazard, and in particular to what degree moral hazard applies to each case. As an example, in quota management option the landings can normally be observed while it is the catches that matter with respect to changes in the fish stock size. On the other hand, in effort management option, moral hazard takes place if the fisherman fish more days than allocated to him or fish at other fishing grounds than permitted. Moral hazard is not viewed as important in effort regulation as in quota regulation. In case a fisherman does not withdraw from fishing after a decommissioning or laying-up grant has been accepted, a moral hazard problem arises. However, it is often easier to observe whether or not a

vessel is used, and moral hazard is not viewed as being relevant in this case.

2.2 Adverse Selection models (hidden information)

In such cases the principal does not know much about e.g. the revenue (utility) or the cost functions of the agents, or the production technology (production function) he uses. All that is known is that the functions differ between agents and that the agent knows his own functions. It is further assumed that the agent wants to maximise his own profit or alternative objective function. In such cases it is important for the principal to find out what type the agent really is. These cases are defined as adverse selection cases, since the problem here is that the agent tend to hide information. This issue seems particularly relevant when capacity adjustment measures (decommissioning and laying-up) and effort regulations are introduced by the authority and the aim is to efficiently distribute capacity reduction or effort.

For example, the adverse selection problem occurs in all cases associated with the principal's aim to allocate the fishing rights to the fishermen in a way that secures economic efficiency. If individual quotas or fishing days or decommissioning grants are allocated, the fisherman may benefit from not revealing his true type to the principal. The fisherman does not necessarily change behaviour after he has been allocated his fishing right, but he could still be in a better position in terms of profit making by announcing a wrong type to the principal. The adverse selection problem addresses how the principal can make the fisherman to reveal his true type. The two cases analysed refer to this specific aspect of the P-A- theory.

Finally, a few words about the case of *lack of information* must be said. This case refers to the situation where both the principal and the agent lack information about relevant parameters. Anyway, in developed fisheries, it is hard to imagine that neither the fisherman (agent) nor the society (principal) have no information at all about catches, costs or effort. Therefore, *lack of information* is not herein taken into consideration.

3. *An application of the principal-agent approach to the effort reduction measure applied to the Thyrrenian and Jonian trawler fleet*

The aim of this case study is to analyse the Italian system of economic incentives, related to the reduction or control of fishing effort (in terms of fishing days), in the framework of the microeconomic model of the *Principal and the Agent,* and therefore validate or not the theoretical information problem.

For a theoretical analysis of the premium scheme within the P-A model, the definition of the subjects involved and of their targets is crucial. The *Principal* is the subject which, in order to achieve its objective, has to induce another subject to adopt a given behaviour, while the *Agent* is the subject which – based upon the contract proposed by the principal – is intended to adopt a given behaviour.

Reduction in fishing effort (meant as capacity, in terms of registered tonnage and engine power multiplied by fishing days) can be achieved either through a final or a temporary withdrawal of the fishing activity. In this paper the effectiveness of the temporary withdrawal and the rationale underlying the acceptance of the "contract" by fishermen will be analysed.

3.1. Choice of the case study

In Italy, the reduction of the fishing effort is implemented also through temporary withdrawal according to vessel gears and fishing areas. With respect to bottom trawlers and mid-water pair trawlers, annuals national regulation provides for a standard 45 days suspension of the fishing activity.[1]

[1] The regulation on temporary withdrawal or has been substantially changed over the years both with respect to the applying periods and their nature (compulsory or facultative).

This regulation is differently enforced in the Adriatic and Tyrrhenian coasts. The main difference relates to the nature of the suspension which is *compulsory* for vessels operating along the Adriatic Sea coasts and *facultative* for vessels operating along the Tyrrhenian Sea coasts. The reference period varies as well. Usually temporary withdrawal covers the months of July-August in the Adriatic area and September–October in the Tyrrhenian and Ionic area. Fishing withdrawal periods are based upon stocks reproduction periods that are very large and diversified.

The application of the P–A model is limited as to the gear used by vessel owners. The causes could be briefly suggested, namely: (a) the only temporary withdrawal measure is the one associated to bottom trawlers, mid-water pair trawlers and dredges; (b) the latter two fishing gears are mainly performed in the Adriatic sea; and, finally, (c) it is meaningless to include into the P–A model a compulsory withdrawal, as applied for the Adriatic sea). Then, the selected Italian case study is the case of the vessels holding bottom trawler licences only and operating in the Tyrrhenian Sea.

3.2. Methodological approach

The methodological approach used in this case-study can be briefly summarised and the following definitions will be used::

Principal: Ministry for Agriculture and Forestry Policy, as the national fishing Authority.

Agents: vessels holding bottom trawler licenses, as operators accepting or not the contract (the premium).

Aim of the principal: reducing fishing effort on demersal stock resources.

Economic incentive signal sent by the Principal: premium.

The (optional) temporary withdrawal is not part of a command and control-based policy (such as TAC, compulsory , and minimum mesh and/or fish size). It is instead a management measure as part of the fishing policy where the degree of “co-operation” of fishermen plays a

crucial role. In order to achieve its target, the principal could send a signal (*premium or allowance*) whose aim is to induce the agent to adopt behaviour consistent with the achievement of the Principal pre-set targets. The agent will then evaluate whether to accept or not this signal. The target will be achieved if the Principal has defined the signal properly, and a proper signal is the signal which, meeting the agent's expectations, will induce him to accept the proposed contract. The contract is the option to accept or not the premium or allowance to temporarily withdraw from the fishing activity.

The analysis of the case study starts by setting the principal's target function – the fishing effort reduction to minimise catches - relating to each single agent. This target is pursued, by hypothesis, by the principal by granting a premium to the agents accepting the contract.

In order to have homogeneous quantities in the target function, the target can be denoted in terms of minimisation of the income resulting from the catch of demersal species [2], hereinafter referred to as *Fog* (acronyms denoting species belonging to the headings "other fishes" which demersal species belong).

The target function of the principal will then be:

$$Min : Y(Fog) \qquad (1)$$

with the constraint

$$P > Y(Fog) \qquad (2)$$

where:

Y(Fog) = income derived from catch of demersal species;

[2] The function can be expressed in terms of returns and not in terms of catches. Supply is highly fragmented and then the single agent cannot affect pricing; consequently to them it will not make any difference making evaluations in terms of minimisation of income or catches.

P= premium or allowance granted to the vessel (agent) accepting the contract, that is the temporary withdrawal of the fishing activity.

The constraint is included in the principal's target function allowing for a rational process; i.e. the agent could not accept the contract if the premium will not be at least equal to the potential income that it could gain during the suspension period.

The identification of the value of *P*, will be the result of the minimisation of (2).

Let's calculate, for (2), the prime derivative of *Y* and *P* against *D* (fishing days) and let's assume it is equal to zero[3]:

$$\left(\frac{\Delta Y}{\Delta D}\right) dY - \left(\frac{\Delta P}{\Delta D}\right) dP = 0 \qquad (3)$$

therefore

$$\left(\frac{\Delta Y}{\Delta D}\right) dY = \left(\frac{\Delta P}{\Delta D}\right) dP \qquad (4)\,.$$

This means that the minimum point of the target function, against *D*, will correspond to the level of *D* (fishing days) where the premium and income variations are equal. Theoretically, in order to calculate the premium the *principal* should allow for premium-income elasticity.

If we impose a linear relationship between income and fishing days, the income average variation will be equivalent to their marginal variation. The analysis will then be based upon the average income per unit of working days on board (fishing days). For the agent to be induced to accept the contract it is necessary to give him an allowance balancing the withdrawal revenues losses; i.e., the loss of income corresponding to 45 fishing work days and the loss of interests accruing as result of any delays in granting the premium.

[3]Also the premium P, being related to income, will be a function of *D*.

Income loss will be equal to

$$C = \sum_{i=1}^{n} Y_i (1+s)^{-(i-1)} \qquad (5)$$

i.e. the agent's opportunity cost,
where:
n = days of suspension of the fishing activity;
Y_i = potential income of the i-th day;
s = discount rate calculated on a daily basis.

To considers the loss of interests a capitalisation operation on *C* for the period *(n-1)+t* has to be made:

$$C_p = C(1+r)^{(n-1)+t_p} \qquad (6)$$

where:

C= current value of the income flows for the withdrawal period as calculated in (5);
r = interest rate on public investments (return on treasury bonds), calculated on a daily basis;
(n-1)+ t_p = capitalisation period given by the sum of the time elapsing from the beginning of the withdrawal period (n-1) and t_p , the "delay" - vis-à-vis the conclusion of the withdrawal period – in granting bonuses (a delay taken into account by the principal).
The *agent* will accept the contract only if the premium granted by the principal will balance the income losses resulting from its temporary withdrawal from the activity, also allowing for the delay factor. The premium – the economic incentive market signal - expected by the agent will be the result of a logical process similar to the one made by the principal. However, while the principal calculates the premium based upon elasticity average values, the agent will calculate it based upon its own elasticity.

The agent will expect a premium equal to:

$$C_a = C(1+r)^{(n-1)+t_a} \qquad (7)$$

where the difference, compared to (6), lies in the elasticity value of each single agent and in the different value of the delay factor. In fact, while t_p denotes the delay expected by the principal (and allowed for in its pay-off planning and of the structure of the suggested bonus grant systems), t_a denotes the previous delay experienced by the agent.

If the agent's evaluations are based on economic factors, the condition of acceptance of the contract will be:

$$C_a \leq C_p \qquad (8)$$

In the case study C_p will be considered equal to the bonus hypothetically established every year by ministerial decree (the proposed regulation) and granted to the units accepting the temporary withdrawal. This decree will also provide for the application period of the measure hereinabove.

The acceptance condition in (8) will then become:

$$C_a \leq P \qquad (9)$$

where:

P = bonus calculated when complying ance with the hypothetical regulation in force on temporary withdrawal from the fishing activity.

The assumptions underlying this methodology of analysis are:
1. the agent perfectly knows the value of its opportunity cost C;
2. the acceptance condition is based on *economic evaluations only*;
3. information on elasticity and then on opportunity cost may not be properly transferred to the principal, facing hidden information; this might be due to a voluntary behaviour of the agent or to faults in the information transfer channels. In case of not observed data the error may also be due to the estimation method used, facing adverse selection.

Once the values of C_a and P have been calculated with respect to each single agent, in relation to these two elements, four situations can be outlined which will hold true provided that the assumptions listed hereinafter are correct:

1. if $C_a \leq P$ and the agent accepts, rational behaviour from the economic standpoint;
2. if $C_a \leq P$ and the agent does not accept, there is a non economic rationale;
3. if $C_a > P$ the agent accepts, as 2.
4. If $C_a > P$ and the agent does not accept, as 1.

3.3. Application of the model to the case study

The study case started by defining the reference year. As the theoretical model of the P-A is consistent only with an optional management measure, the analysis was focused on a sample of vessels holding bottom trawler license only and carrying out their activity in the Tyrrhenian and Jonic waters in the year 1998.[4]

After defining the case study, the model was applied as follows:

1. identification of the vessels included in the sample (see Annex IB, table I.1) and participating in the temporary withdrawal in 1998;
2. identification of the reference year for the calculation of the agents' opportunity cost;
3. with respect to the year in point 2 above, identification of a sample of vessels with technical characteristics similar to those of the vessels included in the sample referring to the year 1998[5];
4. calculation of the opportunity cost of each of above agents;
5. calculation of the hypothetical bonuses to be granted to the vessels which accepted the temporary withdrawal of the activity;

[4] This sample is a sub-group of a wider statistical sample used by IREPA to monitor the production structures of fishing vessels in Italy.
[5] Data collection on returns and costs for both the years 1998 and 1995 covered some sample's units only.

6. with respect to each single agent, comparison between the opportunity cost and the bonus calculations as in point 4.

3.4. Identification of vessels and steps of the analysis

1. To identify vessels which hypothetically accepted the "agent's contract" 1998, reference was made to the vessel formularies transmitted by each single vessel during the withdrawal period, i.e. from 14 September to 28 October 1998.

2. To identify the reference year it was necessary to select the ones where the temporary withdrawal was facultative in the past experience. In fact it should be reminded that, in the past years, temporary withdrawals in the Tyrrhenian and Ionic coasts were sometimes compulsory or facultative. The more recent year until 1998 , when fishermen were free to decide whether to participate or not in the temporary withdrawal was 1995.

3. To identify vessels with tonnage (Grt), overall length (OL-meters) and engine power (kW) which were similar compared to those of 1998 considered, priority was given to select similar size in terms of gross registered tonnage; in second order, the overall length and engine power[6] was considered.

4. Stage three enables calculation of the 1995 daily value added for each vessel under consideration between September - October, which usually are the months covered by the temporary withdrawal in the Tyrrhenian and Ionic Sea. Based upon the above average value, the opportunity cost of each single agent (vessel) was calculated in relation to days vessels were in port for the biological rest as for the decree of 1998. The opportunity cost, as expressed by (5) and (7), is considered equal to the present value of the income flow, which can be obtained by each unit during the withdrawal period. The 1995

[6]While in terms of tons and length the difference between the 1998 and 1995 units ranges between –14% and +4%, in terms of engine power the difference is wider, ranging between – 46% a + 19%.

daily value added was adjusted to consider the increase in the cost of life, allowing for an increase of 6,77%[7], from September 1995 to September 1998. The reference time-discounted rate is the official discount rate in force from April to October 1998[8], calculated on a daily basis. The resulting capitalisation, as expressed in (7) based upon the return of treasury bonds in force as of 31.12.1998[9], was calculated on a daily basis as well in Annex IB, table I.2.

5. The temporary withdrawal on 1998 was regulated by ministerial Decree of 16.06.98 providing for "the modes of implementation of the technical withdrawal of the fishing activities involving bottom trawlers and/or mid-water pair trawlers"; and by the Decree of 09.07.98, providing for the associated social measures, to be addressed to the units which accepted the temporary withdrawal during the biological rest. This latter Decree provides for three different types of allowances:

(a) for the crew: minimum pay for each member of the crew, to partially compensate loss in wages or revenues;
(b) for the ship-owner: social security contributions for the members of the crew;
(c) capacity adjustment in compliance with the regulation in force on labour safety, equal to: 3 millions ITL, up to 10 GRT; 6 millions ITL, from 10,1 to 50 GRT; 11 millions ITL, over 50 GRT.

Based upon the information on the average number of the crew members, the allowance (premium) was calculated as allowing for the composition of the crew; only one unit is considered to be the skipper (see Annex 1A, table I.3).

6. In case of acceptance of the proposed "contract", the parameters and amounts of the associated social measures by the national regulation

[7] Monthly index numbers of consumer prices for household of blue collars and white collars from *Fiscal guide*, Frizzera, B. (1999) based on *Italian Statistical Yearbook 1999*, ISTAT.
[8] Official discount rate from *Fiscal guide*, Frizzera, B. (1999) based on *Italian Statistical Yearbook 1999*, Istat.
[9] Average percentage returns of the monetary market, *Italian Statistical Yearbook 1998*, Istat.

was considered hereinafter coincident with the premium granted to fishermen. The comparison between the agent's opportunity cost and the premium enables the evaluation of what might happen should the agent's decision-making process be based on merely economic evaluations. According to the model, the contract will be accepted by the agent which will be granted a premium higher or equal to its opportunity cost. It was then possible to check whether the real answer given by the sample vessels to the market signal sent by the principal (acceptance or rejection of the contract) corresponds to the situation which would occur in presence of the rational process assumed.

3.5. Model results

The analysis of the correspondence between the real situation and the situation assumed by the model led to the following conclusions:

1. Real situation and economic rational answer are coincident and theoretically correct in 11 of the 22 cases under consideration; i.e., 50% of the cases. This means that the model of analysis can explain half of the cases. 3 of them reproduce situation no. 1 *($C_a \leq P$ and the agent accepts)* [10] and 7 cases reproduce situation no. 4 ($C_a > P$ *and the agent does not accept).* This means that agents have a economic rational behaviour only in 50% of the cases (see Annex 1A, table I4);

2. Out of the five regions investigated, only in Tuscany the model holds true in 100% of the cases. The degree of correspondence between real and economic rational answer in the Lygurian region is equal to 67%, followed by Lazio (44%) and Calabria (33%) regions. In the Campania Region, the answers given by the agents were just the opposite compared to the expected ones resulting from the application of the model.

[10] It was assumed that, in case of a premium slightly lower than the income that might be generated by the fishing activity – the incomes net flow, the agent decides temporally withdraw from the activity, thus preferring a certain income (although slightly lower)- rather than an uncertain income.

3. In the model exercise, 50% of the cases investigated reproduce situation no. 3; i.e. the agent accepts the contract despite its opportunity cost that, in some cases, is much higher than the allowance granted by the principal. Such behaviour suggests that the agent's decision are not based upon economic evaluations only.

3.6. Improving results and conclusions: complementary desk-case study and questionnaires

In addition to the variables taken into account, it is then necessary to identify which are the other variables that generate a different behaviour compared to the one outlined in the model. To this purpose a questionnaire was filled by the previous units under investigation (see Annex 1B). Questionnaires contains questions aimed to investigate about the adhesion or not to the "contract" offered by the Principal on 1998 and also to investigate the rationale either economic or not, that influenced each agent to accept or not the contract. Results are hereinafter reported:

- Among cases of acceptance of the "contract" - 14 on 22, the relevant motivation is the possibility to enjoy a rest from fishing activity; even when real answer and economic rational correspond to premium higher than opportunity costs (3 cases);

- Among cases of no acceptance of "contract" - 8 on 22, merely economic rationales prevail, that are: (a) immediacy and continuity of income flow deriving from fishing activity; (b) in case of adhesion, a fall down of fish prices at the restarting of fishing activity[11]. Furthermore it has to be considered the disagreement of most Tuscany and Ligurian fishermen with the biological rest measure.

[11] It has been noted that, if most of the agents adhere to the temporary withdrawal of fishing activity, commercial activities (e.g. restaurants, wholesaling, retailing, catering) supply themselves with fish products by not local suppliers, in particular by Adriatic ones, where biological rest takes place in a different period. The price of Adriatic fish products is generally lower than the Tyrrhenian ones. Than, after the temporary withdrawal, an adjustment of Tyrrhenian fishing prices to the Adriatic ones may happen, e.g., a fall down.

Answers from questionnaires enabled to add another variable, resulting from this difference:

$$C_a - P = U$$

U represents the utility perceived by fishermen from an economic good, either monetary or not, that will assume different features for each single agent. In fact, in the cases of acceptance of the contract, the positive value of U [12] represents utility of the rest from fishing activity, that is the value that the agent attributes to the possibility to withdraw from fishing for a period of time equal to the biological rest; for this he receives an allowance equal to the premium. This implies that even if the value of C_a is major than the value of P, the agent accepts because this difference represents for him the value of having a period of rest.

In spite, in the cases of no acceptance the positive value of U represents the utility of the income, that is the value that the agent attributes to an income flow characterised by continuity and immediacy.[13] These are the cases for which the methodology is verified (see Annex IB, table I.4).

It's straightforward to assert that the rationale of both *Principal* and *Agent* performs an information problem. It seems also that the nature of the asymmetric information problem depends on the nature or genesis of the analysis. The microeconomic approach of the *Principal –agent* theory cannot allow for good results for a macro context. In fact, in the determination process of the premium, the manager (principal) takes into account medium values of the variables that influence the agent's decision, that is the representative agent.

The result of this process shows that the setting of a premium, as a market signal according to medium values, will not be able to satisfy expectations for all the agents. Every single agent has, in fact, his own utility level related to the goods that make up his own consumption

[12]For data analysis,see Annex IA, table 1.4.

[13]In fact it has to be outlined that it needs not less than 60 days to cash the allowance for the adhesion to the temporary withdrawal period. It's clear that this delay influences the agent's behaviour.

basket or welfare. [14] In the case study, rest and income from fishing activity have different values for different geographical areas and for different agents.

It can be concluded that there is not a single level of the premium, determined by the manager at national level that can reach the result of a general adhesion to the "contract" – the temporary withdrawal for biological rest. Only if the determination process of the premium is supplemented with investigations about each single agent's utility and his view and reaction to the current effort regulation, a good base is formed for the setting of an effective system of economic incentives based on market signals.

[14]It has to be outlined that both utility of rest and income have different values for single productive unit and for single member of the crew. See Annex IA, table 1.

Annex IA: ***Sampling and data analysis***

Table I.1 – Sample vessels under analysis - Tyrrhenian bottom trawlers, 1998.

registration number	region	administrative district	grt	length	kW	average number of crew members'
07CR00080	CALABRIA	Crotone	29,9	18,20	220	3
05CR00494	CALABRIA	Crotone	14,1	16,67	161	3
06CR00250	CALABRIA	Crotone	29,5	18,55	165	3
07SA00750	CAMPANIA	Salerno	45,1	20,67	294	3
12SA00236	CAMPANIA	Salerno	10,0	13,00	162	2
00SA02460	CAMPANIA	Salerno	51,8	22,60	283	4
00CV02113	LAZIO	Civitavecchia	46,8	22,00	411	3
00CV01997	LAZIO	Civitavecchia	57,2	23,45	139	3
00CV02148	LAZIO	Civitavecchia	39,5	18,70	205	3
04GA00955	LAZIO	Gaeta	42,4	22,70	316	3
04GA01116	LAZIO	Gaeta	46,7	19,87	283	3
04GA01016	LAZIO	Gaeta	44,6	20,60	216	3
00GA01238	LAZIO	Gaeta	47,0	23,38	330	2
01GA01325	LAZIO	Gaeta	24,6	17,50	183	3
04GA00562	LAZIO	Gaeta	46,7	16,10	198	3
05GE00085	LIGURIA	Genova	23,9	15,00	158	2
02GE03307	LIGURIA	Genova	17,4	16,50	176	2
00SP04301	LIGURIA	La Spezia	16,3	12,70	161	2
02LI02668	TOSCANA	Livorno	39,5	19,00	294	3
02LI02748	TOSCANA	Livorno	28,0	16,35	272	3
08LI00074	TOSCANA	Livorno	37,4	19,02	172	3
00VG03428	TOSCANA	Viareggio	34,8	19,90	205	3
average values			*35,1*	*18,75*	*227*	*3*

Source: Economic observatory regarding production in marine fisherie in Italy, 1998.

Table I.2 - Added value, net present value and capitalised net present value for a sample of Tyrrhenian bottom trawlers, 1998 (Italian lire).

registration number	Daily added value 1995	Daily added value 1998 (a)	C'' = net present value (b)	Ca (c)
07CR00080	894.345	954.936	31.421.720	31.779.130
05CR00494	690.180	736.939	24.248.630	24.524.459
06CR00250	446.048	476.268	15.671.370	15.849.647
07SA00750	938.030	1.001.581	32.956.553	33.331.419
12SA00236	432.043	461.314	15.179.305	15.351.986
00SA02460	869.174	928.060	30.537.384	30.884.736
00CV02113	655.302	699.698	23.023.231	23.285.123
00CV01997	269.059	287.287	9.453.057	9.560.612
00CV02148	521.138	556.445	18.309.562	18.517.845
04GA00955	621.622	663.737	21.839.944	22.088.378
04GA01116	474.367	506.505	16.666.302	16.855.895
04GA01016	460.599	491.804	16.182.588	16.366.680
00GA01238	883.587	943.449	31.043.749	31.396.860
01GA01325	835.306	891.897	29.347.455	29.681.274
04GA00562	746.466	797.039	26.226.174	26.524.493
05GE00085	917.539	979.702	32.236.635	32.603.313
02GE03307	971.036	1.036.824	34.116.190	34.504.244
00SP04301	718.655	767.344	25.249.075	25.536.282
02LI02668	480.636	513.199	16.886.570	17.078.668
02LI02748	995.368	1.062.803	34.971.038	35.368.814
08LI00074	972.582	1.038.474	34.170.483	34.559.155
00VG03428	797.507	851.538	28.019.443	28.338.158
average values	*708.663*	*756.675*	*24.898.021*	*25.181.235*

Notes: (a) monthly index numbers of consumer prices for household of blue collars and white collars for the period September 1995 - September 1998 (6,77%) from Fiscal guide, Frizzera, B. (1999) based on Italian Statistical Yearbook 1999, Istat; (b) net present value based - for the 45 days of temporary withdrawal - on the actualization rate in force from April to October 1998 (5%), calculated on a daily basis (0,013%)- Official discount rate from Fiscal guide, Frizzera, B. (1999) based on Italian Statistical Yearbook 1999, Istat; (c) The value of Ca is the capitalisation of the value of C'' at the interest rate of treasury bonds in force at 31.12.1998 (6,55%), calculated on a daily basis (0,0174%) - Average percentage returns of the monetary market, Italian Statistical Yearbook, 1998, Istat. Capitalisation period is : (n-1)+ta, equal to 44+65 days.

Table I.3 – Equivalent allowances granted for the adhesion to temporary withdrawal of fishing activity for a sample of Tyrrhenian bottom trawlers, 1998 (Italian lire).

registration number	average number of crew member	shipowner's allowance (a)	shipmen's allowance (b)	total allowance
07CR00080	3	6.000.000	9.625.714	15.625.714
05CR00494	3	6.000.000	9.625.714	15.625.714
06CR00250	3	6.000.000	9.625.714	15.625.714
07SA00750	3	6.000.000	9.625.714	15.625.714
12SA00236	2	3.000.000	6.579.731	9.579.731
00SA02460	4	11.000.000	13.647.227	24.647.227
00CV02113	3	6.000.000	9.625.714	15.625.714
00CV01997	3	11.000.000	10.601.244	21.601.244
00CV02148	3	6.000.000	9.625.714	15.625.714
04GA00955	3	6.000.000	9.625.714	15.625.714
04GA01116	3	6.000.000	9.625.714	15.625.714
04GA01016	3	6.000.000	9.625.714	15.625.714
00GA01238	2	6.000.000	6.579.731	12.579.731
01GA01325	3	6.000.000	10.601.244	16.601.244
04GA00562	3	6.000.000	9.625.714	15.625.714
05GE00085	2	6.000.000	6.579.731	12.579.731
02GE03307	2	6.000.000	6.579.731	12.579.731
00SP04301	2	6.000.000	6.579.731	12.579.731
02LI02668	3	6.000.000	9.625.714	15.625.714
02LI02748	3	6.000.000	9.625.714	15.625.714
08LI00074	3	6.000.000	9.625.714	15.625.714
00VG03428	3	6.000.000	9.625.714	15.625.714
average	*3*	*6.318.182*	*9.204.926*	*15.523.108*

Notes: (a) amounts disposed by M.D. 09.07.1998 providing for the associated social measures to be addressed to the units accepting temporary suspension of fishing activity; (b) average shipman's allowance has been obtained by the use of minimum pay resulting from previdential tables for shipmen.

*Table I.4 - Comparison between op*portunity cost and the premium for a sample of Tyrrhenian bottom trawlers, 1998 (Italian lire).

registration number	region	grt	Ca = opportunity cost	Pa = allowance	Ca - Pa	real answer	rational answer (a)
07CR00080	CALABRIA	29,85	31.779.130	15.625.714	16.153.416	YES	NO
05CR00494	CALABRIA	14,07	24.524.459	15.625.714	8.898.745	YES	NO
06CR00250	CALABRIA	29,51	15.849.647	15.625.714	223.933	YES	YES
07SA00750	CAMPANIA	45,12	33.331.419	15.625.714	17.705.705	YES	NO
12SA00236	CAMPANIA	9,95	15.351.986	9.579.731	5.772.255	YES	NO
00SA02460	CAMPANIA	51,80	30.884.736	24.647.227	6.237.509	YES	NO
00CV02113	LAZIO	46,80	23.285.123	15.625.714	7.659.409	YES	NO
00CV01997	LAZIO	57,16	9.560.612	21.601.244	- 12.040.632	YES	YES
00CV02148	LAZIO	39,52	18.517.845	15.625.714	2.892.131	YES	NO
04GA00955	LAZIO	42,38	22.088.378	15.625.714	6.462.664	NO	NO
04GA01116	LAZIO	46,68	16.855.895	15.625.714	1.230.181	NO	NO
04GA01016	LAZIO	44,59	16.366.680	15.625.714	740.966	YES	YES
00GA01238	LAZIO	47,03	31.396.860	12.579.731	18.817.129	YES	NO
01GA01325	LAZIO	24,60	29.681.274	16.601.244	13.080.030	YES	NO
04GA00562	LAZIO	20,45	26.524.493	15.625.714	10.898.779	YES	NO
05GE00085	LIGURIA	23,85	32.603.313	12.579.731	20.023.582	YES	NO
02GE03307	LIGURIA	17,42	34.504.244	12.579.731	21.924.513	NO	NO
00SP04301	LIGURIA	16,34	25.536.282	12.579.731	12.956.551	NO	NO
02LI02668	TOSCANA	39,53	17.078.668	15.625.714	1.452.954	NO	NO
02LI02748	TOSCANA	27,99	35.368.814	15.625.714	19.743.100	NO	NO
08LI00074	TOSCANA	37,37	34.559.155	15.625.714	18.933.441	NO	NO
00VG03428	TOSCANA	34,80	28.338.158	15.625.714	12.712.444	NO	NO
average VALUES		*33,95*	*25.181.235*	*15.523.108*	*9.658.127*		

Note: (a) It was assumed that, in case of a premium slightly lower than the income that might be generated by the fishing activity, the agent decides to withdraw from the activity, thus preferring a certain (although slightly lower) income- rather than an uncertain income.

Annex 1B: Questionnaire
Vessel name: XXXXXX
Registration number: 0000000
GRT: 000

Adhesion to temporary withdrawal period: yes/no.
What are the main reasons of adhesion/not adhesion to the temporary withdrawal period (cross out not concerning items)?

Motivations	*Comments*
premium higher/lower to potential income	_____ _____
self-perception of over/under exploitation of resources	_____ _____
imitation/refuse of others fishermen's behaviour	_____ _____
direction to adhere/not adhere from fishermen's association	_____ _____
immediate liquidity requirements/not immediate liquidity requirements	_____ _____
delay/not delay to pocket the premium	_____ _____
possibility/refuse to have a withdrawal from job	_____ _____

Chapter 3 References

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4. The "driftnet" italian programme ban: The Sicilian case

4.1. Introduction

The aim of this exercise is to analyse an applied case study within a specific economic incentive mechanism related to the reduction or control of fishing effort (in terms of capacity).

Under the condition applied to this case-study, the *Principal* is the subject which, in order to achieve its objective, has to induce another subject to adopt a given behaviour, while the *Agent* is the subject which – based upon the contract proposed by the principal - will accept to adopt a given behaviour.

In this case the effectiveness of a definitive withdrawal or a re-conversion of capacity towards other fishing activities and the rationale underlying the acceptance of the "contract" by the industry operators will be analysed.

The case study covers the Italian "Driftnet Programme". It is considered as an applied case for definitve fishing effort reduction and, within the P-A theory , represents a radical condition to test acceptance or not of the "contract" offered by the Principal, meant as an economic incentive market signal.

4.2. Background and choice of the drifnet case study

Driftnets have been accused of not being sufficiently selective and of trapping unacceptable numbers of cetaceans, marine mammals, birds and reptiles. Driftnets are nets that are held on or just below the surface of the water thanks to floats. In the case of large nets, their height is generally comprised between 20 to 30 metres. Nets can drift on their own or with the vessel to which one end is tied. They are generally set at night, at least for large species, and tend to target pelagic species - swimming close to the surface of the water - such as tuna, swordfish and salmon.

In the early 1990s, responding to public concern, the United Nations (UN) passed a resolution asking for a moratorium on the use of large driftnets. The EU Council of Ministers decided to impose a maximum limit of 2.5km on driftnets used by EU vessels and, from 1994, to ban driftnets, but Member States were unable to adopt this proposal. Only on June 1998, the Council of Ministers took the decision to ban the use of driftnets for the capture of swordfish in the Mediterranean from 1 January 2002. Since the ban had a negative economic and social impact on the communities concerned, the European Union, in co-operation with Member States, provided measures to ensure that this impact was kept to a minimum.

Italy put in place a programme - the Spadare Programme -, which offered financial incentives to vessel owners prepared to abandon driftnets and convert to more selective techniques, retrain or leave the fishing sector. This programme was in place until the end of 1999 and EU assistance to Italian vessel owners and crews affected by the ban was provided. These measures included refurbishing vessels in order to allow for the use of safer techniques in targeting the same fisheries, transferring to other fisheries, compensation for vessel owners and fishermen ending their fishing activities and training for fishermen wishing to turn to alternative activities.

The funds for such measures were taken from the financial allocation to each of the Member States within the framework of the Structural Funds. The Commission also allocated committing some funding to co-financing studies and pilot projects seeking to find safer techniques, more ecologically friendly and profitable in swordfish fisheries. Thus, until the end of 2001, in the thoughts of the EU Commission, driftnets were considered to be gradually but rapidly phased out and fishing pressure to be reduced as quickly as possible. In the intentions, the 1998 number of vessels taking part in swordfish fisheries with driftnets was expected to be forty per cent lower than the numbers involved on previous three years, while fishing effort had to be gradually reduced over the next years.

Italy presented the national programme to the European Commission detailing the means and measures to allow for the vessels and crew

phasing out by 1st January 2002 driftnets, when they had to be forced out from the Italian swordfish fisheries.

The Italian authority was then facing a very difficult situation. In fact the Ministry for Agricultural and Forestry Policy, while being aware of the crucial socio-economic role of fishing by driftnets in some districts (such as Bagnara in the Region of Calabria), had to implement nevertheless a set of measures to eliminate this fishing gear.

At national level the plan was approved by the M.D 23.05.97. The plan had to be implemented in the period 1997-99. Some additional problems - such as the request made by the fishermen associations not to levy any duties on the premiums received for participation in the plan - postponed the actual implementation of the plan, which was started in 1998. Participation in the Plan was also accelerated by the decision made by the Community Council in June 1998 to enforce the ban of driftnets as from 1 January 2002.

The "Spadare" Plan in detail

To promote withdrawal of driftnets used for swordfish fishing, the Plan provided operators with two options: re-conversion or final withdrawal from the activity. Bonus beneficiaries are the shipowner or the owner/shipowner and the members of the crew.

Shipowners or owners/shipowners are entitled to receive:

- retirement allowance, in case of a final withdrawal from any fishing activities;
- re-conversion allowance, if they want to continue their activity by using fishing gears other than driftnets.

The allowances included in the "Spadare Plan" and addressed to shipowners or owners/shipowners are related to the vessel tonnage (grt) and to the year of participation in the plan (the amount of money in ECU[15], decreases in case of late participation). Of course retirement

[15] The "Spadare" Plan was enforced before the date of enforcement of Euro as single currency of the European Union (01.01.1999).

allowances are higher than re-conversion ones. Those who decided in favour of a final withdrawal and applied for retirement allowance had to submit their fishing license along with the nets. Those who accepted the re-conversion option had to submit both their nets and their fishing license that were replaced with another license.

The members of the crew were able to join the Plan only if the shipowner participated as well. In this case each member of the crew decided whether to apply for retirement allowance or re-conversion one, regardless of the form of participation in the plan decided by the shipowner or owner/shipowner.
The members of the crew of the vessel included in the plan were entitled to receive:

- retirement allowance, if they committed themselves not to carry out any economic activities;
- re-conversion allowance if they shifted to other fishing activities carried out by gears other than driftnets or to other economic sectors.

Both the retirement and the capacity adjustment allowance amounted to 10.000 EURO per year on board (up to a maximum ceiling of 5 years). This amount decreased as a function of the years still missing to be entitled to the retirement pension. In the time span elapsing, between the submission of the application and the reception of the premium, participants were given a "waiting" allowance covering the period between their withdrawal from the fishing activity and the issue of the decree by the Harbour Office by which the retirement or capacity adjustment allowance was granted. The "waiting" allowance varied according to the length between perpendiculars – higher or lower than 24 m. – and according to the size of the vessel (gross registered tonnage).

4.3. Short description of the analysis model.

The study of the "spadare" case, chosen for the analysis associated to the capacity segment, was conducted by referring to the model firstly developed by Ifremer (Kalaydjian, 2000) and expressed in (1):

$$\sum_{t=1}^{T_i} Y_{it}(1+r)^{-t} + PK_{iT_i}(1+r)^{-Ti} + PL_{iT_i}(1+r)^{-Ti} \leq P(grt, age)_t + PK_{it} \quad + PL_{it} \qquad (1)$$

Equation (1) denotes the acceptance by the agent of a "contract" proposed by the principal, where withdrawal or capacity adjustment is required to get a premium (allowance). Specifically, the addends of the member on the left of the inequality sign of (1) denote the opportunity cost. The opportunity cost consists of :

$$\sum_{t=1}^{T_i} Y_{it}(1+r)^{-t} = net\ present\ value\ of\ income\ flows\ in\ the\ actualization\ period$$

$$PK_{iT_i}(1+r)^{-Ti} = net\ present\ value\ of\ the\ capital\ value\ of\ the\ vessel\ at\ the\ end\ of\ the\ actualization\ period$$

$$PL_{iT_i}(1+r)^{-Ti} = net\ present\ value\ of\ license\ at\ the\ end\ of\ the\ actualization\ period$$

while the addends on the right denote:

$$P(grt, age)_t = premium\ granted\ to\ the\ agent\ who\ accept\ the\ contract$$

$$PK_{it} = \text{capital value of the vessel at the moment of the agent's acceptance of the contract}$$

$$PL_{it} = value\ of\ the\ license\ at\ the\ moment\ of\ the\ agent's\ acceptance\ of\ the\ contract$$

Generally, the agent will accept the contract if his opportunity cost will be lower or equal to the economic incentive provided by the principal, increased by the value of the vessel and of the fishing license. Such an acceptance condition is based on the assumption that the agent's decision-making process is driven by merely economic evaluations.

4.4. Application and adjustment of the model to the Sicilian "spadare" case.

The application of model (1) to the specific drifnet case study requires some adjustments.

First, in calculating the agent's opportunity cost the value of the licence is not taken into account; in fact, due to the deadline set out for the use of drift nets (01.01.2002, as established by the EU Council Decision n. 1239/98), the calculation of the licence value, which cannot be re-used or transferred, is useless.

Secondly, it has to be outlined that the adhesion to the Spadare plan with the retirement modality (and clearly with the re-conversion one) does not imply necessarily the vessel scrap. The shipowner who asks for the retirement bonus oblige himself to not exercise any fishing activity; he has only to deliver drift nets and the related fishing license but not the vessel[16]. So he has different options to retain the vessel's property and stop fishing, to sell it or to ask for the premium for final withdrawal (scrapping) as in the Reg. EC 3699/93[17]. The first option, in this analysis, is not considered as it is not rational from an economic point of view.

Furthermore, including in the calculation of the right member of equality (1), the capital value of the vessel at the moment of the agent's acceptance of the contract or the value of the premium for final withdrawal, is useful only if the shipowner asks for the retirement bonus. Only in this case a definitive stop from every fishing activity takes place and the sale of the boat in the second hand market or its demolition can be considered as a meaningful consequence. On the contrary, if the shipowner asks for the re-conversion bonus, he can use the vessel for

[16] This condition is required in re-conversion case too but in this latter case fishing license has to be delivered to maritime authorities and substituted with the new one.

[17] EC Reg. of the Council 3699/93, concerning financial instruments for fishery (FIFG) and defining the criteria and requirements of the structural community actions in fishery, aquacolture, processing and commercialisation of the relevant products.

other fishing activities; in this case the sale of the boat is no more a consequence because it can be re-used.

In order to better explain the real decision process of the agent (in this case composed by the shipowner and by the whole equipment[18]), some considerations are rerquired concerning the different form the model will assume in relation to the different type of renouncement asked to the owner of the boat and to the fishermen by the plan in the two cases (retirement and re-conversion). In fact, as previously reported, shipowners or owners/shipowners are entitled to receive:

- retirement allowance, in case of a final withdrawal from any fishing activities *(that is he is allowed to exercise other economic activities other than fishing ones)*;
- re-conversion allowance, if they want to continue their activity by using *fishing gears* other than driftnets.

On the other side, the members of the crew of the vessel included in the plan are entitled to receive:

- retirement allowance, if they commit themselves not to carry out any economic activities (*that is they have to withdraw definitively by the whole economic sector);*
- re-conversion allowance if they shift to other fishing activities carried out by gears other than driftnets or to other economic sectors.

Based on these assumptions, in the "spadare" case the model (1)

becomes:

$$Y + PK + WgO(T_i, N) + WgF(T_i, N) \leq P_{rt}O + Pk + WgO(t_i, N) + P_{rt}F \qquad (2)$$

as for the hypothesis of retirement followed by selling the vessel and

$$Y + PK + WgO(T_i, N) + WgF(T_i, N) \leq P_{rt}O + PS + WgO(t_i, N) + P_{rt}F \qquad (3)$$

as for the hypothesis of retirement followed by scrapping the vessel.

[18] This configuration of the agent depends on the crucial role that the rationales of the fishermen have on the owner's decision process to accept or not the contract.

On the contrary, as for the hypothesis of re-conversion (1) becomes

$$Y + PK + WgO(T_i, N) + WgF(T_i, N) \leq P_{rc}O + WfO(t_i, N) + P_{rc}F + WgF(t_i, N) \qquad (4)$$

where:

$$Y = \sum_{t=t_i}^{T_i} Y_{it}(1+r)^{-(T_i - t_i)}$$

net present value of income flows in the 1997 – 2001 period; this value represents the summation of the remuneration both of shipowner and crew members labour;

$$PK = PK_i(1+r)^{-(T_i - t_i)}$$

net present value of the 2001 capital value of the vessel (selling of the boat);

$$WgO\ (T_i, N) = \sum_{t=T_i}^{N} WgO_{it}(1+r)^{-(N - T_i)}$$

net present value of the expected stream of a generic wage of the labour market by shipowner after the banning year 2001;

$$WgF\ (T_i, N) = \sum_{i=1}^{n_i} \sum_{t=T_i}^{N} WgF_{it}(1+r)^{-(N - T_i)}$$

net present value of the expected stream of a generic wage of the labour market by crew members after the banning year 2001;

$$P_{rt}O = [P_{rt}O_i(1+r)^{(N - t_i)}](1+r)^{-[N - t_i]}$$

net present value of the capitalised value of the retirement bonus for the shipowner;

$$Pk = [Pk_i(1+r)^{(N - t_i)}](1+r)^{(N - t_i)}$$

net present value of the capitalised 1997 value of the vessel;

$$WgO(t_i, N) = \sum_{t=t_i}^{N} WgO_{it}(1+r)^{-(N - t_i)}$$

net present value of the expected stream of a generic wage of the labour market by shipowner after the acceptance of the adhesion to the plan with retirement modality;

$$P_{rt}F = \sum_{i=1}^{n_i} [P_{rt}F_i(1+r)^{(N-t_i)}](1+r)^{-(N-t_i)}$$

net present value of the capitalised value of the retirement bonus for crew members;

$$PS = [PS_i(1+r)^{(N-t_i)}](1+r)^{-(N-t_i)}$$

net present value of the capitalised value of the allowance for final withdrawal (scraping of the vessel);

$$P_{rc}O = [P_{rc}O_i(1+r)^{(N-t_i)}](1+r)^{-(N-t_i)}$$

net present value of the capitalised value of the re-conversion bonus for shipowner;

$$WfO\ (t_i, N) = \sum_{t=t_i}^{N} WfO_{it}(1+r)^{-(N-t_i)}$$

net present value of the expected stream of a wage of the fishery labour market by shipowner after the acceptance of the adhesion to the plan with re-conversion modality;

$$P_{rc}F = \sum_{i=1}^{n_i} [P_{rc}F_i(1+r)^{(N-t_i)}](1+r)^{-(N-t_i)}$$

net present value of the capitalised value of the re-conversion bonus for crew members;

$$WgF\ (t_i, N) = \sum_{i=1}^{n_i} \sum_{t=t_i}^{N} WgF_i(1+r)^{-(N-T_i)}$$

net present value of the expected stream of a generic wage of the labour market by crew members after the acceptance of the adhesion to the plan with re-conversion modality;

with:

i = the generic agent (shipowner + crew members)

O_i = the generic shipowner

F_i = the generic member of the crew
n_i = the number of crew members of the generic vessel.
t = time
t_i = the beginning time of the considered period (in this case 1997)
T_i = the ending time of the considered period (in this case 2001)
N = the ending of the time horizon of the agent

Of course the reference period for the analysis is the period of implementation of the "Plan for the Rationalisation and Capacity Adjustment of the Spadare", that is 1997-99.
In order to give a time horizon to the analysis, it has been decided to consider a short term period as the reference for the economic decision process of the agent (both shipowner and crew members). For this reason N of the formulation has been fixed as the 2001 year. Because of this as:
$T_i = N$ *then*

$$WgO(T_i, N) = 0$$

and

$$WgF(T_i, N) = 0.$$

The study of the effects resulting from the implementation of an allowance-based system is focused on a sample of 8 vessels, belonging to three Sicilian administrative districts traditionally devoted to this type of fishery, namely vessels belonging to the districts of Mazara del Vallo, Palermo e Syracuse (see Annex IB, table I.1). Driftnetters located in the above area account for 240 units (35,3% of the national fleet devoted to this technique). As to 31.12.99, out of the 240 vessels of these districts, 63% applied for participating in the plan.

Consequently, the model was applied as follows:

1. calculation of the current value of income flows for the period 1997 – 2000, with respect to each unit of the sample hereinabove;
2. calculation of the value of the vessel at the beginning and at the end of the period under investigation and of the premium for the scrap of the vessel allowed by EC Reg. 3699/93;

3. calculation of the allowance to be granted to the vessels participating in the Plan, for both the retirement and re-conversion hypothesis;
4. calculation of the net present value of generic and fishery wage stream expected both by shipowner and fishermen;
5. comparison between the left and right member of the (1), (2) and (3) expressions for each agent.

4.5. Analysi framework

1. The current value of income flows is calculated as income deriving, to each agent, from driftnets during the period between the beginning of the implementation of the 1997 "Spadare" Plan and the 2001 deadline set out by the community. Income is represented by the added value (VA = value of landings – operational costs – fixed costs). The nominal income was assumed to be unchanged during the period 1997–2001 (see Annex IB, table I.2). Based upon a discount rate equal to 6,25% (ordinary portfolio discount at 30.06.1997)[19], the "net present value" of the income flows is calculated, as reported at Annex IB, table I.3.

2. To calculate the 1997 and 2001 vessel values, the estimation based on RINA (Italian Register of Vessels) parametershave been used. This estimation is based upon the cost of the materials used in the Italian shipyards and allowing for the scale economy achieved when tonnage increases; in fact the value per unit of gross registered tonnage decreases when the vessel size increases. The estimate is time-discounted allowing for the inflation rate recorded in the period 1993– 1999[20] and for the inflation programmed for the period 1999–2001[21]. To calculate allowance for the scrap of the vessel the premium set by EC Reg. 3699/93 for final withdrawal have been considered. 1997 vessel value and final withdrawal allowance have

[19] Monetary and financial rates, Italian Statistical Yearbook 1998, Istat.
[20] Index number of the consumer prices for households of blue collars and white collars, Italian Statistical Yearbook 1998, Istat. With respect to the value of the year 1999 reference was made to the Istat notice, November 1999.
[21] Planned inflation rate as set out in the Economic-Financial Planning Report , 2000–2003.

been first capitalised (to consider the interests they produce in the considered period) and than actualised to 1997 (the year of the agent's decision). On the contrary, the 2001 vessel value has been actualised to 1997 (for the discount rate see point 1). Capitalisation has been made considering the interest rate of 6,55% (return of treasury bonds in force at 1997 - Average percentage returns of the monetary market, Italian Statistical Yearbook, 1997, Istat). (see Annex IB, table I.4).

3. To calculate the allowances to be granted by the Plan, the average composition of the crew has been taken into consideration - as recorded by the monitoring carried out through Irepa data collection network - along with the amounts set out in the M.D. 23.05.1997 which ratifies the Plan at national level. Both options were considered: retirement and re-conversion. The retirement and re-conversion allowance is the result of the sum of the bonus granted to the owner/shipowner and of the bonuses granted to each member of the crew (see Annex IB, table I.5).

4. To calculate the net present value of a generic wage stream expected by shipowner (retirement) and fishermen (retirement) the "average yearly gross retribution for the non agricultural private sector, year 1994" has been taken into account; an actualisation, based on the average yearly index number for labour retributions (1994 –1997), has been made.[22] To calculate the net present value of the fishery wage stream expected by shipowner (re-conversion) the average labour cost for purse seine and small scale fishery has been considered, for they are the only fishing gears to which a shipowner is allowed to re-convert.[23] The actualisation has been made on a discount rate equal to 6,25% (see point 1) – Annex IB, table I.6.

5. The double option given to each agent enabled us to make three different comparisons among:

   - C e P_1
   - C_2 e P_2
   - C_2 e P_3

[22] Italian Statistical Yearbook 1997, Istat.
[23] Economic Observatory of Italian Fisheries, Irepa, Italy 1997.

where:
C: the left member of the expression (2), (3) e (4);
P_1: the right member of expression (2);
P_2: the right member of expression (3);
P3: the right member of expression (4).

(see Annex IB, table I.7).

4.6. Model results

The comparison mentioned in point 4 above leads to the following conclusions :

1. The difference between C and P is positive in 38% of the cases; for these cases ($C - P > 0$ or $C > P$) swordfish represents most of the catches;
2. In the remainder 62% it results that $C - P < 0$ or $C < P$; in particular, the value of P_1 (retirement followed by the sell of the boat) is the highest value among C, P_1, P_2 (retirement followed by the scrap of the boat) and P_3 (re-conversion). In these latter cases catches are composed partly (3.4% to 28.4%) by small pelagic species, like anchovies and sardines. The average price of these species, generally lower compared to that of swordfish, influences the average price of the productive mix and, as a consequence, of total revenues (the base for the calculation of C).

At a first sight these results suggest that the market signal send by the *Principal* – the premium – is, somehow, lower than that the *Agent* opportunity cost's. Only for boats with lesser swordfish target specification the *Principal-premium* is higher than the *Agent-opportunity cost's*. In other words, the principal settled the premium according to weighted values of the fleet segments without catch composition order consideration.

4.7. Improving results and conclusions: complementary desk-case study and questionnaires

Model results exposed in paragraph 4.6 have successfully been completed with a complementary desk-case study. In order to have a more detailed view of the real effectiveness of national policy measures concerning adjustment capacity, specifically measures provided for in the Italian "Spadare" Plan, a questionnaire has been given to the units under analysis. The aim of the questionnaire (Annex IC) is to investigate about the adhesion or not to the "contract" offered by the principal and also to investigate the rationale, either economic or not, that influenced each agent to accept or not the "contract".

The answers to the questionnaires allow the following information:

a) modality of adhesion to the "Spadare" Plan both of shipowner and of each member of the crew[24];
b) year of adhesion;
c) for each fisherman, years on board and number of years until retirement pension in order to calculate bonus granted by fishery authority;
d) rationale, either economic or not, influencing each agent to accept or not the "contract".

Questionnaires results are hereinafter reported:

- 87,5% of the vessels belonging to the sample adhered to the Plan, i.e accepted the "contract", from its outset in 1997; only one unit adhered in 1998.

- 50% of shipowners asked retirement bonus, while the other 50% asked the re-conversion one.

- Only 15% of the crewmembers asked for retirement bonus, i.e. 3 units out of 20; on the contrary, 14 crewmebers (70% on the total)

[24] In fact in the first phase of the analysis (see paragraph 5, point 3) the calculation of both retirement and re-conversion bonuses have been calculated. Both of them have been successfully compared to the value of the opportunity cost (see paragraph 5, point 4).

asked for re-conversion to other fishing activities; finally 3 crewmembers did not asked for bonus at all (see Annex IB table I.8)[25].

- The agents' decision to accept the "contract" was influenced mainly by the following reasons: a) fishing by the use of drift nets of a maximum allowed length of 2,5 kilometres is considered to be economically no profitable by fishing operators;
  b) controls on driftnets fishery were considered as making fishing activity difficult to carry on; in other words, situation of moral hazard is to be consider impracticable – now and mostly in the future.

- In 50% of the cases, even if agents accepted the "contract", the premium P is lower than the opportunity cost of each agent. In particular it results that in half of these latter cases $C_1 > P_1 > P_2$ and in the other half that $C_1 > P_3$ (see Annex IB, table I.9).

- In the remainder 50% of the cases it can be seen that $P > C$. In particular it results that in half of these latter cases $P_1 > C > P_3$ and in the other half that $P_3 > C$. (see Annex IB, table I.9).

- The correspondence between real and rational answer to the contract is verified in 50% of the cases. This means that the model of analysis can explain half of the cases.

If the aim of the "Spadare" Plan was to induce operators (agents) using driftnets to a general adhesion or to a general acceptance of the "contract", it can be concluded that the target has been reached. Nevertheless, the main reason should not be conduced to "economic rationality" or, in the case, to the premium offered by the Principal. The

[25] The latter situation is probably an exceptional case. Three among four members belonging to a vessel's crew asked for no one bonus. This is a very strange situation: a father and his two sons lost about 300 millions ITL hoping to continue fishing with drift nets if they not adhere personally to the Plan. In this case, monetary concerns had not applied to agents' decision and non monetary economic incentives should be taken into consideration.

premium was not perceived as equivalent to an "economic incentives" in any case.

The Sicilian case study of the "spadare"[26] demonstrates that the underlying agents' decision process cannot be justified in the framework of the microeconomic model of the *Principal and Agent*. The agents' decision process was not influenced only by a mere economic logic. In fact, in many cases, fishing by the use of driftnets allows to obtain an income much higher than the bonuses granted by Ministry for Agriculture and Forestry Policy for the adhesion to the "Spadare" Plan.[27] As such, from a theoretical point of view, the *Agents* should have refused the "contract" offered by the *Principal* instead of accepting.

Command and control policy seems to be the general framework environment underlining agent's decision. Precisely, the premium as a proxy of an economic incentive inducing operators to stop driftnets fishing before the 1st January 2002 deadlines, was not the main cause for acceptance.

In the applied case, the market signals do not give everywhere a quantitative measure of the influence on the agents' behaviour and on their decision to accept the "contract"; therefore, the minimum allowance premium does not perform as an economic incentive. Premium was accepted only to partially compensate losses.

The main reason for a general adhesion or for a general acceptance of the "contract", was the impossibility to follow a moral hazard approach thanks to a command and control scheme. So far, economic incentives were not a substitute of rules set upon a command and control scheme for capacity reduction.

It is not by chance that premium allowance were undertaken only and exclusively because of the crucial socio-economic implications of the ban. The allowed provisions compensate only partially the negative economic and social impact on the communities concerned. In this

[26] This conclusion is probably valid also for the others Italian geographical areas devoted to this type of fishery.
[27] For a quantitative description of data analysis see Annex IA

respect, economic incentives, meant as free signal market for underlying agents' decision process, should not be confused with minimum allowances and vice-versa.

The previous results demonstrates that in the case of hidden information or adverse selection the *Principal* is not able to set economic incentives meant as correct free market signals and the *Agents*' decisions process is not exclusively influenced by a mere economic logic.

Annex IB: *Sampling and data analysis*

Table I.1 – Sample of vessels under analysis – Sicilian "spadare", 1997.

registration number	administrative district	tonnage (grt)	length (OL· meters)	engine power (kW)	average number of crew member	fishing days
01MZ00846	Mazara del Vallo	5,4	10,3	46	2	170
01MZ00937	Mazara del Vallo	7,9	10,0	40	2	158
01MZ00988	Mazara del Vallo	7,4	12,3	198	3	176
06MZ00397	Mazara del Vallo	15,9	15,9	109	3	107
04PA00919	Palermo	5,8	9,9	80	2	186
04PA00959	Palermo	10,0	10,3	95	2	166
04PA01040	Palermo	16,2	14,9	105	5	184
03SR00936	Siracusa	21,9	15,4	161	3	128
average values		*11,3*	*12,4*	*104*	*3*	*159*

Source: Irepa, Economic Observatory of Fisheries, Italy 1997

Note: the name of the vessels is omitted because of privacy rules.

Table I.2 – Harvests, earnings and average price of sample's units, 1997

registration number	harvests (tons)	earnings (ITL '000)	average weighted price (ITL/kG)
01MZ00846	52.814	289.333	5.478
01MZ00937	42.780	360.084	8.417
01MZ00988	65.890	358.073	5.434
06MZ00397	15.093	174.231	11.544
04PA00919	6.812	90.043	13.218
04PA00959	6.435	83.563	12.986
04PA01040	10.978	162.539	14.806
03SR00936	15.176	143.870	9.480
average values	*26.997*	*207.717*	*10.170*

Source: Irepa, Economic Observatory of Fisheries, Italy 1997

Table I.3 – Earnings, operative costs, added value and "net present value" of sample's units,
1997 (ITL '000).

registration number	earnings	operative costs	added value	net present value of income flows (1)
				A
01MZ00846	289.333	80.366	208.967	874.291
01MZ00937	360.084	124.972	235.112	983.678
01MZ00988	358.073	145.442	212.631	889.620
06MZ00397	174.231	27.510	146.721	613.861
04PA00919	90.043	30.460	59.583	249.287
04PA00959	83.563	27.878	55.685	232.979
04PA01040	162.539	60.843	101.696	425.483
03SR00936	143.870	66.224	77.646	324.861
average values	*207.717*	*70.462*	*137.255*	*574.257*

Source: Irepa, Economic Observatory of Fisheries, Italy 1997

Note : (1) net present value calculated for the period 1997-2001 on the actualization rate of 6,25% (ordinary portfolio discount at 30.06.1997 - Monetary and financial rates, Italian Statistical Yearbook 1998, Istat).

Table I.4 – Vessel value at the coming in force of "Spadare plan" (1997) and of the definitive
banning of driftnets (2001) and final withdrawal allowance (ITL '000).

registration number	vessel value 2001 (a)	vessel value 1997 (a)	allowance for final withdrawal (b)
	B	C	D
01MZ00846	169.242	158.070	46.987
01MZ00937	246.342	230.080	76.825
01MZ00988	232.865	217.493	87.235
06MZ00397	437.131	408.275	178.600
04PA00919	182.092	170.072	60.943
04PA00959	312.785	292.137	93.977
04PA01040	444.262	414.935	195.995
03SR00936	457.582	427.375	276.703
average values	*310.288*	*289.805*	*127.158*

Source: (a) Irepa elaboration on RINA data, Italian Register of Vessels. Estimation of RINA of a single grt unit refers to 1992. Actualization has been made using inflation rate for the period 1993 - 1999 (Index number of the consumer prices for households of blue collars and white collars, Italian Statistical Yearbook 1998, Istat. With respect to the value of the year 1999 reference was made to the Istat notice, November 1999) and planned inflation rate for the period 2000 - 2001. (b) Irepa elaboration on amounts disposed by EC Reg. 3699/93 for final withdrawal.

Note: 1997 vessel value and final withdrawal allowance have been first capitalised (to consider the interests amount they produce in the considered period) and than actualized to 1997 (the year of the agent's decision). On the contrary, the 2001 vessel value has been actualised to 1997. For discount rate: see table 3. Capitalization has been made on the interest rate of 6,55% (return of treasury bonds in force at 1997 - Average percentage returns of the monetary market, Italian Statistical Yearbook, 1997, Istat).

Table I.5 – Retirement and re-conversion bonuses in the hypothesis of adhesion to the "Spadare plan" (ITL '000).

	E	**F**
01MZ00846	391.249	256.997
01MZ00937	391.249	256.997
01MZ00988	487.144	295.355
06MZ00397	583.038	333.713
04PA00919	391.249	256.997
04PA00959	391.249	256.997
04PA01040	678.933	372.070
03SR00936	421.936	287.683
average values	*467.006*	*289.601*

Source: Irepa, Economic Observatory of Fisheries, Italy 1997

Note: for calculation of retirement and re-conversion allowances we refer to decree of implementation of "Spadare plan" (M.D. 23.05.1997). The hypothesis consider: a) adhesion to the plan, for all units, in 1997; b) for shipmen, average years on board equal or major than 5 years and average years until retirement equal or major than 5. Retirement and re-conversion bonuses have been first capitalised (to consider the interest they produce in the considered period) and than actualised to 1997 (the year of the agent's decision). For discount rate: see note in table 1.3. For interest rate see note in table 1.4

Table I.6 - Generic and fishery wage stream expected both by shipowner and crew members after the adhesion to the driftnets plan (ITL '000).

average values	*130.437*	*358.701*	*78.453*

Source: (a) Irepa elaboration on "average yearly gross retribution for the non agricultural private sector, year 1994" in Italian Statistical Yearbook 1997, Istat. (b) Irepa elaboration on Economic Observatory of Fisheries, Irepa, Italy 1997.

Note: (a) an actualisation, based on the average yearly index number for labour remunerations, have been made.(b) average labour cost for purse seine and small scale fishery has been considered, for they are the only fishing gears to which a vessel's owner can re-convert

Table I.7 – Opportunity cost and premium for hypothesis of retirement and re-conversion (ITL '000).

registration number	C	retirement		re-conversion	rational answer to the contract
		P_1	P_2	P_3	
01MZ00846	1.043.533	679.757	568.674	596.324	no
01MZ00937	1.230.020	751.766	598.511	596.324	no
01MZ00988	1.122.485	835.074	704.815	765.118	no
06MZ00397	1.050.993	1.121.750	892.075	933.913	yes (P_1)
04PA00919	431.380	691.758	582.629	596.324	yes (P_1)
04PA00959	545.764	813.824	615.663	596.324	yes (P_1)
04PA01040	869.744	1.224.304	1.005.365	1.102.708	yes (P_1)
03SR00936	782.442	979.748	829.076	627.010	yes (P_1)
average values	*884.545*	*887.248*	*724.601*	*726.755*	

Source: Irepa elaboration, 2000

Note : C = A + B; P_1 = C + E + G ; P_2 = D + E + G; P_3 = F + H + I (see tables I.3, I.4; I.5, I.6). P_1 represents retirement followed by the sell of the vessel; P_2 represents retirement followed by scrap of the vessel (see paragraph 4 of the paper). In fact, because the information related to the vessel's destiny after the adhesion to the driftnets plan, is not known, we have considered both the options.

Table I.8 – Adhesion form to the "Spadare plan" resulting from questionnaires and calculation of total bonus for each sample unit.

registration number	grt	number of shipmen (a)	year of adhesion (b)	adhesion form of shipowner (b)	adhesion form of shipmen (a)		bonus (ITL '000) (d)			
					RT	RC	shipowner (b)	retirement crew members (c)	re-conversion for crew members (c)	total
							L	M	N	O
01MZ00846	5,4	2	1997	RT	1	1	189.871	95.894	38.358	324.123
01MZ00937	7,86	2	1997	RC	-	2	180.282	-	76.716	256.997
01MZ00988	7,43	3	1997	RC	-	3	195.625	-	115.073	310.698
06MZ00397	15,9	4	1997	RT	-	1	199.460	-	38.358	237.818
04PA00919	5,81	2	1997	RC	-	2	105.484	-	76.716	182.199
04PA00959	9,98	2	1998	RC	-	2	157.267	-	76.716	233.982
04PA01040	16,2	3	1997	RT	1	2	199.460	95.894	76.716	372.070
03SR00936	21,9	2	1997	RT	1	1	230.147	95.894	38.358	364.399
average values	*11,3*						*182.199*	*35.960*	*67.126*	*285.286*
total		*20*			*3*	*14*				

Source: Irepa elaborations, 2000

(a) responses surveyed by questionnaires

(b) Irepa elaborations based on Ministry of Agriculture and Forestry Policies. Note: RT stands for retirement; RC stands for re-conversion.

(c) calculation based on questionnaires' answers and on M.D. 27.05.1997 ("Spadare plan")

(d) retirement and re-conversion bonuses have been first capitalised (to consider the interests amount they produce in the considered period) and than actualised to 1997 (the year of the agent's decision). For discount rate: see note in table I.3.

Table I.9 – Calculation of opportunity cost of the premium on the basis of questionnaires' answers (ITL '000) and comparison between rational and real answer to the contract.

registration number	adhesion form of shipowner	C (a)	P (b) p_1	P (b) p_2	P (b) p_3	rational answer to the contract	real answer
01MZ00846	B	1.043.533	612.630	501.547	-	no	yes
01MZ00937	R	1.230.020	-	-	596.324	no	yes
01MZ00988	R	1.122.485	-	-	650.025	no	yes
06MZ00397	B	1.050.993	776.530	546.855	-	no	yes
04PA00919	R	431.380	-	-	782.400	yes (p3)	yes
04PA00959	R	545.764	-	-	573.309	yes (p3)	yes
04PA01040	B	869.744	917.442	698.503	-	yes (p1)	yes
03SR00936	B	782.442	922.211	771.539	-	yes (p1)	yes
average values		*574.257*	*282.087*	*290.584*	*672.433*		

Source: Irepa 2000

(a) see table I.7

(b) $p_1 = C + O + G$; $p_2 = D + O + G$; $p_3 = O + H + I$ (see tables I.4; I.5, I.6, I.7 and I.8). p1 represents retirement (for the shipowner) followed by the sell of the vessel; p2 represents retirement (for the shipowner) followed by scrap of the vessel (see paragraph 4 of the paper). In fact, because the information related to the vessel's destiny after the adhesion to the driftnets plan, is not known, we have considered both the options.

Annex IC: *Questionnaire*

Vessel name: XXXXXX
Registration number: 0000000
GRT: 000

Years on board of fishermen (reference year: 1997):

Fishermen	Numbers of years on board
1°	
2°	
3°	
4°	
5°	

Number of years until retirement pension (reference year: 1997):

Fishermen	Number of years until retirement
1° o	
2°	
3°	
4°	
5°	

Adhesion to "spadare" plan: yes/no
Year of adhesion: 1997, 1998 or 1999?
Adhesion form: definitive withdrawal (or retirement)/ re-conversion
What are the main reasons of adhesion/not adhesion to the "spadare" plan (cross out not concerning items)?

Motivations	Comments
premium higher/lower to potential income	_____
self-perception of over/under exploitation of resources	_____
imitation/refuse of others fishermen's behaviour	_____
direction to adhere/not adhere from fishermen's association	_____
immediate liquidity requirements/not immediate liquidity requirements	_____
delay/not delay to pocket the premium	_____
possibility/refuse to have a stop from job	_____
possibility/impossibility to change fish gear	_____
other	_____

Chapter 4 References

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