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### French Decommissioning Schemes: A DEA Evaluation of the Performance of a Public Policy.

#### A first draft

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#### **Introduction**

In an economy where public interventions are in constant decrease in almost all the sectors, national and European public interventions in the French fishing industry remain numerous. Indeed since the start of the nineties the weight of public grants, in this sector, has been getting more and more significant in France with by consequently, an increase of the complexity of the public assistance system. At the moment, there exist three levels of public interventions. Thus, if the European Union (EU) provides some allocations, the French government allots grants too. Moreover local communities (regions and departments), even if they have a lower budget at their disposal, are great suppliers of subsidies too.

Public assistance to the French fishing industry includes budgetary and non-budgetary assistance (protectionism, access to resources, derogatory arrangements concerning competition...).

In this paper we focus on budgetary assistance which is usually more simple to quantify. Budget subsidies can be distinguished into varied grants: some of them are public expenses while the others are fiscal subsidies. The latter is of considerable importance but will not be considered in our study which is focused on public expenses and more particularly on public expenses aimed at structural actions. Two kinds of structural actions are financed by public funding. Financial support can be allocated for the construction and modernisation of fishing

vessels to ensure the competitiveness of the fleet but grant aid can be allocated to eliminate excess capacity too. (Giguelay, 1999)

In this presentation we focus, on public amounts given out to encourage fishermen to end their activity by scrapping their vessel or export them out of the Community waters.

The objective of this contribution is to underline some numerous assets of the Data envelopment Analysis (DEA) method in the evaluation of the performance of the decommissioning scheme policy introduced in the French legislation at the beginning of the nineties in order to reduce French fishing fleet capacity. Even if this paper is a preliminary analysis to present data and DEA models that we are going to use, it allows to present DEA models specified in an original context far from the traditional theory of production. The paper is organised as follows:

In a first time we are interested in the reasons why decommissioning schemes were launched in France.

Then we introduce some questions regarding this public action by presenting data and models we are going to use.

### 1 Decommissioning scheme: a new tool in French public interventions

#### **11 Overcapitalisation and public intervention**

The introduction of withdrawals' policy in the fisheries sector comes from the peculiarities of fish resource. Indeed, sea fishes are a natural, renewable and mobile resource whose reproduction and movements cannot be controlled. Fish resource is a common resource. So no one can own fishes until they have been captured. Equally every fish that is taken from the sea is one fewer available to the rest of fishermen. These two above properties of fish resource are commonly called non-exclusivity and soustractibility (Berkès, 1989). The combination of these properties naturally leads to a phenomenon of overcapitalisation. This combination supplies some negative externalities between fishermen who exploit a same fish stock. Consequently, every fisherman is vulnerable to the actions of the other catchers.

These peculiarities of fish resource leads to a situation of overcapacity which is the natural consequence of the exploitation even if the natural exploitation is not efficient. (Giguelay, Boncoeur, 1999)

Overcapitalisation, which induces smaller stocks, would lead to endanger fishermen. That is why the European Commission tries to obtain a better balance between vessels and fish resource available. Overfishing due to overcapitalisation is a real threat for fish and for fishermen too! This justifies the necessity of a public intervention in order to decrease fishing capacity.

## 12 Weight of decommissioning schemes in public subsidies

The European structural policy of the Common fisheries policy introduced in 1983 the first Multi-annual guidance program (MAGP) with the main goal of limiting the excess of fishing capacity. Even if overfishing and fish stock decline was obvious, this first program had a very low impact on the European fleet structure. Nobody was really concerned by fishing resource protection.

However, at the beginning of the nineties the actors of the fishing industry and the state members become aware of the fact that there are too many vessels in the European Union for the fish availability. This new awareness of the overcapitalisation appears when the European Commission threat state-members which do not decrease the fishing effort of their fleet to suppress their subsidies for new vessels' construction. It was up to each member state to decide how to reach the restricting targets agreed in the MAGP.

In March 1991 the French government chooses to introduce a policy of public financial incentives to boat decommissioning to meet the European requirements of the 2<sup>nd</sup> MAGP concerning fleet capacity reductions for the period 1987-1991. The launch of the first decommissioning scheme -known as "the Mellick Plan" was intended to reduce the power capacity of the French fleet of 10%. The aim was to withdraw as quickly as possible more than 100.000 kW.

The idea was to scrap vessels, to use them in other sectors or to transfer vessels outside Community waters.

Since 1993, several other plans were adopted, aiming like the first one at fulfilling European fleet capacity reduction targets but the first scheme stays the plan where the higher amounts of grants were allocated. Indeed financial support to decommissioning, which had fallen in relative and absolute terms after the achievement of the "Mellick Plan" at the beginning of the decade, increased again with the new schemes which were launched from 1993, without reaching the level of 1991.

The following tables depict the place taken by decommissioning schemes (in bold characters) within the general frame of EU and Government assistance to the French fishing industry and aquaculture over the period 1991-1996 (MAP, 1997) :

Table 1. Evolution of EU and French government expenditures in aid of the French fishing industry and aquaculture, 1991-1996 (millions of constant 1996 FF)

Area	1991	1992	1993	1994	1995	1996
1. Exploitation of natural resources	668.3	405.6	489.3	399.0	354.9	448.8
<i>including :</i>						
- Investment in the fishing industry	310.1	223.8	280.7	148.8	101.4	198.3
- Support to landing prices	85.9	80.2	79.9	141.1	144.9	69.1
- <b>Decommissioning</b>	<b>195.8</b>	<b>13.5</b>	<b>29.8</b>	<b>15.6</b>	<b>37.6</b>	<b>41.7</b>
- Temporary assistance	10.3	3.0	46.2	61.0	0.1	58.8

Calculated from MAP 1997 (INSEE 1997/1 for the price index)

Table 2. EU and French government expenditures in aid of the French fishing industry and aquaculture.

Yearly average 1991-1996 (constant French Francs)

Area	Average yearly amount*	Structure	Sources of financing	
			French govt	EU
1. Exploitation of natural resources	461	8.5%	65%	35%
<i>of which :</i>				
1.1 Aquaculture	39	0.7%	33%	67%
1.2 Fishing industry	422	7.8%	68%	32%
<i>of which :</i>				
- Investment	211	3.8%	90%	10%
- Support to landing prices	100	1.8%	38%	62%
- <b>Decommissioning</b>	<b>56</b>	<b>1.0%</b>	<b>27%</b>	<b>73%</b>
- Temporary assistance	30	0.6%	100%	ε
- Miscellaneous	25	0.5%	60%	40%
<i>Other areas</i>				
2. Marketing and processing	91	1.7%	65%	35%
3. Research, training, administration	421	7.7%	100%	ε
4. National insurance	4462	82.1%	100%	0%
<b>Total</b>	<b>5435</b>	<b>100.0%</b>	<b>96%</b>	<b>4%</b>

\* millions of constants 1996 French Francs. Calculated from MAP 1997 (INSEE 1997/1 for the price index).

With an average of 56 million French Francs per year, the amounts allocated by the EU and the French Government to decommissioning schemes represent only slightly more than 1% of the total expenditures of these authorities in aid to the sector over the period 1991-96.

The financing of decommissioning schemes represents 13% of the total EU and Government expenditures for the "exploitation of natural resources" area (not including aquaculture), far behind subsidies to investment (representing 50% of the whole set, and constituted up to 98% by direct subsidies to ship building or modernising and by compensation of reduced interest rates of loans to fishing firms), and support to landing prices (24% of the whole set). (Giguelay, Boncoeur, 1999)

Thus it appears that, during the period under survey, EU and government subsidies, aiming at reducing the pressure on fish stocks, were outnumbered by subsidies liable to have the opposite effect. This phenomenon will have to be taken into account to interpret some results of our models. The priority stays the investment and the competitiveness of the fleet.

### **1.3 Characteristics of the decommissioning schemes.**

The evaluation of a public action is not always simple. Some different parameters and constraints have to be taken into consideration. In the case of the policy of financial incentives launched by the French government to withdraw vessels from French fleet, the direct effects of the scheme are obvious enough to bring to the fore. Indeed the withdrawal of a vessel is the direct consequence of the allocation of the grand aid. Thus, it is possible to quantify the direct effects of the financial support. In the evaluation of a public action it is not always the case. For example, a region launches a program of public subvention to increase employment. (Badillo, Romain, 1999). Some months later a raising of the employment can be underscore. The cause of this fact is probably not the program alone, some other factors can explain this increase (the revival in the economics..) Moreover, it is difficult to define the opportune time to evaluate the impact of this policy.

In the case of French decommissioning schemes the judicious moment of the evaluation is when every vessels are withdrawn consequently to the allocation of the grand aid.

Thus we can provide a "real" evaluation of the French decommissioning schemes.

French public decommissioning schemes can be appraised according to two points of view. The instigator of the public measures appraised the effects of the action but fishermen who benefit by this program have an opinion and their own appraisal of the public action too.

In this paper we made up our mind to assess the consequences of the launch of decommissioning schemes according to the only view of the public actors which financed these programs. From a public point of view, this study provides an evaluation of the

performance of subsidies, involved in the decommissioning scheme policy, in reducing fishing capacity.

This approach rests on an ex-post evaluation of the launch of a decommissioning scheme. This analysis will be based on the use of different input-oriented DEA models<sup>1</sup>. (Charnes, Cooper, Rhodes, 1978), (Banker, Cooper, Charnes, 1984)

Let us underline the original use of these models. Most of the time, they attract economists' interest in a production context. How produce better? How produce cheaper?

In our study the target is the suppression of the capacity of production! This kind of policy remains relatively rare.

## **2 Data and models**

### **2.1 Data**

The first decommissioning schemes will be the subject of our study for two reasons. It inaugurated the beginning of the use of a new tool and it was the most important scheme launched in term of money.

The choice to assess the performance of public subsidies by using the DEA method needs to define inputs and outputs used in the different models.

So three kinds of subsidies are allocated to each fisherman who wants to withdraw his vessel from the French fleet. These subsidies have to take into account not only the cost of the vessel but also the psychological cost of the end of his activity for the fisherman too.

These subsidies have to be just incentive enough to incite fishermen to withdraw their vessels from fleet. Thus, the inputs are the three grand aids allocated by the French State, by the region of Brittany and by the department of Morbihan. Indeed the first decommissioning scheme was co-financed by French government and local communities (regions and departments).

It was necessary to collect data by getting in touch with each region and department, a task which up to now has been undertaken only for the region of Brittany and the department of Morbihan.

<sup>1</sup> In further research the use of output-oriented DEA models will enable us to exploit the DEA method in a decision perspective. The fixed funding will lead us to evaluate the fishing capacity which could have been eliminated in the scope of a decommissioning scheme. At the same time we will assess the performance of the policy according to the point of view of the fishermen.

Brittany was not chosen simply for practical reasons of proximity, but mainly for its prominent position in the French fishing industry.

We shall therefore limit our presentation to the department of Morbihan for which a complete set of data concerning public subsidies at the national, regional and department levels has been collected. (Giguelay, Boncoeur, 1999)

However the official aim of the schemes is not the withdrawal of vessels but the destruction of the excess of fishing capacity<sup>2</sup>. It is worth withdrawing a very powerful vessel than two little small fishing boats if the state really wants to get the requirements of the European Commission.

A recent report of the European Commission brings to the fore the fact that the decrease of the fishing capacity can represent a good indicator of the reduction of fishing effort even if fishing effort is defined as capacity multiplied by activity expressed in days spent at sea. Thus, we take account of technical attributes of vessels to assess a certain decrease of fishing effort.

For each vessel scrapped, we have collected its attributes. The capacity of a fishing vessel is measured according to its size (tonnage, length), the power of its engines and the age of the vessel which is an indirect indicator of the measure of the fishing effort too. Indeed, new vessels have greater fishing power than old ones thanks to advances in technology. The impact of technological progress on the fishing capacity of the fleet is real. Thus, four outputs will be taken into account to evaluate the eliminating of excess capacity.

The table below sum up the inputs and outputs collected for 69 vessels.

Table 3. Variable description

Input 1	Input 2	Input 3	Output 1	Output 2	Output 2	Output 4
Subsidies from French state (French Franc)	Subsidies from the Region of Brittany (French Franc)	Subsidies from the Region of Morbihan (French Franc)	Length of the vessel (meter)	Tonnage of the vessel (GRT)	Engine power of the vessel (kW)	Construction year of the vessel

## 2.2 Models

Consider there are N vessels scrapped in the scope of the first decommissioning scheme in the department of Morbihan and P subsidies allocated by the French public institutions (the French state, the region of Brittany, the department of Morbihan) to withdraw, from the fleet, C fishing capacity.

Note  $x_{jp} \geq 0$  the amount of subsidies p allocated to the owner of the vessel j to withdraw it from the fleet and  $y_{qj} \geq 0$  the fishing capacity c eliminated by the fisherman j in the scope of the decommissioning scheme.

The interest of the society is that public authorities launch the less expensive policies as possible.

A decommissioning scheme is deemed inefficient when a lower level of subsidies would have led to a higher or an equal fishing capacity reduction.

In political context, the question, which guides our interpretation of the results, is : could the same fishing capacity reduction be obtained with a lower amount of public financing? (the fishing capacity is reduced in this model to the power engine of the vessel). Notice that a positive answer to this question do not always mean that the policy is inefficient. We will come back on this certain contradiction below...

The first model is an input-oriented model with 3 inputs (the grand aid allocated by the French State, the region of Brittany and the department of Morbihan). In order to meet the first requirements of the European Community, which goal is to reduce the power of the European fleet, we just consider 1 output: the power engine of the vessel expressed in kW.

We can underline that reducing fishing capacity to the power of the vessel is not very rigorous. A vessel can be fewer powerful and can bring a high pressure on the fish resource if its tonnage is important, it depends on the kind of fishing activity practised.

<sup>2</sup> The elimination of the excess of capacity is an intermediary goal. The real aim is to preserve fish resource to insure the durability of the activity of fishermen.

Model I:

The fishing capacity eliminated is represented by only one attribute : the power-engine.

Let us consider a vessel  $k$  ( $k = 1, \dots, J$ ).

$v_{pk}$  and  $u_{pk}$  will be the weights determined for every variable by the solution of the model for the vessel  $k$ . For each vessel we search the weights which maximise the efficiency of the vessel according to the official view of the public actors.

The model can be defined as follows:

$$\text{Max } w_k = E_k$$

s/t

$$\begin{cases} E_j - \sum_{p=1}^P v_{pk} x_{pj} \leq 0 & j = 1, \dots, J & (\lambda_{kj}) \\ \sum_{p=1}^P v_{pk} x_{pk} = 1 & & (h_k) \\ E_k \geq 0 \\ v_{pk} \geq 0 & p = 1, \dots, P \end{cases} \quad (1)$$

The subject of this model is to reduce to a single dimension the three subsidies allocated by the public suppliers. We construct a single "virtual" subsidy.

In this non-parametric analysis, the mathematical programme consists in  $J$  optimisations (one for each vessel withdrawn in the scope of the scheme.)

$w_k$  is the radial measure of the technical efficiency which projects an "inefficient" vessel on the efficient frontier (according to the public suppliers..)

In this model the efficiency score of an efficient vessels will show a value of 1 (this value is inferior to 1 for the inefficient vessels). This efficient vessel is on the technical frontier, it is efficient according to the Farrell definition.

A variable returns to scale assumption is made since we cannot assume the existence of a proportionality between the allocated grants and the eliminated fishing capacity.

So we obtain the following model:

$$\text{Min } h_k$$

s/t

$$\begin{cases} \sum_{j=1}^J \lambda_{kj} E_j & \geq E_k \\ - \sum_{j=1}^J \lambda_{kj} x_{pj} + h_k x_{pk} \geq 0 & p = 1, \dots, P & (v_{pk}) \\ \sum_{j=1}^J \lambda_{kj} = 1 & & (\mu) \\ \lambda_{kj} \geq 0 & j = 1, \dots, J \\ h_k \text{ free} \end{cases} \quad (2)$$

We add at the dual form of the model 1 the constraint:

$$\sum_{j=1}^J \lambda_{kj} = 1$$

which represents the assumption of variable returns to scale.

- $\lambda_{kj}$  : the intensity variable of the vessel  $k$  associated with the withdrawn vessel  $j$ ,
- $h_k$  : efficiency score.

A vessel  $k$  will be efficient on two conditions : every variable will be equal to 0 excepted  $\lambda_{kk}$  and  $h_k$  which will be equal to 1 while a vessel  $k$  is inefficient if  $h_k$  is less than unity.

As regards the inefficient vessels, the  $\lambda_{kj}$  will be equal to 0 excepted when the vessel  $j$  is used to construct a "virtual vessel" with which the vessel  $k$  can be compared. We try to minimise the subsidies allocated to this "virtual vessel" which would be a linear combination of the real efficient vessels which enter the construction of this "virtual" vessel.

In order to obtain an efficient allocation, the non-efficient vessel would have to present all the attributes of the "virtual vessel".

Model II:

The fishing capacity eliminated is represented by only one attribute : the tonnage.

This programme can be solved by using the tonnage as the only one representation of the fishing capacity of the vessel. Indeed the French schemes allocate subsidies in function of the tonnage of the vessel even if they want to reduce the power of the fleet. Thus, the same model as presented above is computed by using the tonnage as the only output or representation of the fishing capacity of the vessel.

Then, it will be interesting to compare the results provided by of the models I and II.

Model III:

The fishing capacity eliminated is represented by every technical attribute of the vessels

The model presented below deems to be the most realist model in function of the official targets announced. Indeed every attribute (length, tonnage, power-engine and construction year of the vessel) is taken into account to evaluate the fishing capacity of a vessel. Even if the fishing capacity is not the fishing effort, the capacity of a vessel can be considered as a good indicator of the pressure on the fish stocks of a vessel. So in these models we construct a "virtual" output thanks all attributes of the vessels.

Min  $h_k$

s/t

$$\begin{cases} \sum_{j=1}^J \lambda_{kj} y_{cj} & \geq y_{ck} \quad c = 1, \dots, C & (u_{ck}) \\ - \sum_{j=1}^J \lambda_{kj} x_{pj} + h_k x_{pk} & \geq 0 \quad p = 1, \dots, P & (v_{pk}) \\ \sum_{j=1}^J \lambda_{kj} & = 1 & (\mu) \\ \lambda_{kj} & \geq 0 \quad j = 1, \dots, J \\ h_k & \text{free} \end{cases} \quad (3)$$

Even if they are very interesting, the results of these models present certain limits. Indeed the first one is that the projection on the frontier is not pareto-optimal. This projection is based on the Debreu-Farrell measure of the efficiency which presents problems when the section of the piecewise linear frontier run parallel to the axes. (Farrell, 1957)

The non-radial measurement allows us to find a pareto-optimal efficient projected point according to Koopmans. (Koopmans, 1951)

The introduction provided by the slacks variables leads to determine a pareto-efficient projection on the frontier.

In this paper we consider the following model which introduces slacks variables in the previous models:

Model IV:

Introduction of slack variables

The fishing capacity eliminated is represented by only one attribute : the power-engine.

$$\text{Min } h_k - \epsilon \left( \sum_{m=1}^M S_k^+ + \sum_{n=1}^N S_{pk}^- \right)$$

s/t

$$\begin{cases} \sum_{j=1}^J \lambda_{kj} E_j & - S_k^+ = E_k \\ - \sum_{j=1}^J \lambda_{kj} x_{pj} + h_k x_{pk} - S_{pk}^- = 0 & p = 1, \dots, P \\ \sum_{j=1}^J \lambda_{kj} = 1 & \\ \lambda_{kj} \geq 0 & j = 1, \dots, J \\ S_k^+ \geq 0 & \\ S_{pk}^- \geq 0 & p = 1, \dots, P \\ h_k & \text{free} \end{cases} \quad (4)$$

Every constraint is presented in equalities form.

Two slacks' vector are introduced:

- $S_k^+ \in R_k^+$  : slack variables linked to constraints on fishing capacity eliminated. (In this first model we consider only one technical attribute of the vessel withdrawn : the power-engine)

-  $S_k^- \in R_+^P$  : slack variables linked to constraints on subsidies allocated;

and  $\varepsilon$  which is a non Archimedean Quantity.

So a vessel is efficient according to Koopmans in this model if  $h_k = 1$  and if simultaneously all slack variables are equal to 0.

*Model IV:*

*Introduction of slack variables*

*The fishing capacity eliminated is represented by only one attribute : the tonnage.*

The same model as presented above is computed by using the tonnage as the only output or representation of the fishing capacity of the vessel.

*Model V:*

*Introduction of slack variables*

*The fishing capacity eliminated is represented by every technical attribute of the vessels*

$$\text{Min } h_k - \varepsilon \left( \sum_{c=1}^C S_{ck}^+ + \sum_{p=1}^P S_{pk}^- \right)$$

s/t

$$\left\{ \begin{array}{l} \sum_{j=1}^J \lambda_{kj} y_{cj} - S_{ck}^+ = y_{ck} \quad c = 1, \dots, C \\ - \sum_{j=1}^J \lambda_{kj} x_{pj} + h_k x_{pk} - S_{pk}^- = 0 \quad p = 1, \dots, P \\ \sum_{j=1}^J \lambda_{kj} = 1 \\ \lambda_{kj} \geq 0 \quad j = 1, \dots, J \\ S_{mk}^+ \geq 0 \quad c = 1, \dots, C \\ S_{mk}^- \geq 0 \quad p = 1, \dots, P \\ h_k \text{ free} \end{array} \right. \quad (5)$$

## Conclusion

Results provided by these models will allow us to analyse the efficiency of the decommissioning schemes according to the score obtained by the different vessels involved in the scheme. Let us consider some possible analysis

In a first time, a comparison of the results of the first models (model I, model II and model III) will be necessary to appreciate the logic of the tables based on the tonnage as regards the objective which is to decrease the power-engine of the fleet!

Then a second stage of the study will be to find some relation between in the hand the efficient vessels and in the other hand the non-efficient ones in order to determine the real targets of the launch of the decommissioning schemes.

Let's suppose that the policy is not efficient as regards a category of vessels, it will be interesting to analyse this inefficiency. Perhaps this inefficiency is not a real inefficiency but an incentive means to convince some reticent fishermen to end their activities...

Finally, the last three models which introduce the slack variables will be particularly interesting to underline the windfall effects which are omnipresent in the results of this kind of policy but which are very difficult to prove. In the scope of the first decommissioning schemes, we suppose that the owners of the old vessels benefited by a windfall effect as regards their age. They would have received too much money regard to their age. The combination of a low score and a positive slack variable on the construction year of the vessel would justify the windfall effect...

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