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**Decommissioning Schemes in the French Fishing Industry: An Evaluation of the Performance of a Public Policy.**

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**Introduction**

In an economy where public interventions are in constant decrease in almost all 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, consequently, an increase of the complexity of the public assistance system. At the moment, there exist three levels of public interventions. While the European Union (EU) provides some allocations, the French government allots grants too. Moreover, local communities (regions and departments) are important suppliers of subsidies even if they have a lower budget at their disposal.

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

In this paper we focus on budgetary assistance which is usually more simple to quantify. Budget subsidies can be distinguished between public expenses and fiscal subsidies. The latter are of considerable importance but are not considered in this study. We focused on specific public expenses aimed at structural actions. Two kinds of structural actions are financed by public funding. Financial support can be allocated either for the construction and modernisation of fishing vessels to ensure the competitiveness of the fleet or to eliminate excess capacity.

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This work focuses on public amounts provided to encourage fishermen to end their activity by scrapping their vessels or by exporting 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 evaluating the performance of the decommissioning scheme policy introduced in French legislation at the beginning of the nineties to reduce French fishing fleet capacity. Thus, this paper uses DEA models in an original context far from the traditional theory of production.

The first section specifies the reasons why decommissioning schemes were launched in France.

The second section presents data and models and the last section provides results and concludes.

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

### **1.1 Overcapitalisation and public interventions**

The introduction of a withdrawals' policy in the fisheries sector is related to the peculiarities of fish resource. Indeed, sea fish is a natural, renewable and mobile resource whose reproduction and movements cannot be controlled. Fish resource is a common resource, in that no one can own fish until it has been captured. Equally, every fish that is taken from the sea is one fewer available to the rest of fishermen. These two properties of fish resource are commonly called non-exclusivity and soustractibility (Berkes, 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 others.

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.

Overcapitalisation, which inevitably induces smaller stocks, leads to endanger the very existence of fishermen. This is the reason why the European Commission tries to obtain a better balance between vessels and fish resource availability. Overfishing due to overcapitalisation is a real threat for fish and fishermen. This justifies the necessity of public interventions to decrease fishing capacity.

## 1.2 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 for main goal the limitation of excess in 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 really appears when the European Commission threatens state-members to suppress their subsidies for new vessels' construction if they do not decrease the fishing effort of their fleet. 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”- intended to reduce the power capacity of the French fleet by 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 highest 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 however reaching the level of 1991 (see table 1).

The two 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 to 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 to 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 constant 1996 French Francs. Calculated from MAP 1997 (INSEE 1997/1 for the price index).

With an average of 56 million French Francs per year (see table 2), 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 about 13% of the total EU and government expenditures for the “exploitation of natural resources” area (without 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, 1999).

During the period under survey, it appears that EU and government subsidies, aiming at reducing the pressure on fish stocks, were outnumbered by subsidies liable to have the opposite effect (Giguelay, 1999). The priority of most policies remains targeted out the investment and the competitiveness of the fleet.

This phenomenon is taken into account when we interpret the results of DEA models.

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

The evaluation of a public action is not always simple since various parameters and constraints have to be taken into consideration. In the case of financial incentives policy 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 a grand aid allocation. Thus, it is possible to quantify the direct effects of this financial support. In the evaluation of a public action this is not always the case. As regards French decommissioning schemes the judicious moment for a policy evaluation is when every vessels are withdrawn consequently to the allocation of the grand aid.

Thus it allows us to provide a “real” evaluation of French decommissioning schemes.

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

In this paper we assess the consequences of the launch of decommissioning schemes according to the sole view of the public actors financing 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. The analysis is based on the use of different input-oriented DEA models (Charnes et al. 1978), (Banker et al. 1984).

This paper provides an original use of DEA models. Most of the time, they are used in a production context. How produce better? How produce cheaper?

However, in this study, the objective is the suppression of a capacity of production. This kind of policy remains relatively rare.

## **2 Data and models**

### **2.1 Objectives of the paper**

The aim of this study is to assess the performance of public subsidies according to the view of public authorities. The interest of the society (public actors and taxpayers) is that public authorities launch the least expensive policies as possible.

Thus we consider the funds allocated and their consequences in term of excess capacity eliminated.

Indeed, the official aim of the schemes is not the withdrawal of vessels but the destruction of the excess of fishing capacity. It is more 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. We can underline that the elimination of excess capacity is an intermediary goal. The official aim of this policy is the preservation of fish resource to insure the durability of the activity of fishermen.

Some contradictions seem to exist between the tables adopted by the European Commission and the announced targets. The tables are based on the tonnage of the vessels while the objectives are expressed in terms of kW. Consequently, the fishing capacity is reduced, in the models of this paper, to one technical attribute (the engine-power or the tonnage of vessels) to represent the reality of the objectives.

From a political point of view, the question which guides our interpretation of the results is : could a similar fishing capacity reduction (engine-power or tonnage of vessels) have been obtained from a lower amount of public financing?

The aim of this study is not to discuss the requirements of the UE but to analyse the performance of public subsidies allocated in function of the official targets announced. That is the reason why two DEA models are computed. In the first one the fishing capacity is represented by the engine-power of the vessel and by the tonnage of the fishing boat in the second one.

Then, DEA results allow us to underline the windfall effects which are always present in most incentive policies.

## 2.2 Data

The first decommissioning scheme, launched in France in 1991, is the subject of this study for two reasons. It inaugurated the beginning of the use of a new tool and it was the most important scheme launched in terms of funds allocated.

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>. Three kinds of subsidies are allocated because the first decommissioning scheme was co-financed by French government and local communities (region and department)

Brittany was chosen for its prominent position in the French fishing industry.

This study only considers the department of Morbihan for which a complete set of data concerning public subsidies at the national, regional and department levels has been collected.

Table 3. Summary of Data for efficiency analysis (69 vessels of Morbihan<sup>2</sup>)

	<b>Construction year</b>	<b>length (m)</b>	<b>tonnage (GRT)</b>	<b>horse-power (kW)</b>
Mean	69,65	10,26	29,30	114,65
Standard deviation	5,31	8,81	92,86	228,07
Min	57,00	4,00	0,75	3,00
Max	81,00	54,25	58,64	1472,00

	<b>Subsidies from Brittany*</b>	<b>Subsidies from Morbihan*</b>	<b>Subsidies from the French state*</b>
Mean	45263	22585	155304
Standard deviation	39021	30036	295687
Min	25000	3560	17800
Max	215250	175580	1755800

(\*subsidies expressed in French francs)

Table 4 presents the technical characteristics of the sample (department of Morbihan) and compares it with the technical attributes of vessels withdrawn in the scope of the first decommissioning program in all Brittany region. We can underline the absence of statistical

<sup>1</sup> Brittany is shared in four departments : Côtes d'armor, Finistère, Ille-et-Vilaine and Morbihan

<sup>2</sup> One vessel has been suppressed from the original sample because it presented extremal values in the amount of subsidies. These values can bias DEA results.



differences between the means of the whole population of Brittany and the means of the Morbihan sub-sample (except for the age of the vessel).

Table 4. The region of Brittany. Representativeness of the sample used in the study of the first decommissioning scheme : mean of the technical attributes

Technical attributes	Brittany ( $n_1 = 364$ )		Morbihan ( $n_2 = 70$ )		Margin between $m_1$ and $m_2$	
	Mean $m_1$	S- deviation $\sigma_1$	Mean $m_2$	S- deviation $\sigma_2$	$m_2 - m_1$	significant threshold (5%)
Length (meters)	10,2	8,0	10,2	8,8	0,0	no
tonnage (GRT)	27,9	14,1	28,9	92,9	1,0	no
Horse-power (kW)	106,8	226,0	113,6	228,2	6,8	no
Age in 1991 (years)	23,7	7,4	21,4	5,3	-2,3	yes

Source : CAAM.

The DEA approach was used to assess the performance of public subsidies.

The Decision Making Units (DMU) are the vessels of Morbihan withdrawn in the scope of the first decommissioning scheme. Each vessel corresponds to a fisherman who was ready to end his fishing activity.

The inputs are the three grand aids allocated by the French State, the region of Brittany and the department of Morbihan to each fisherman who wanted to withdraw his vessel from the French fleet. These subsidies take into account not only the cost of the vessel but also the psychological cost of the end of fisherman's activity.

These subsidies are supposed to have been just incentive enough to incite fishermen to withdraw their vessels from the fleet.

Moreover, even if all these subsidies are expressed in French Francs, we don't aggregate these allocations because the sources of these funds come from different administrative levels. A French Franc allocated by the region or the department is not similar to a French Franc allocated by the French government.

A recent report of the European Commission highlights the fact that the decrease of the fishing capacity can represent a good indicator of the reduction in fishing effort even if fishing effort is defined as capacity multiplied by activity expressed in days spent at sea. For each vessel scrapped, all its technical attributes have been collected to assess a certain decrease in fishing effort. However for the different reasons explained above the evaluation of excess capacity is represented by the engine-power or the tonnage of the vessel.<sup>3</sup>

<sup>3</sup> In further research all technical attributes of the vessel will be taken into account to evaluate its fishing capacity. Indeed, this type of modelling model seems more realistic as regards the official targets announced.

The table below sums up the inputs and outputs used in our different models.

Table 5. Variables description

Input 1	Input 2	Input 3	Output: Model I	Output: Model II
Subsidies from French state (French Franc)	Subsidies from the region of Brittany (French Franc)	Subsidies from the department of Morbihan (French Franc)	Engine-power of the vessel (kW)	Tonnage of the vessel (GRT)

### 2.3 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  $C$  fishing capacity from the fleet.

Let's note  $x_{pj} \geq 0$  the amount of subsidies  $p$  allocated to the owner of the vessel  $j$  to withdraw it from the fleet and  $y_{cj} \geq 0$  the fishing capacity  $c$  eliminated by the fisherman  $j$  in the scope of the decommissioning scheme.

In this modelling a withdrawal is deemed inefficient when a lower level of subsidies could have led to a higher or an equal fishing capacity reduction.

*Model I:*

*When the fishing capacity eliminated is measured by vessels engine-power.*

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). To meet the first requirements of the European Community, which goal is to reduce the fishing engine-power capacity of the European fleet, we just consider one output: the engine-power of the vessel expressed in kW.

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,

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Even if the fishing capacity is not the fishing effort, the capacity of a vessel, represented by all technical attributes of the boat, can be considered as a good indicator of the pressure on the fish stocks of a vessel.

it depends on the kind of fishing activity practised. As the same, the age of the vessel is an indirect indicator of the fishing effort. 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.

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

In this DEA analysis, the mathematical program consists in  $J$  optimisations (one for each vessel withdrawn in the scope of the scheme.)

For each vessel withdrawn, the model searches if it is possible to eliminate the same fishing capacity with an equiproportional reduction in all subsidies. If this reduction is not possible, the withdrawal is deemed efficient. The observed vessel was scrapped with the lower amount of the three grants as possible. If this reduction is possible, withdrawal is deemed inefficient. The same engine-power capacity or tonnage could have been eliminated with a lower amount of public financing.

The DEA model used is defined as follows:

*Min*  $h_k$

s/t

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

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.

The constraint  $\sum_{j=1}^J \lambda_{kj} = 1$  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  $k$  is efficient if every variable is equal to 0 except  $\lambda_{kk}$  and if  $h_k$  equals 1 while a vessel  $k$  is inefficient if  $h_k$  is less than unity.

As regards the inefficient vessels, the  $\lambda_{kj}$  are 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 is a linear combination of the real efficient vessels.

In order to obtain an efficient allocation, the non-efficient vessel should have had all attributes of the “virtual vessel”.

*Model II:*

*When the fishing capacity eliminated is measured by vessels tonnage.*

This programs 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<sup>4</sup>.

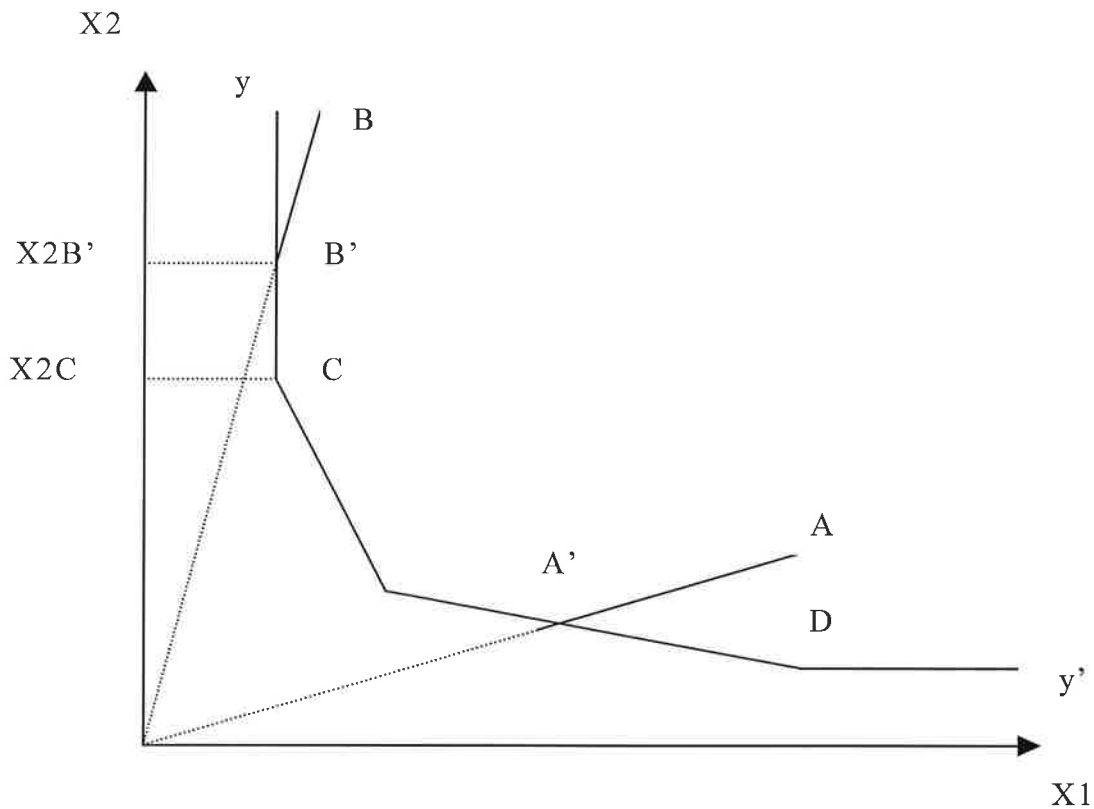
Then, it will be useful to compare the results provided by of model I and II.

Each withdrawn vessel deemed efficient is used to build up a frontier of optimal subsidy allocation. All vessels deemed inefficient are projected on this frontier to evaluate how far they are from their optimal grants. However, this projection onto the frontier is not always pareto-optimal (Koopmans, 1951). This is the case when the efficiency measurement is derived from a point which is on a section of the piecewise linear frontier which runs parallel to the axes as shown in figure 1.

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<sup>4</sup> The possible correlation between the engine-power and the tonnage, as it can be seen in the next section, does not influence DEA results.

Figure 1. Measurement of efficiency according Koopmans



In figure 1, X1 and X2 represents two subsidies allocated to reduce the fishing capacity of the fleet and  $yy'$  is the frontier of lower subsidy allocation as regards a same fishing capacity eliminated. The vessel A' is technically efficient and pareto-optimal since it is not possible to obtain a better subsidy allocation. The vessel B' is efficient based on Farrell's definition (1957) (equiproportional reduction of each grant allocated). However, it is still possible to reduce the amount of subsidy X2 since vessel C contributes to the same fishing capacity elimination as B' with the same amount of subsidy X1 but with a lower amount of subsidy X2. Thus, B' is not pareto-optimal as defined by Koopmans (1951).

The introduction of slacks variables allows us to capture this difference between the two definition presented above<sup>5</sup>. These variables are introduced in DEA models to change each constraint of (2) in equalities. Now, a withdrawn vessel is deemed efficient if and only if  $h_k = 1$  and simultaneously all slack variables are equal to zero.

<sup>5</sup> Other methods, like the non-radial measurement, for example, allow to find a pareto-optimal efficient projected point according to Koopmans (Koopmans, 1951)

### **3 Results**

#### **3.1 Efficiency measurement**

Table 6 presents the population mean and standard deviation of estimated technical efficiency scores for model I (engine-power) and II (tonnage). On average, the estimated technical efficiency score of model I is 0.86 with a standard deviation of 0.182. It indicates that, on average, a 14% reduction in grant allocations could have been realised to withdraw the same fishing power capacity. In model II, the potential reduction is of 15.3% since the estimated efficiency score is 0.847 with a standard deviation of 0.224.

Table 6. Radial technical efficiency estimates of model I and model II

	<b>model I*</b>	<b>model II**</b>
Mean	0,860	0,847
Standard deviation	0,182	0,224
Min	0,242	0,242
Max	1,000	1,000

\*model I: the only one output is the engine-power

\*\*model II: the only one output is the tonnage.

Based on these first results, it seems that the use of tonnage as a representation of the fishing capacity of the French fleet is not in contradiction with the objective of reducing vessel power capacity. We can even notice that the funds allocated to the tonnage of the vessels are more efficient when we consider that they have contributed to the elimination of kW.(the efficiency score of model I is higher than the one of model II)

#### **3.2 The issue of correlation between the tonnage and the engine of the vessels**

The correlation between the tonnage and the engine-power of a vessel seems to be obvious. However this correlation exists only for the biggest units when we considered the smallest boats of our population it appears that this correlation is not so evident. In fact the link between the tonnage and the engine-power of a vessel depends on the fishing activity practised. Thus it seems to be interesting to compare results obtained by the computing of model I and model II on two different populations.

The first population is the whole sample which presents a correlation between the tonnage and the power-engine. (Results have been presented above).

The second population is a sub-sample of the whole sample characterised by the smallest vessels (56 vessels of less than 9m) for which no significant correlation exists.

In the two cases, results are going in the same way: whatever the model used, each population presents similar performances.

Thus financing the withdrawal of GRT is not in contradiction with the main goal which is to suppress kW from the fleet whatever the vessels considered.

Thus the logic of the policy is not challenged by the adoption of tables based on the tonnage as regards the empirical results obtained.

Table 7. Distribution of estimated technical efficiency scores in model I

<b>kW VRS</b>	<b>vessels</b>	<b>%</b>
Of 1*	35	50.72
SCORE between 0.95 and 1	2	2.90
SCORE between 0.85 and 0.95	6	8.70
SCORE : below 0.85	26	37.68
<b>Total</b>	<b>69</b>	<b>100.00</b>

\* These vessels are efficient according to Farrell that is to say that all these productive units are not pareto-efficient.

Table 8. Distribution of estimated technical efficiency scores in model II

<b>GRT VRS</b>	<b>vessels</b>	<b>%</b>
Of 1*	36	52.17
SCORE between 0.95 and 1	4	5.80
SCORE between 0.85 and 0.95	6	8.70
SCORE below 0.85	23	33.33
<b>Total</b>	<b>69</b>	<b>100.00</b>

\* same remark as above.

Tables 7 and 8 present the distribution of estimated efficiency scores in model I and II. More than half of the vessels withdrawn in the scope of the first reduction program in the department of Morbihan present an efficiency score equal to 1. (this result is almost the same for the two models computed.)

The 35 vessels identified as efficient in model I (score=1) are efficient in model II.

### 3.3 Underscoring the windfall effect of decommissioning schemes by DEA.

The underscoring of the windfall effect needs to introduce slacks variables presented in Figure 1. Indeed, these slack variables lead to evaluate the optimal performance of the different suppliers.

The different estimations below take into account these slacks variables.

Table 9. the windfall effect generated by the first decommissioning scheme in the Morbihan.

	20 years old and more	less than 20 years old
# of vessels	41	28
Construction year	66.17	74.75
Length (m)	10.56	9.81
Tonnage (GRT)	21.27	41.04
Engine-power(kW)	97.63	139.57
Subsidies from French state**	136355 (67.5)*	183052 (72.0)
Subsidies from Brittany	44768 (22.2)	45988 (18.1)
Subsidies from Morbihan	20920 (10.4)	25023 (9.8)
<b>Average efficiency</b>		
Model I***	0.840 (0.173)	0.888 (0.189)
Model II****	0.838 (0.208)	0.862 (0.244)

\*Standard deviation.

\*\* Subsidies expressed in current French francs of 1991

\*\*\*Model I: the output is the engine-power.

\*\*\*\*Model II: the output is the tonnage.

In table 9, recent and old vessels are small vessels (on average less than 12 m). Recent vessels have on average a higher tonnage and engine-power than the older. All the more a new kW is always more powerful than an old one. This shows that a vessel, with the importance of the technical progress, always becomes more destructive for fish resource. Consequently, to a real protection of fish resource, it is worth withdrawing a recent vessel than an old one which would present the same technical attributes.

On average, subsidies allocated to recent vessels are higher than funds allocated to old vessels however it seems to be justify by the technical attributes of recent vessels.

Almost 60% of the vessels withdrawn from the fleet are 20 years old and more. Both old and recent vessels appear to be over-subsidised in the two models. Old units seem to have obtained even more allocations than recent vessels as regards the power fishing capacity withdrawn. Indeed efficiency scores for old vessels are lower than for recent ones. (0.840 and 0.888 respectively for model I ; 0.862 and 0.838 for model II).



According to empirical results obtained, in model I and in model II, public authorities have encouraged the withdrawal of the oldest vessels. Consequently the owners of these old vessels have benefited of a windfall effect when the first decommissioning scheme was launched in the Morbihan.

Moreover, subsidies allocated to the decommissioning scheme are deemed less efficient in model II than in model I .

In this way, this public action appears to be inefficient as for the losses observed in the withdrawal of old vessels. However an other explanation may be put forward. It is highly likely that the hidden target of public authorities had been the elimination of “the old scraps” from the French fleet. Indeed, this would allow to maintain the fleet competitiveness while meeting the requirement of the European Commission. Consequently, results have to be interpreted with cautious. Figures do not always reflect the announced target but they allow to lift the veil from other goals less respectable as regards the protection of fish resource!

### **3.4 Sources of inefficiency**

The tables below enable us to identify the main sources of inefficiency among the different grant suppliers.

To obtain the optimal level of subsidies which would have been allocated to the vessels, we still need to take into account slack variables. They allow us to calculate the minimal fund necessary to withdraw a vessel from the fleet. Technical efficiency score is not enough. Indeed a vessel can present an efficiency score of 1 but, in function of its position on the efficient frontier (see Figure 1), it is sometimes possible to reduce more of the subsidies allocated to it.

Thus the allocations presented in table 10 are pareto-optimal allocations.

Table 10. Optimal DEA subsidy level.

<b>Mean/vessel</b>	<b>optimal allocation from B**</b>	<b>optimal allocation from M**</b>	<b>optimal allocation from F**</b>
20 years old and more			
Model I	29223	12832	95232
Model II	31133	13970	105662
less than 20 years old			
Model I	34813	17967	148341
Model II	35139	17477	146418

\* Subsidies expressed in current French francs of 1991.

\*\*B: Brittany; M: Morbihan; F: French state.

Even if the estimated efficiency scores of model I are higher than the estimated efficiency scores of model II (table 9), optimal allocation (that is to say the lowest subsidy allocated as regards the fishing capacity eliminated) are most often lower in model I (table 10). In other words potential savings that could have been made are more important in model I than in model II (except for savings of the department of Morbihan and the French State as regards the recent units).

The last results can seem contradictory. However this phenomenon can be explained by the presence of positive slack variables on inputs. As slack variables values are higher in model I than in model II, inefficiency and, consequently, potential savings are higher too. (table 11)

Table 11. Potential subsidies reduction.

<b>Efficiency gain</b>	<b>gain from Brittany</b>	<b>gain from Morbihan</b>	<b>Gain from the French state</b>
20 years old and more			
Model I	637335	331581	1686037
Model II	559037	284940	1258403
less than 20 years old			
Model I	312912	197578	971909
Model II	303772	211298	1025737

\* Subsidies expressed in current French francs of 1991.

However the results are going in the same way as for the fact that the old vessels have been much more over-subsidised than the recent ones. (table 12)

Table 12. Efficiency gain in %

<b>efficiency gain in %</b>	<b>Saving for Brittany</b>	<b>Saving for Morbihan</b>	<b>Saving for the French state</b>
20 years old and more			
Model I	34,72	38,66	30,16
Model II	30,46	33,22	22,51
less than 20 years old			
Model I	24,30	28,20	18,96
Model II	23,59	30,16	20,01

The gap between old and recent vessels concerning the savings of subsidies allocated is stronger in model I especially as regards funds allocated by the French government. Indeed, the French State would have save almost 30% of the subsidies allocated to old vessels and only almost 19% of those allocated to recent vessels.

The gap between the potential savings in model II is smaller; except for the allocation of Brittany.

### **Conclusion**

Since the launch of the first decommissioning scheme, in France in 1991, no estimation of funds involved in these programs was done.

The use of DEA methodology is perfectly reliable for evaluating the co-ordinated performance of the subsidies allocated by the three sources (the French State, the region of Brittany and the department of Morbihan).

This paper allow us to come back on the validity of the tables used to evaluate the funds allocated in function of the tonnage of the vessel scrapped.

According to this first study, these tables would be quite efficient and more particularly as regards the kW withdrawn. A comparison made between the EU objective in terms of engine-power reduction and the French implementation in terms of tonnage points out that there is no contradiction between the financing of tonnage withdrawal to obtain a engine-power withdrawal.

Moreover DEA results bring to the fore a windfall effect, effect which is difficult to underscore even if it can seem obvious. Indeed, the owners of old vessels seem to have benefited of larger amounts of subsidies than necessary to leave the French fleet.

However, even if the results underline the fact that the withdrawal of old vessels was over-subsidised, this study highlight that this obvious political inefficiency can be the consequence of an other political line of the French fishing policy since ensuring the competitiveness of the French fleet remains the priority of the French government.

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