Analyzing fishermen behaviour face to increasing energy costs – A French case study

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ICES Annual Science Conference
17-21 September, Helsinki

Abstract

Increasing fuel price is becoming a major consideration in fisheries due to its contribution in total cost to produce fish. Fishermen have to reallocate production inputs according to their price, and /or accept substantial modifications in revenues. However, the impact of increasing fuel cost has to be analyzed in relation to the type of fishing gear used. The results are indeed different for trawlers (active gear) compared to netters/liners/potters (passive gear). This paper addresses to technical change between trawling and others fishing techniques, considering on the one hand, the evolution of capital valuation from 1990 to 2005, and on the second hand cost and earnings changes since 1998 to 2005. In particular, fuel expenses are examined under a special French regime implemented in 2004 and called "Fund for the prevention of risks to fishing". If this fund has been created by producer organisations to compensate the fluctuations of energy prices, the regime is considered as a subsidies scheme fuelled by the State according to the European Union. This financial support is a major element in the examination of fishermen behaviour in France. It is shown paradoxically that fishing vessels can maintained their fuel consumption in a context of a high rising fuel cost, thanks to such a State aid.

First, materials are presented, describing the state of the Bay of Biscay fisheries from 1990 to 2005. This study concerns indeed exclusively French fishing vessels operating in the Bay of Biscay. Methods used consist to study fishermen behaviour face to the fuel component. In this respect, a very simple model based on adaptative expectations is suggested and seems to suit well to represent fishermen behaviour according the fleet segment in a context of increasing energy costs. Results are presented for the estimated model. Lastly, discussion is oriented around two main economic components, earnings and costs. Fleet contribution to total earnings is appreciated according to fishing methods used. The impact of fuel cost is then characterized for constant samples (1998-2005) under the State aid scheme.

Key-words :

JEL Classification : C15 Simulation Methods, C81 Microeconomic Data, D21 Firm Behaviour,

D24 Production, Q22 Fishery

1 Introduction

The focus of this paper is oriented toward the substitution effect between the main four fishing methods, trawling, dredging, seining, passive techniques (as netters, potters and liners), under the impact of fuel cost. Increasing fuel price is becoming a major consideration in fisheries due to its contribution in total cost to produce fish. Fishermen have to reallocate production inputs according to their price, and /or accept substantial modifications in revenues. However, the impact of increasing fuel cost has to be analyzed in relation to the type of fishing gear used. The results are indeed different for trawlers and dredgers (active gear) compared to netters/liners/potters (passive gears) or seiners. Consequently, the economic viability of vessels can be questioned in relation to the fishing method used. Hence, the question is: does the energy cost influence the fishermen decision-making in the adoption of a production technique?

This paper addresses to the French fleets operating in the Bay of Biscay (the French Atlantic Coast) and is drawn on two sources of information covering at least part of the 1990-2005 period. Firstly, the French vessel register provides information regarding vessel numbers and characteristics each year, from 1990 to 2005. The national register is completed with information collected by Ifremer concerning the activity of fishing vessels, in terms of metiers (Berthou *et al.,* 2003). This information is used as a basis for the classification of vessels into fleets according to families of main gears used (passive, seiners, dredgers and trawlers). Secondly, bookkeeping data have been collected by the Regional Economic Observatory of Fisheries in Brittany, a NGO created by a professional fishers organisation in 1989. This data covers the 1998-2005 period for a constant sample of fishing vessels, classified in two sub-groups, active and passive vessels, and according to length segments.

First, materials are described, through figures and statistics on the state of the fishery from 1990 to 2005. Technical parameters are given for a constant sample of vessels, on the period 1998-2005. Methods consist to study fishermen behaviour face to the fuel component on the second way. In this respect, a very simple model based on adaptative expectations is suggested and seems to suit well to represent fishermen behaviour according to the fleet segment in a context of increasing energy costs. Results are then presented. Technical change can be observed and occurred in the mid-nineties to the detriment of trawlers. This trend is explained in details from constant samples with the adaptative model. Finally, discussion is engaged around two main economic components, earnings and costs. Fleet contribution to total earnings is appreciated in relation to families of main gears used (passive, seiners, dredgers and trawlers). The impact of fuel cost is then characterized for constant samples (1998-2005) under the State aid scheme.

2 Material and methods

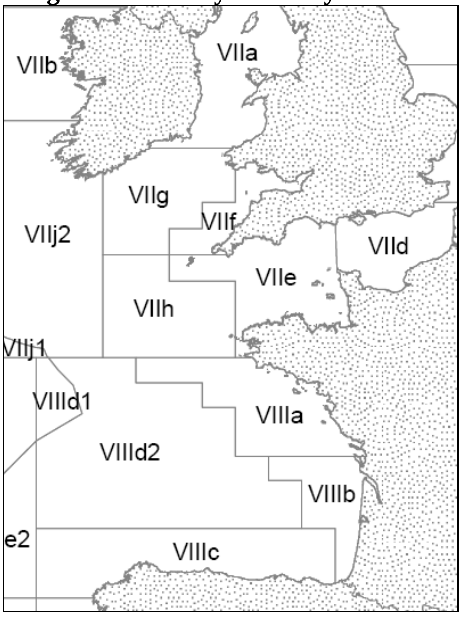
21 Materials

The fishery

Data used in the description of landings trends come from two sources. Information on catches and landings has been collected from ICES databases and the French Marine Fisheries and Aquaculture Directorate.

Data in term of volume (in tons) are issued from ICES statistical records, selecting production for areas VIII (a, b, c, d, e) defining the Bay of Biscay fisheries, except for the year 1999, for which no information has been sent by the French Authorities to ICES. In this case, we used production data published by the National Office for Sea and Aquaculture Products (Office National Interprofessionnel des Produits de la mer et de l'Aquaculture), for the French Atlantic coast, exclusively for a panel of selected species. As ICES database is focused on catch statistics, no economic information (price or value) can be used to analyse trends in production by fishing area.

Figure 1. The Bay of Biscay fisheries

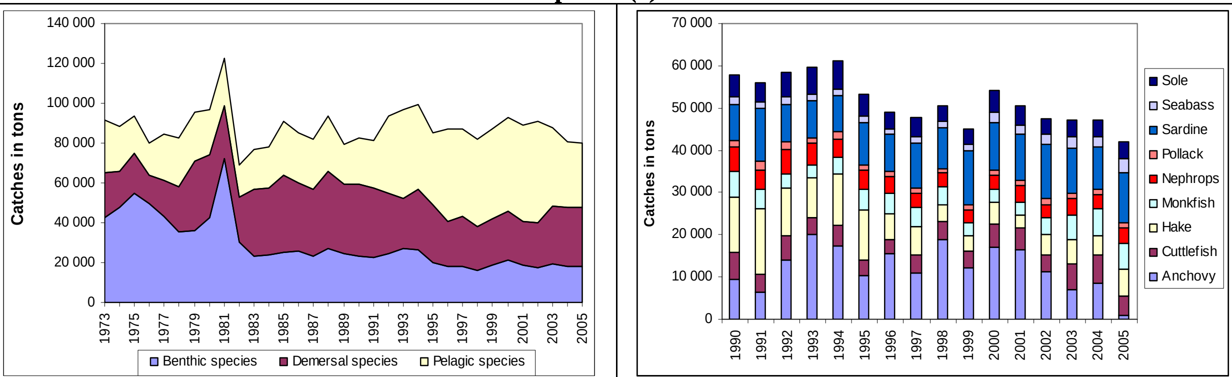


Source: International Council for the Exploration of the Sea (ICES)

Figure 2 *(a)* shows thrends of catches for the French production in the Bay of Biscay fisheries. Excepted the peak occurring in 1981 with landings by 120 thousands tons, production has been stabilised around 80-90 thousands tons. Pelagic species are dominant since the mid-nineties al benthic production was the highest in seventies.

If we consider a panel of 9 targeted species, considered as the more important outputs exploited in the Bay of Biscay by the French fleets, we see that the combined production of selected species represents 52% of total catches at least, from 1990 to 2005 for the French production. Two of them are pelagic, anchovy *(Engraulis encrasicolus)* and sardine *(Sardina pilchardus).* Four others are demersal, Cuttlefish *(Sepia officinalis)*, Seabass *(Dicentrarchus labrax)*, Pollack *(Pollachius pollachius)*, and hake *(Merluccius merluccius)*. The last three are benthic, monkfish *(Lophius piscatorius)*, nephrops *(Nephrops norvegicus)* and sole *(Solea solea)*.

Figure 2. French landings from the Bay of Biscay fisheries in tons, total catches *(a)* and selected target species *(b)*



(a) ***(b)***

Source: ICES International Council for the Exploration of the Sea (ICES) and Office National Interprofessionnel des Produits de la mer et de l'Aquaculture

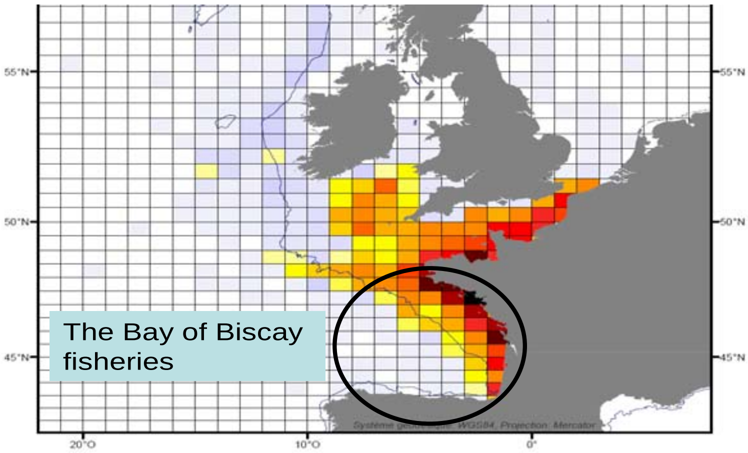
The two pelagic species (anchovy and sardine) represents 39% to 78% of total pelagic production. The share of demersal (cuttlefish, seabass, Pollack, hake) is comprised between 48% to 68% to this category. Catches of monkfish, nephrops and sole are spread from 52% to 75% of total benthic production.

Trends of total catches is declining on the study period (figure 2 *(b)*), from 58 thousands tons in 1990 to 42 thousands tons in 2005, with a peak of 62 thousands tons in 1994. The highest contributions are due to anchovy, hake and sardine. If the outputs level for the third specie remains constant over the time, the two others have decreased dramatically during last years.

Fleet data

The Bay of Biscay area is the most important fishing area of the French fishing vessels compared to the Channel, Celtic Sea or North Sea areas. The highest levels of fishing activity concentration are along the coast line. The coastal zone, limited to 12 nautical miles from the shoreline, is mainly exploited by smallest vessels with a length under 12 meters. It is showed that coastal fleets account for more half of the total gross value added generated by artisanal vessels (of less than <24 meters in length) in Brittany (Le Floc'h *et al.*, 2006). Others components of the French fleets (offshore vessels with a length generally comprised between 16 and 24 meters) move from coastal zone (passive units) to southern of the Irish coast (trawlers). In the case of the Bay of Biscay fisheries, offshore fishing units are under 20 meters.

Figure 3. The fishing activity of the French vessels per fishing areas (2005)



Source: Ifremer

Census Data on Fleet and vessel activity: Coming from the French ministry, the French annual fleet register is available for this study since 1990. This register contains for each vessel of the French fleet its technical characteristics (size in length, kW or GRT, age) and the geographical location of the owner. Additional information regarding the monthly fishing activity for each vessel present in the Fleet register exists at Ifremer through exhaustive surveys developed annually since 2000. This information is complementary to logbooks which are available only for vessel over 10 meters and allows to affect each vessel of the national register to a specific fleet taking into account "métier" made during a year.

Sampling data on cost and earnings: Bookkeeping databases provide landings value, operating and financial costs. Bookkeeping data are collected by the Regional Economic Observatory of Fisheries in Brittany. In the case of the French fishing statistics to measure economic and financial performance of the fleets, two sources can be used, bookkeeping and field surveys. A comparison of economic and financial indicators estimated from these two methods of collection was made, based on a same set of boats located in Brittany (Boncoeur *et al.*, 2004). The main conclusions showed a good similarity between earnings and various cost categories. In this paper, constant samples have been made up considering that each fishing unit is involved 7 years out of 8 at least, from 1998 to 2005. Finally, 6 samples are defined according to the fishing method used (active or passive) and length segments (<12 meters, 12-16 meters, 16-20 meters, >20 meters). As explained previously, most of boats over 20 meters exploit resources in offshore fishing areas, mainly situated outside the Bay of Biscay. However, offshore vessels using active gears, mainly bottom trawling technique (Active >20 meters) are very sensitive to fuel cost and are considered in this research as the reference units. For the year 2005, costs and earnings data are available for a constant sample of 180 units, exclusively located in South Brittany. Mean values and standard deviation (in brackets) are given for technical characteristics in the table 1.

Table 1. Technical characteristics : constant samples 1998-2005

Constant samples	Number of vessels in 2005	Mean values Age in 2005 (years)	Length (meters)	Tonnage (TJB)	Engine power (Kw)	Crew size (men)
Active <12 meters	27	26,5	10,3	11,3	119,9	2,1
		(7,6)	*(1,2)*	*(5,9)*	*(36,5)*	*(0,6)*
Active 12-16 meters	39	23,0	14,8	32,3	225,5	3,4
		(7,4)	*(1,2)*	*(9,4)*	*(52,0)*	*(1,0)*
Active 16-20 meters	21	21,9	17,2	40,7	300,6	4,8
		(3,9)	*(1,3)*	*(10,6)*	*(43,3)*	*(0,9)*
Active >20 meters	34	17,9	22,2	87,6	431,7	6,1
		(3,1)	*(1,4)*	*(21,1)*	*(74,8)*	*(0,6)*
Passive <12 meters	49	20,6	9,4	8,2	123,0	2,2
		(6,9)	*(1,4)*	*(4,4)*	*(42,1)*	*(1,2)*
Passive >12 meters	10	18,5	13,2	23,7	177,6	4,2
		(2,6)	*(1,5)*	*(12,1)*	*(32,8)*	*(0,8)*
All vessels	180	21,5	14,2	33,5	226,8	3,6
		(6,6)	*(4,9)*	*(30,8)*	*(126,3)*	*(1,8)*

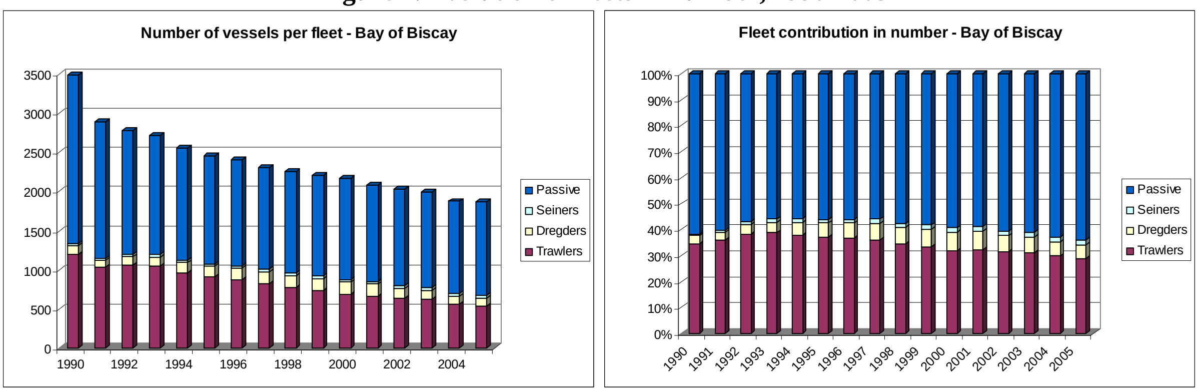
Source: Observatoire économique régional des pêches

22 Methods

Analysis of the observed trends allows a preliminary assessment of the impacts on fleet activity and fleet performance of different categories of management policies (mainly conservation measures). One example of management classic conservation measures which have had strong impacts on fleets is capacity reduction programmes. The analysis of changes in the structure of the Bay of Biscay fleets provides some insights as regards the impacts that capacity reduction programmes adopted over the study period (1990-2005) have had on these fleets. One of the main access regulation measures that was set up in the French context at the end of the 1980s was the adoption of the “Permis de Mise en Exploitation” (or Operation Permit) system, leading to a *de facto* limited entry scheme. Following the enforcement of limited entry, several decommissioning schemes were carried out in France during the 1990s, as part of the Multi-Annual Guidance Programs for capacity reduction.

The figures below present the impact of these decommissioning schemes on the fleets considered as active in the Bay of Biscay. Depending on the fleet and year, buyback policies have contributed to reduce vessels number by 46% from 1990 to 2005. The highest percentage over the period concerns the trawlers fleet (-55%), followed by the passive units (-44%).

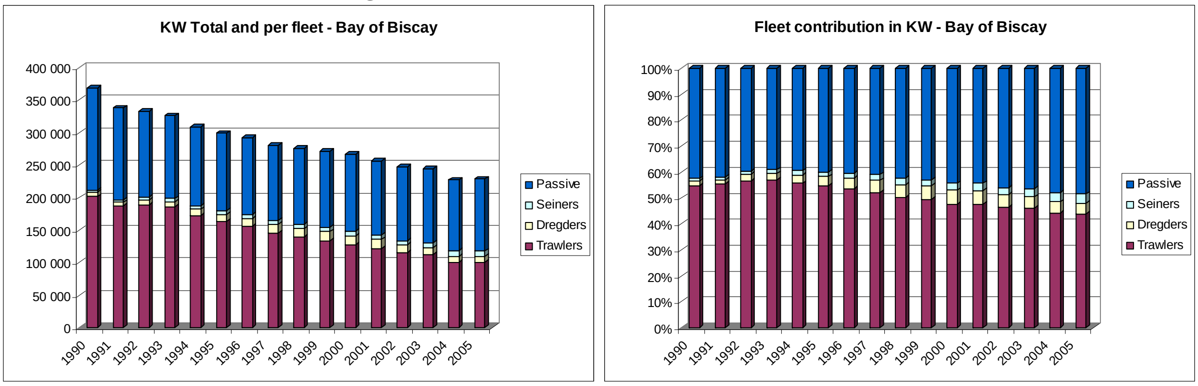
Figure 4. Evolution of fleets in number, 1990-2005



Source: Ifremer

Measured from engine power (kW), the reduction in capacity appears less dramatic, by 38% for the entire fleet (figure 5). Overall, decommissioning schemes explain a large proportion of the reduction in the size of the fleets, although other motives have also led vessels to exit from the fleets. Hence, fleet buyback policies have contributed significantly to the reduction in size of these fleets. During the nineties, the contribution of trawlers in term of kW remained comprised between 50 and 56% of the total capacity. The fact that this segment seemed relatively unaffected by these policies can also be interpreted as a direct consequence of public policies. First, it appears that buyback schemes were designed to provide incentives to decommission mainly small vessels (Guyader *et al.*, 2004). However, their contribution decreased under 50% from 1999 and followed continuously this trend until 2005. Consequently, it can be argued that the rising cost of fuel has progressively affected this fleet, more dependent with the energy resource.

Figure 5. Evolution of fleets in KW, 1990-2005



Source: Ifremer

Stepwise regression methods

Fishermen behaviour face to increasing fuel cost basically depends on the implemented fishing method. In more, the potential production capacity, measured through the net capital stock, is constrained to the energy requirements. Analyzing producer behaviour in the fishery sector induces to define homogeneous fleet segments, as made with constant samples. Length and fishing methods are assumed as relevant standards to study the path dependency of each fleet segment *vis à vis* fuel consumption. Biggest trawlers (active >20 meters) are considered as the reference segment. Only a few of them are operating in the Bay of Biscay fisheries. Aims of the econometric model are then to measure gaps between others fleet segments (active <20 meters and passive units) and trawlers over 20 meters, assuming there are the more dependent with the energy input. Stepwise regression methods have been used to select the best econometric model. The choice is based on two criterion, Akaike information criterion (AIC) and Bayesian information criterion (BIC). We suggest to explain fuel consumption in quantity, expressed in log (log ($fuel_t$)), according to gross revenue computed one and two years before (log(GR_{t-1}) and log(GR_{t-2})), technical characteristics (deviation from TJB and from kW), building year and dummy variables (table 2).

Table 2. Dummy variables of fleet segments

Dummy	Art	Classe de longueur 4
D_{11}	Active	<12 meters
D_{12}	Active	12-16 meters
D_{13}	Active	16-20 meters
D_{14}	Active	>20 meters
D_{21}	Passive	<12 meters
D_{22}	Passive	>12 meters

Stepwise methods have tested the full model for 6 years (from 2000 to 2005 as it is required to use gross revenue with a two years lag, data availability starting in 1998). Finally, the best model includes as explaining variables gross revenue one year before (GR_{t-1}), deviation from kW and all dummy variables (D_{14} being the reference fleet segment).

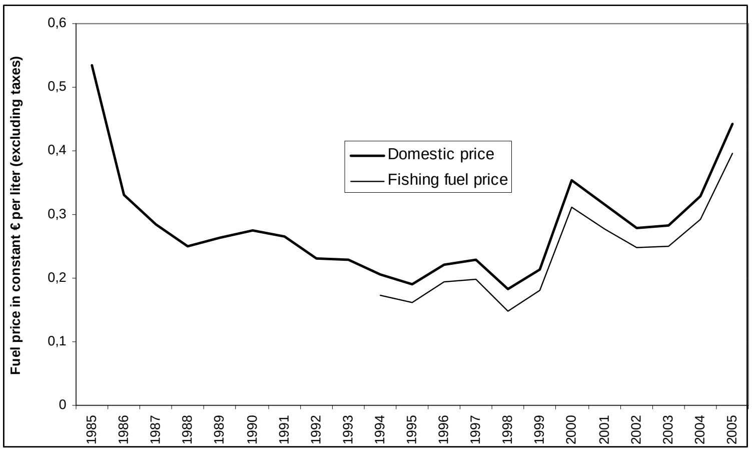
$$\log(Fuel_t) = \alpha + \beta \log(GR_{t-1}) + \gamma d_{kW} + \lambda_1 D_{11} + \lambda_2 D_{12} + \lambda_3 D_{13} + \lambda_4 D_{21} + \lambda_5 D_{22} + \varepsilon$$

3 Results

Fuel prices have been collected since 1985 for the domestic price in France and since 1994 in the fisheries sector. Monthly average price of fuel for fishing activity is provided by the Fishermen Association in Southern Brittany (Coopérative Maritime du Pays Bigouden) and domestic price is given by The French Ministry of Industry.

Figure 6 shows the evolution of these prices excluding taxes and depicts during the observed period (1990-2005), two peaks occurring in 2000 (0,35 €/litre for the domestic price and 0,31 €/litre for the fishing fuel price) and in 2005 (respectively 0,44 €/litre and 0,40 €/litre). As it is said previously, technical change interpreted via the net value of the capital stock has been seen for the first time in 1996 in a context of low prices for the energy resource.

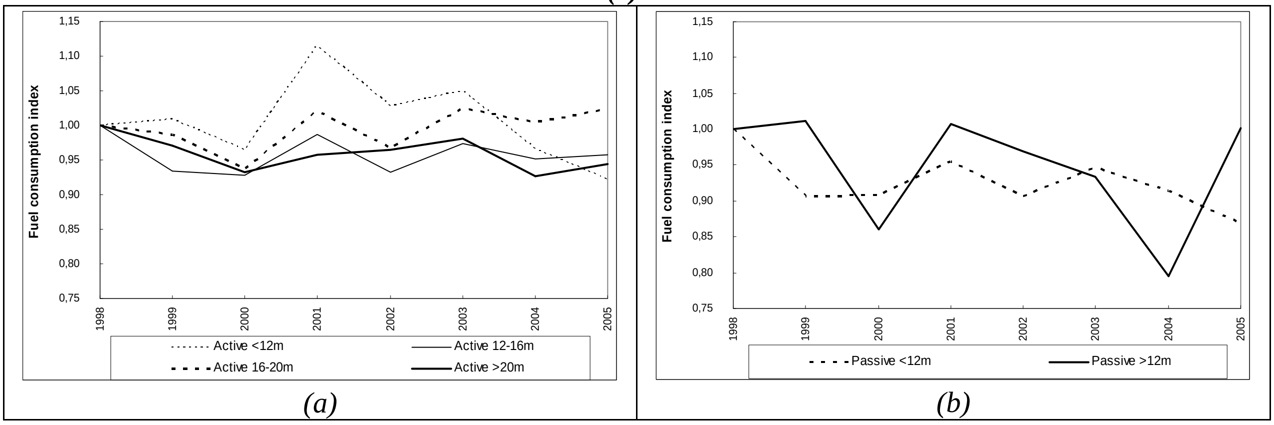
Figure 6. Fuel price per litre on the French market (constant € 2005)



Source: The French Ministry of Industry (domestic price) and Coopérative Maritime du Pays Bigouden (fishing fuel price)

It is obvious that the fuel cost had no impact during the nineties. In reverse, its rising trend could have enhanced the substitution effect in 2000 and more particularly in 2005 due to the strongest dependence of active units with fuel compared to passive boats. Answering to this assumption requires a study leaded from economic results based on costs and earnings. We consider basically active and passive fleets, segmented in length classes. Trawlers and dredgers are grouped in samples of active units, seiners are assimilated to passive units (see table 1). Whatever the fuel price, fuel consumption has been maintained to similar levels between 1998 and 2005. The lowest index is by 0,9 for active units (figure 7 *(a)*) and the minimum threshold for the biggest boats using passive gears is by 0,8 in 2004 (figure 7 *(b)*). It cannot prove a decrease in the use of energy input when fuel price is strongly increasing, as it happened in 2000 and 2005.

Figure 7. Fuel consumption index (constant € 2005) for active fleet segments *(a)* and passive fleet segments *(b)*



Source: Observatoire économique régional des pêches

Particularly, fishermen's behaviour can be analysed according to fluctuations in costs of variable inputs. Amongst them, fuel cost appears as the main preoccupation of crew members. Traditionally, fuel expenses are paid commonly by skip-owner and crew members. Hence, every time this input price is soaring, labour remuneration is dropping. In these conditions, it appears pertinent to focus our attention on a potential effect of inputs prices on capacity levels. This approach can be related to input usage modifications. Permanently, fishermen have to respond to input variations, in terms of prices or abundance, and can change their fishing strategy as an adjustment to market forces or biomass variability.

Usually, fuel cost appears as the more important variable cost for fishing units, specifically for vessels using active gear (trawling and dredging). For this reason, fishermen's behaviour can be influenced in a context of strong variations of fuel price. During the study period, from 1998 to 2005, fuel price increased by 10% a year ($\ln(fuelprice) = 0{,}1017 * Year - 200{,}42$). In these conditions, we could expect modifications in fishing strategies through a weaker utilization of potential capacity. Mechanically, labour and/or capital remuneration have to decrease in relation with a constant rise in fuel price.

For instance, a permanent increase on fuel price might change fishermen's behavior by a reduction in fishing time, thereby developing an excess capacity phenomenon. This assumption has been made in a clear and concise explanation of excess capacity concept (Ward *et al.*, 2005). Indeed, a few fishing companies, managing 30-35 meters trawlers in South Brittany, decided to stop their activity for a short period during the summertime in the year 2000, reported in the French newspaper *Le Monde* (August, 22, 2000). However, boats under 24 meters length, representing the artisanal fishing sector, did not stop their activities. Consequently, it does not seem that fuel price could be considered as a driving force in fishing behavior modification inside a specific segment. In the short run, fishermen did not change their fuel consumption. Results derived from the econometric model, based on adaptative expectations[1], confirm this assumption.

[1] In this paper, we assume fuel consumption, as the explained variable, derived from others variables, as gross revenue, engine power and dummy variables representing fleet segments. Hence, fuel consumption is not self-dependent from the previous steps as considered in the theory of adaptative expectations in economics (Cagan, 1956).

Table 3. Results of the econometric model

$\log(fuel_t)$	R^2	*n*	Constant	$\log(gr_{t-1})$	$Dev(e_{kw})$	D_{11}	D_{12}	D_{13}	D_{21}	D_{22}
2000	0.94	*178*	0.77 (0.37)	0.98 (<0.01)	0.61 (<0.01)	-1.35 (<0.01)	-0.53 (<0.01)	-0.17 (0.09)	-1.62 (<0.01)	-1.43 (<0.01)
2001	0.94	*179*	1.43 (0.09)	0.86 (<0.01)	0.61 (<0.01)	-1.28 (<0.01)	-0.50 (<0.01)	-0.18 (0.07)	-1.69 (<0.01)	-1.25 (<0.01)
2002	0.94	*188*	-0.95 (0.28)	0.89 (<0.01)	0.57 (<0.01)	-1.28 (<0.01)	-0.54 (<0.01)	-0.19 (0.05)	-1.76 (<0.01)	-1.33 (<0.01)
2003	0.94	*180*	-0.69 (0.41)	0.91 (<0.01)	0.57 (<0.01)	-1.26 (<0.01)	-0.48 (<0.01)	-0.15 (0.12)	-1.68 (<0.01)	-1.31 (<0.01)
2004	0.93	*184*	-0.13 (0.89)	0.95 (<0.01)	0.44 (<0.01)	-1.16 (<0.01)	-0.43 (<0.01)	-0.09 (0.44)	-1.49 (<0.01)	-1.33 (<0.01)
2005	0.88	*180*	-1.76 (0.20)	1.09 (<0.01)	0.53 (<0.01)	-1.15 (<0.01)	-0.51 (<0.01)	-0.04 (0.89)	-1.40 (<0.01)	-1.11 (<0.01)

The best model, selected with the stepwise method, includes gross revenue (gr_{t-1}) the year before, deviation from kW and dummy variables. All variables, excepted the constant and the dummy D13 representing the 16-20 meters trawlers, are significant. It can be argued that the 16-20 meters active boats behave as the reference segment (>20 meters trawlers). Expressed in logarithms, the influence of gross revenue is positive and proportional on the fuel consumption the year after. An increase by 10% of gross revenue (or landings value) leads to a higher fuel consumption by 9% or 11% the following year. As we could expect, fuel needs are lower for smallest boats (D11, D21) and passive units (D21, D22). In this sense, the hierarchy according fishing gears (active versus passive) and potential production capacity (length segments) is well ordered.

In the long run, fuel cost brings modifications of economic performance of different fishing methods, when it is soaring. In this way, technical change is accelerated in favour of low energy fishing techniques as passive gears.

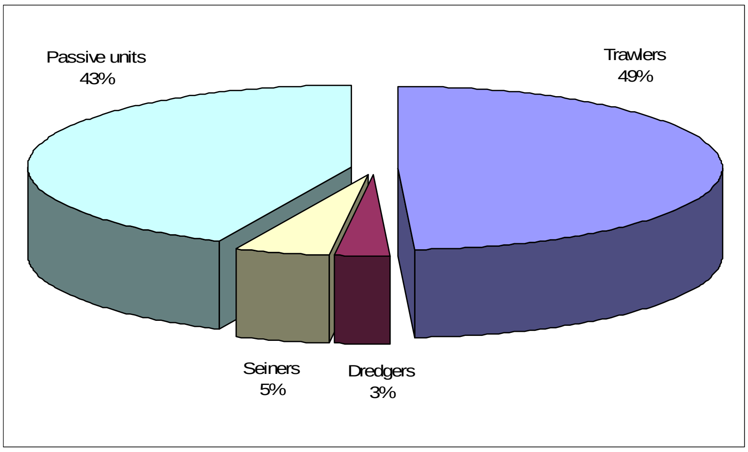
4 Discussion

In the present circumstances, the biggest trawlers exploiting the Bay of Biscay fisheries are penalized due to their strongest dependence with fuel consumption. On the one way, fleet contribution to total earnings could be then reassessed in the future if the technical change, from active to passive techniques, is confirmed. On the other way, the impact of fuel cost has to be questioned taking into account public choices.

41 Fleet contribution to total earnings

Trawlers contribution to total earnings in 2005, generated from the Bay of Biscay fisheries, has been assessed to 49%. This result is based on fleet population, excluding trawlers above 20 meters. Active (trawlers and dredgers) and passive (including seiners) units had then a similar influence in the economic wealth derived from the sea. Considering the phenomenon of technical change since 1996 and the stronger impact of fuel cost on trawlers economic results, we can expect a higher contribution of passive units in the future unless active units use innovative technique.

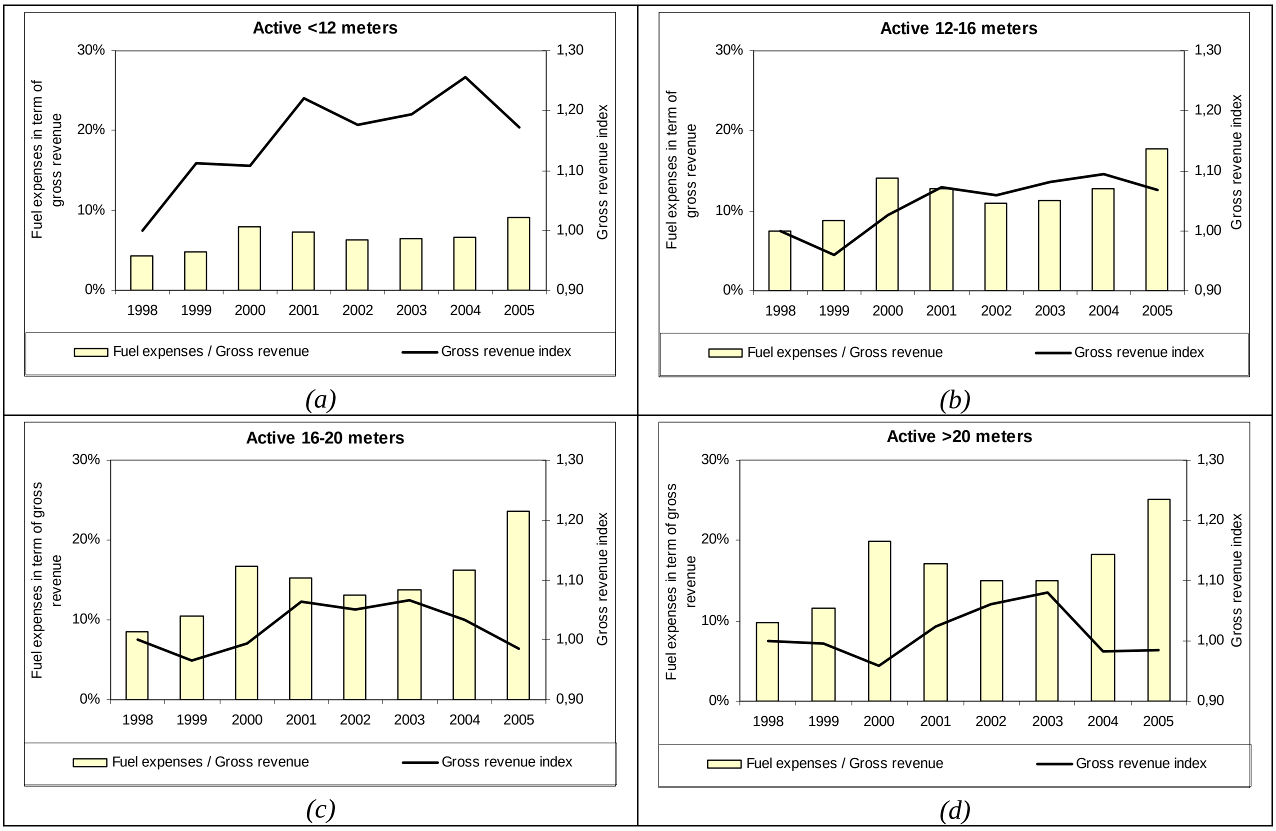
Figure 8. Fleet contribution to total earnings in 2005 for the Bay of Biscay

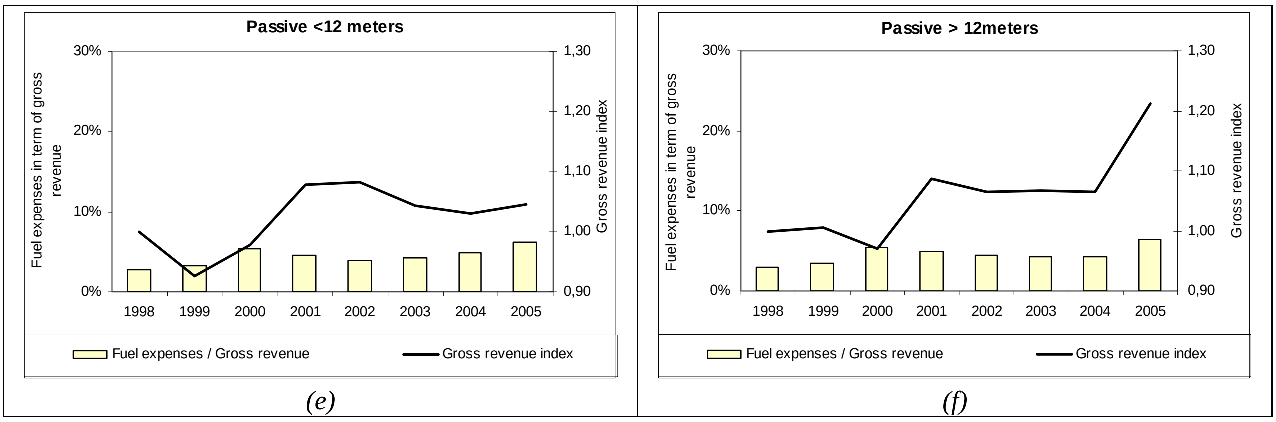


Source: Ifremer

Comparing mean fuel expenses and gross revenue index (figure 9) from fleet samples, shows an increasing path-dependency for active units (essentially trawlers). Expressed in term of gross revenue, fuel expenses represented 7-10% in 1998 for active units over 12 meters length *(b, c, d)*. In 2000, it rose to 14-20%, and came to 18-25% in 2005. In the meanwhile, fuel expenses maintained under 10% for passive units *(e, f)* and active under 12 meters *(a)*. The crucial problem stems from the evolution of gross revenue. As earnings index has improved for passive units during the last years, it has been decreased for boats using active gears. Trawlers over 16 meters landed an equivalent value (in constant € 2005) in 2005 than in 1998, while fuel expenses increased twofold.

Figure 9. Evolution of fuel expenses (in term of gross revenue) and gross revenue index, constant samples, 1998-2005





Source: Observatoire économique régional des pêches

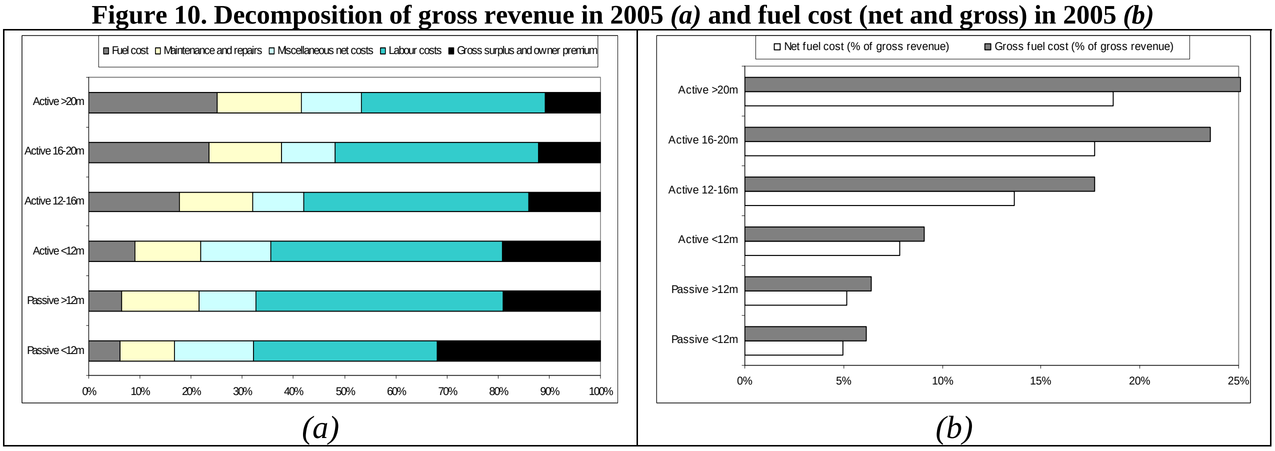
42 Fuel Cost and public choices

In the present economic situation, it must be questioned why technical change, from trawling technique to passive methods, has not been accelerated due to poorest economic performance for the former fishing technique considering the impact of fuel cost.

In the French context, fuel expenses have to be examined under a special regime implemented in 2004 and called "Fund for the prevention of risks to fishing". This regime has been conceived to limit the consequences of the energy resource price on fleet's profitability.

Figure 10 shows on the one side *(a)* the share of operating costs (fuel, maintenance & repairs, miscellaneous net costs), labour costs and gross surplus (including owner premium), and on the second side net and gross fuel cost. Both figures are expressed in % of gross revenue.

Figure 10. Decomposition of gross revenue in 2005 *(a)* and fuel cost (net and gross) in 2005 *(b)*



Source: Observatoire économique régional des pêches

Decomposition of gross revenue reveals an opposite relation between fuel cost and the remuneration for the entrepreneur (gross surplus and owner premium). Consequently, active units over 12 meters length made less profit (11% to 14%) than others segments (19% for active under 12 meters and passive units over 12 meters). In the case of the smallest passive units, the profit appears greater than other boats (32% of the gross revenue). There is nothing surprising about that because the share system in the artisanal sector is applied to boats above 12 metres long and, more randomly, for small units. Frequently labour costs correspond to social costs when the skipper-owner is the only member of the crew, as it happens frequently on passive units under 12 metres.

Figure 10 *(a)* can be interpreted indeed through the share system for the crew remuneration. The remuneration's share system is often used as a shock absorber in the fishing industry to compensate for the rise of other variable costs such as fuel expenses (Gaspart *et al.*, 2003). Moreover, fishermen are usually said to have low opportunity costs. Consequently, they have no economic incentives to cut back their level of activity in a context of rocketing fuel price (what has been seen in figure 7).

Furthermore, they can expect to receive subsidies from public agencies, as it is the case in the French fisheries with the special regime fully implemented in the year 2005 ("Fund for the prevention of risks to fishing"). Figure 13 *(b)* shows net and gross fuel cost. Fishermen received financial allowances, included in miscellaneous net costs (figure 13 *(a)*), to limit the impact of the rising fuel cost. Finally, fuel expenses rose to 19% instead of 25% of gross revenue for the biggest trawlers (active units over 20 meters), considering the special regime.

If this fund has been created by producer organisations to compensate the fluctuations of energy prices, the regime is considered as a subsidies scheme fuelled by the State (C 91/30 EN Official Journal of the European Union, 19.04.2006). This financial support is a major element in the examination of fishermen behaviour in France, explaining that fishing vessels can maintained their fuel consumption in a context of a high rising fuel cost, thanks to such a State aid. In the short run, this regime can delay the technical change process. But it is likely that trends on the fuel market will be at comparables levels that observed in 2005 (Brook *et al.*, 2004). In this perspective, a high level of fuel price raises two challenges for trawlers. On the one hand, the economic viability of active techniques as trawling can be called into question, assuming a process without political implications. With this assumption, it is likely that technical change will increase. On the other hand, fishermen can take a great interest to stand a special regime designed to limit the impact of high fuel prices. In this case, there is a financial side to the question, considering that a State aid is not permitted.

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