Has the European Structural Fisheries Policy Influenced on the Second Hand Market of Fishing Vessels[1]?

Ikerne del Valle*, Kepa Astorkiza,* and Inmaculada Astorkiza*[2]
* Department of Applied Economics V. University of The Basque Country (UPV-EHU)
Avda. Lehendakari Agirre No. 83, 48015 Bilbao, Spain
ikerne.delvalle@ehu.es

Abstract. The main objective of this paper is to analyze the potential effects that the principal instrument of European structural fisheries policy, that is the Multi-Annual Guidance Plans (MAGP), may have exercised in the second hand market of fishing vessels. In order to test the starting hypothesis that the shortage generated in the periods with the most significant and radical capacity adjustment may have influenced increases on prices of vessels, the main determinants of the second hand market of fishing vessels are analyzed by estimating and discriminating among alternative hedonic price models, such as the linear, log-linear, semi-log, mixed semi-log, TRANSLOG or Box-Cox. Especial attention is paid not only to the correct specification of the numerical variables by carrying out a battery of tests to discriminate among alternative non-nested models, but also to checking for structural change and the convenience of using alternative estimation methods including OLS, weighted least squares (WLS) and trimmed least squares (TLS), based on heteroskedasticity and OLS regression diagnostic. Pooled data is available for 228 transactions taking place during the period 1985-2005 for the Basque artisan and trawling fleets. The principal results achieved indicate that the higher increase of prices precisely happens under the MAGP with major capacity adjustment.

Keywords: European Fisheries Policy, Second Hand Market of Fishing Vessels, Hedonic Model.

---

1 This study has received financial from the EFIMAS project (No SSP8-CT-2003 502516) and ETORTEK2003/IMPRES (Basque Government).

2 The authors are grateful to conference participants at 4th Conference Developments in Economic Theory and Policy (10-11 July 2008, Bilbao) and 35th Annual Conference of the Eastern Economic Association (Feb27-March1 2009, New York). All errors and opinions are the author's responsibility.

1 Background and Problem Definition

Since the mid eighties the European Fisheries Structural Policy has been leaning on the figure of Multi Annual Guidance Plans (MAGP) as the principal vehicle to adapt fleet's fishing capacity to the abundance of the fishing stocks. Basically the design of MAGP has been oriented to the reduction of fishing effort by the limitation of capacity in order to adjust fleets to the real biological situation of fish stocks and also to incentive the modernisation and competitiveness of fishing fleets. In practice the principal materialisation of the measure has been the elimination of vessels by giving incentives in the form of decommissioning grants, the exportation of the vessel to third countries outside the European Union, and even, although is less degree, the reallocation of vessels to another activities. Each MAGP establishes the specific fleet reduction target by member States for a period of 5 years starting from 1982.

Our initial hypothesis is that the shortage generated in the periods with the most significant and radical capacity adjustment, may have influenced increases on prices of the second hand market of vessels. Notice that since entry to the fisheries is limited to those having an authorised vessel, the only way for a firm to add another vessel to the business is by accessing to the second hand market. Moreover, since the effective adjustment patterns differ by State and fishing sub-sector, one may expect disparities on the influence on prices depending not only on MAGP but also on the State and fishing sub-sector. Therefore, some of the related questions we intend to answer are: Have MAGP influenced on the prices of second hand market of fishing vessels? Have they affected homogeneously to the different fishing sub-sectors? Is this potential effect on prices especially significant during some of the MAGP? Is there any interaction effect between the previous the fishing sub-sector and MAGP? We focus on the Basque artisan and trawling fleets to address the researching questions set out.

Vessels constitute a heterogeneous asset. Even when the specifications and their technical characteristics are the same, if the age differs, the degree of deterioration differs accordingly, so that one might say that there are no two identical vessels, or to put in another words, vessels have the particularity of few equivalents. Moreover, the quality of vessels may change with time owing to technological progress. Heterogeneity and potential quality improvements justify the need of methods able to compare heterogeneous vessels prices at different times. These methods should distinguish between movements in prices and changes in the composition of vessels sold from one period to the next. Moreover the objectives of the paper demand a modelling approach open to accommodating for structural changes. The structure of the market changes in accordance with the changes in the preferences of vessels owners, which are influenced in turn by the situation of the fisheries, and specifically by the fisheries policy. This implies that in more or less degree but the model should be open to structural flexibility.

There are two price modelling approaches that specifically focus on the issues resulting from heterogeneity and changes in quality: the hedonic approach ([1], [2], [3]) and the repeat sales technique [4]. The former controls for quality by using regression models with the attributes of the good as independent variables, while in the second quality control is directly achieved by only including the transactions involving the same assets. The hedonic approach as three principal advantages. First, it uses all of the information on sales in each sample period and not just the data that can be matched, which mitigates the sample selection bias issue. Second, it can adjust for the effects of depreciation if the age of the structure is known at the time of sale. Third, it can adjust for the effects of renovations and repairs if expenditures on renovation and extensions are known at the time of sale.

Different basis explain our methodological choice in favour of the hedonic approach. For one side, since the fluidity of the second hand fishing vessel market is rather low, the sample selection bias would be an extremely large problem if the repeated sales method was adopted. Moreover, we could not get a usable database containing repeated sales transactions of the same vessels because there were an insufficient number of matched observations. Last but not least, since the Boskin report [5], hedonic analysis is gaining academic acceptance as a tool for quality adjustment. Proof of this is it has been applied in a great variety of goods and services, such as automobiles ([2], [6], [7]), Internet services ([8], [9]) and very especially computers ([10], [11]) and houses ([12], [13], [14], [15], [16]), by far the two most popular products for which much of the hedonic research has been concentrated on. To our knowledge this is the first application following the hedonic approach that concerns fishing vessels.

Two alternative approaches have been followed in the literature when dealing to incorporate structural change in the hedonic regression framework ([16], [14], [17]): the characteristic price index approach (CPI) ([2], [6]) and the time dummy variable method (TDV). In the CPI a separate regression is performed for each time period included in the sample, which allows both the coefficients of the good's characteristics and the intercept to change across different periods. The TDV approach consists of performing a pooled regression including time dummy variables to discriminate among different time periods, and thus estimating a common set of coefficients for the attributes, often under the assumption of time independent implicit prices. Compared to the TDV, the CPI has the advantage of being completely structurally unrestricted. Notice however that additional flexibility might be gained in the TDV approach by estimating implicit prices with a time trend, including a series of time dummies for each hedonic characteristic or by including cross terms between the hedonic characteristics and time dummies.

Although the CPI is clearly preferable due to its less demanding assumptions and its structural flexibility, not only the own objectives of the paper but also the data structure and availability (in some individual years we have not enough data to undertake the regression analysis) entails the adoption of the TDV. Thus in the framework of the time dummy variable method, we follow the approach developed by [18]), [19], [20]) and [15] in order to face the structural change and separate the data in different sub-periods using exogenously determined breaking points based on the different MAGP periods. The breaking points of structural change may also be endogenously identified using a switching regression model [15]. However, for the purposes of our study it is reasonable to divide the entire sample into 5 sub-samples, namely "$MAGP_1$", "$MAGP_2$", "MAGP3", "$MAGP_4$" and SUB, attending to the MAGP under which the transaction was materialized. In order to gain the additional structural flexibility needed to test whether each plan has affect in different way to vessels belonging to different sub-sectors, artisan or inshore vessels (B) and offshore or trawler vessels (A) the interaction term "$MAGP_i$ * $SECTOR_i$" will be also included in the model.

2 Data and Fleet Performance

Sample data is available for N=228 transactions of the second hand market of fishing vessels taking place in the Basque Country during the period 1985-2005. N_B=159 transactions correspond to artisan vessels (B), and the remaining N_A=69 are trawlers (A). The information includes the transaction price (P) (in € 2006), gross tonnes of the vessel (GT), horse power of the engine when the sale took place (HP), length (ESL), the AGE of the vessel, the sector the vessel belongs to (i.e. artisan (B) or offshore vessels (trawlers) (A) and the date of the transaction. Following the time dummy variable method we are dividing the data using the breaking points determined by each MAGP. Thus, the category $MAGP_1$ groups all the transactions taking place during the period (1982-86), $MAGP_2$ the ones during the validity of the second plan (1987-1991), $MAGP_3$ includes the ones during the years (1992-1996), MAGP4 the transactions happening during (1997-2001) and finally SUB the ones in the period (2002-2005). Data sample statistics are summarised in Table 1.

Table 1. Data Sample Statistics.

	Variable	Mean	Median	ST	CV	N_{TI}	%
Artisanal vassels (B)	P_B	286.080	183.170	329.410	1,15	-	-
	GT_B	50,09	24,78	48,64	0,97	-	-
	ESL_B	18,42	16,20	7,46	0,4	-	-
	AGE_B	18,38	19,00	8,23	0,44	-	-
	HP_B	242,77	170,00	201,33	0,79	-	-
	$PMAGP_{1B}$	145.705	52.551	188.996	1,29	15	9,43
	$PMAGP_{2B}$	292.127	190.367	246.597	0,84	24	15,09
	$PMAGP_{3B}$	269.879	182.762	324.574	1,20	44	27,67
	$PMAGP_{3B}$	310840	200.573	353.962	1,13	55	34,59
	$PSUB_B$	348.561	218.672	328.855	0,94	21	13,21
Trawlers (A)	P_A	1.248.000	1.057.700	993.700	0,79	-	-
	GT_A	239,36	230,81	100,94	0,42	-	-
	ESL_A	34,32	33,60	6,61	0,19	-	-
	AGE_A	20,12	20,00	6,85	0,34	-	-
	HP_A	772,04	750,00	308,89	0,4	-	-
	$PMAGP_{1A}$	343.331	364.944	175.509	0,51	9	13,04
	$PMAGP_{2A}$	697.471	910.969	467.175	0,66	11	15,94
	$PMAGP_{3A}$	1.457.085	1.293.103	799.756	0,54	26	37,68
	$PMAGP_{3A}$	1.190.145	1.085.686	542.831	0,45	12	17,39
	$PSUB_A$	2.107.555	1.706.94	1.596.29	0,75	11	15,94

N_B=159, N_A=69 N=226
Source: Public Record

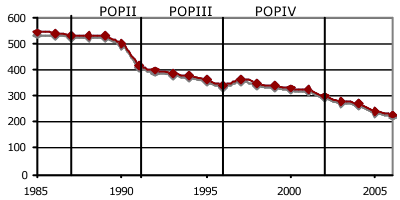
Figure 1 and Table 2 show how the different MAGPs have affected the Basque artisan and offshore fleets obeying alternative indicators such as the number of vessels (NB), the total gross tonnage or capacity (GT), total horsepower (HP) and the number of fishermen (L). First, it seems that the $MAGP_1$ hardly did affect the Basque fleet. For one side, since Spain didn't join the European Economic Community (EEC) until 1986, Spanish fleets were not under the requirements of the $MAGP_1$. For another, the level of compliment of European fleets was really low and the deviations above the targets were remarkable even for the member States. In fact, at the end of the $MAGP_1$ the capacity and power increased 4.5% and 8.1% respectively. Second there is an asymmetric path in the degree and temporal affectation on each of the fleets. Contrary to what happened in the artisan fleet, the offshore fleet had an imperceptible adjustment during $MAGP_2$. Even the number of vessels (NB_A), the capacity (GT_A), the power (HP_A) and also the direct employment (L_A) increased during $MAGP_2$. However, in the $MAGP_3$ the negative variations in the indicators fluctuate between 25% and 45%. This negative pattern continues across $MAGP_4$, although much more slightly. This really means that the effective restructuring of the offshore sub-fleet took place during $MAGP_3$. In the case of the artisan fleet, the adjustment has been more gradual and uniform. However, it seems that the $MAGP_3$, and very specially the $MAGP_2$ are the ones implying the most dramatic and immediate adaptations. Notice that practically the totality of the adjustment during $MAGP_2$ took place in hardly a couple of years (1989 and 1990). Although the reduction on NB_B is sensibly higher during $MAGP_2$, the fact that the variation on GT_B and HP_B was considerably lower may indicate that it were the smallest vessels the ones, which were withdrawal.

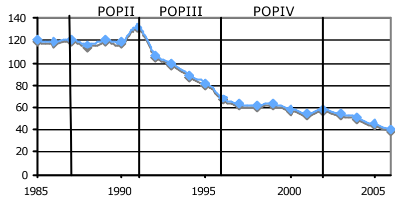
Thus taking into account that the adjustment paths have been different attending to each of the sub-fleets and MAGP, it seems reasonable to cross the two dummy variables (ie. $SECTOR_i$ and $MAGP_i$). This way all the transactions will be grouped in 10 categories. The inshore or artisan vessels sold during $MAGP_1$ have been established as the base category ($MAGP_{1B}$). $MAGP_{1A}$ corresponds to the offshore vessels sold during $MAGP_2$, and so on until completing the rest of the subgroups (i.e. $MAGP_{2B}$, $MAGP_{3A}$, $MAGP_{3B}$, $MAGP_{4A}$, $MAGP_{4B}$, SUB_A y SUB_B.

Table 2. Variation (%) on NB, GT, HP and L by sub-sector and MAGP.

MAGP	Period	$\%NB_B$	$\%NB_A$	$\%GT_B$	$\%GT_A$	$\%HP_B$	$\%HP_A$	$\%L_B$	$\%L_A$
$MAGP_1$	1982-86	-	-	-	-	-	-	-	-
$MAGP_2$	1987-91	-21,35	9,09	-9,90	15	-9,13	13,38	-8,48	-0,14
$MAGP_3$	1992-96	-13,75	-36,45	-15,29	-35,93	-8,28	-26,28	-25,43	-41,38
$MAGP_4$	1997-01	-18,03	-7,94	-10,08	-10,36	-13,13	-14,61	-18,97	-15,73
SUB	2002-06	-18,44	-25,93	-17,70	-29,82	-16,96	-33,34	-	-

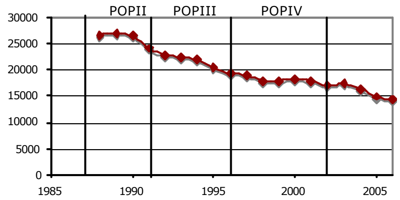
Figure 1. Evolution of NB, GT, HP and L across MAGP and Fishing Sector.

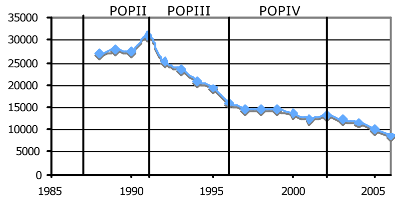




Number of artisan vessels (NB_B)

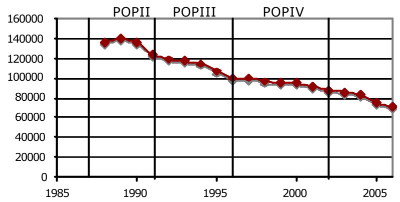
Number of trawlers (NB_A)

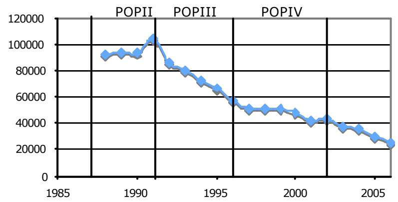




GT artisan fleet (GT_B)

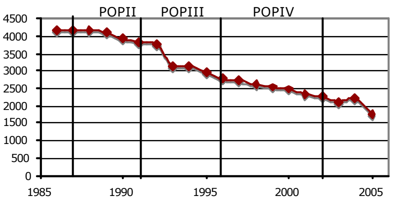
GT trawlers (TRB_A)

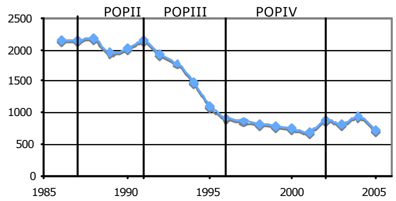




HP artisan fleet (HP_B)

HP trawlers (HP_A)





Employment artisan fleet (L_B)

Employment trawlers (L_A)

3 An Empirical Model for the 2nd Hand of Fishing Vessels

Following the hedonic approach, vessels are considered to be composite products formed by a heterogeneous set of attributes, whose market price at time t (P_{it}) is determined by a set of characteristics $X=(X_1, X_2,\ldots, X_n)$ (i.e. GT, AGE, the fishing SECTOR the vessel belongs to) and by the potential effects that the European Fisheries Structural Policy, via MAGP, may have exercised on the second hand market ($MAGP_t$). Therefore, when acquiring a vessel, we can consider the price to be the sum of the price paid for each one of its attributes [(X_i=GT, AGE, SECTOR), $MAGP_t$)], so that an implicit price, or hedonic price exists for each one of the attributes defining the vessel.

Hence, assuming an optimal behaviour by buyers and sellers the second hand market fishing vessels price hedonic function may be estimated under market equilibrium and using transactions data P_{it}=f((X_i=GT, AGE, SECTOR), $MAGP_t$). The essence of the approach consists of finding what portion of the price is determined by each of the atributtes (X_i, $MAGP_t$). This information is obtained by calculating the partial derivative of the price with respect to each of the attributes $(\partial P_{it}/\partial X_i, \partial P_{it}/\partial MAGP_t)$. Besides the marginal willingness to pay for an additional unit of each of the vessels' characteristics, this method also gives us the *structural policy asset*, allowing us to obtain an estimate of its monetary value. To put in another words, we focus on vessels of the same quality (i.e. vessels sharing identical characteristics (X_{it}), and then compare the hedonic price at different time periods grouped in each of the MAGP. This way, the part of overall price change from one MAGP to another, which is not accounted by the changes in characteristics may be then interpreted as pure price change related to changes in economic policy. If this price change is significantly great under the most radical fleet adjustment one may derive that the structural policy is affecting the market.

The modelling requirements implicit in the applied hedonic regression literature focuses the attention on three major points: a) the specification of the functional form; b) the configuration of models suitable to test for structural break; and c) the discussion of the appropriate estimation method, mainly discriminating among OLS and weighted least squares (WLS). All of these topics are covered in the next three subsections. Since this is the first application of the hedonic framework to fishing vessels, special attention will be plaid to the functional form selection procedure. This procedure is based on two steps. First the performance of a priori established functional forms in undertaken attending to the usual goodness of fit measures and the signs of the estimated parameters. Second a battery of non-nested test is completed in order to check the performance of alternative transformations of the numerical variables included in the model chosen in the first step. Afterwards the issue of the structural time stability is addressed in the framework of the previously selected function by estimating an augmented model incorporating time varying slopes for the numerical independent variables; and carrying on a related F test. Finally the convenience of using other estimation methods instead of OLS is considered based on heteroskedasticity tests and also the regression diagnostic. The estimated coefficients derived by OLS, WLS and trimmed least squares (TLS) are compared in other to see if the results do not radically change depending on the estimation method.

3.1 The Functional Form

Although the specification of the functional form of hedonic regression models has been the subject of considerable debate, the hedonic theory does not give an explicit answer to this central issue and there is no a priori structural restriction on the choice of functional forms. The general view is that the functional form of a hedonic model is purely an empirical issue (Rosen, 1974) and that therefore decisions should be made on a case-by-case basis, taking into account several interrelated issues such as, the purpose for which the hedonic regression is undertaken, the kind of data used, the estimation method, the appropriateness of the derived empirical results and also the results of homoskedasticity tests.

In most empirical studies carried on durable goods using the hedonic framework the model selection procedure is limited to choosing among three popular functional forms (the linear (1), the semi-log (2) and the log linear (or double log) (3)) based on the usual goodness of fit measures (R^2, the standard error of the regression, AIC, etc.). Notice that strictly speaking when dummy variables are included, since these are not transformed, equation (2) is in fact a mixed functional form. Besides, all of the variables of the right side of the equation need not have the same form. For example Barzyk [21] employed a mixed functional form in which some of the variables appear linearly and some logarithmically depending on the data fit and the empirical standards summarized in (Wooldridge [22])[3]. Following the terminology in Triplett (2004) we will refer to these forms as mixed–semilog functions. The semilog and log-linear forms are usually preferred, mainly because they generate a better goodness of fit and because heteroskedasticity is mitigated [23]. However, a simple log model may not be the correct specification due to the

[3] When a priori choosing which of the variables are transformed it is usual to take logs when working with monetary variables taking high values. However, the variables measured in years normally appear in their original form.

possible nonlinear relationship between price and characteristics and interactions between characteristics. Hence joint with the above-mentioned forms, the mixed semilog with quadratic and cross terms (4), the mixed semilog with quadratic but not cross terms (4^R) and the translog (5) will be also tested. Furthermore, attention will be plaid on the Box-Cox model (Box and Cox, 1964) (6), which nests the linear, the semilog and log-linear forms.

Thus the functional forms a priori considered in this paper (i.e. the linear, semi-log, double log, mixed-semilog, translog, Box-Cox) are listed as follows:

$$P_i = \beta_{0t} + \sum_{k=1}^{K} \beta_k X_{ikt} + \sum_{s=2}^{t} \delta_s MAGP_s + \varepsilon_{it} \quad (1)$$

$$\ln P_{it} = \beta_{0t} + \sum_{k=1}^{K} \beta_k X_{ikt} + \sum_{s=2}^{t} \delta_s MAGP_s + \varepsilon_{it} \quad (2)$$

$$\ln P_{it} = \beta_{0ti} + \sum_{k=1}^{K} \beta_k LnX_{ikt} + \sum_{s=2}^{t} \delta_s MAGP_s + \varepsilon_{it} \quad (3)$$

$$\ln P_{it} = \beta_{0t} + \sum_{l=1}^{L} \beta_l LnX_{ilt} \sum_{l=1}^{L} \beta_l (LnX_{ilt})^2 + \sum_{k=1}^{K} \beta_k X_{ikt} + \sum_{k=1}^{K} \beta_k (X_{ikt})^2 + \sum_{s=2}^{t} \delta_s MAGP_s + \varepsilon_{it} \quad (4)$$

$$\ln P_{it} = \beta_{0t} + \sum_{k=1}^{K} \beta_k LnX_{ikt} + 1/2 \sum_{i=1}^{k} \sum_{j=1}^{k} \beta_{ij} LnX_{it} Ln\, X_{jt} + \sum_{s=2}^{t} \delta_s MAGP_s + \varepsilon_{it} \quad (5)$$

$$P_{it}^{\lambda} = \beta_{0t} + \sum_{k=1}^{K} \beta_k MAGP_{ikt}$$
$$P_{it}^{\lambda} = \begin{cases} \dfrac{P_{it}^{\lambda} - 1}{\lambda} & if \quad \lambda \neq 0 \\ LnP_{it} & if \quad \lambda = 0 \end{cases} \quad (6)$$

where P_{it} denotes the prices of a vessel (for all the periods included in the sample), $ß_k$ is the coefficient of characteristic k, X_{ikt} the value of characteristic k of vessel i in period t, δ_s the parameter of the time dummy variable in MAGPs and ε_{it} the random disturbance term. $MAGP_s$ is the time dummy variable, and takes a value of 1 if the transaction occurs at the certain period t, and 0 otherwise. This model configuration is said to be a structurally restricted hedonic model (SRHM) because it assumes that the regression coefficient $ß_k$ of the vessel-price determining factor X_{ikt} is constant throughout all the periods. However in the next subsection we are adding structural flexibility by allowing one of the attributes (i.e. SECTOR) to change throughout all the periods.

As well as the signs and value of the coefficients and the usual measures (i.e. adjusted R^2, the standard error of the regressions, F test, Akaike Information Criterion (AIC), Schwarz Bayesian Criterion (SBC) and Hannan-Quinn criterion (HQC), the criteria for comparing among alternative model specification includes a full battery of nested on non-nested tests: Ramsey's RESET test, Davidson-MacKinnon (1981) (DM) test, Minzon y Richard (1986) (MR) test, Wooldridge (1994) and Box Cox test (1964). Notice that while RESET is limited to nested models, DM F and MR t tests are useful to discriminate between non-nested models of the independent variables, provided that the model includes the same dependent. However DM and MR are not valid in order to contrast among alternative non-nested models when they have different dependent variables, such as $\log(P_i)$ against P_i. Since in these cases you cannot make direct comparisons of R^2 or the sums of the squares of the residuals (SSR), additional test, such the Box-Cox test (1964) (BC) and Wooldridge (1994) tests (W) are required. The OLS results for the lineal (1), semi-log (2), log-linear (3), mixed semilog with quadratic and cross term between TRB and AGE (4), mixed-semilog with quadratic but no interaction term (4^R), and the translog (5) are summarised in Table 3. For one side, attending both to adjusted R^2, the AIC, SBC and HQC the linear model performs worse than the others, although at least it passes the RESET test for model configuration. The models including quadratic and or cross terms perform better attending to the R^2, the AIC, SBC and HQC. Besides, all of them pass the RESET. Moreover apart from the translog the signs for the estimated parameters are the expected ones. Both the AIC and the rest of the models selection criteria and F test for the omission of the cross term between AGE and TRB constitute complement arguments in favour of model (4^R) [$F(1, 213)=0.05$, p-value=0.8147].

Table 3. Regression results for alternative functional forms

Variable	Linear(1)	SemiLog(2)	Loglinear(3)	MSemilog†(4)	MSemilog(b)†(4)R	Traslog(5)
	165,017	7.6785	8.3568	6.7097	6.7621	6.0342
constant	(145,761)	(0.2829)***	(0.3563)***	(0.4768)***	(0.4204)***	(0.8550)***
	[93,286]*	[0.2903]***	[0.3537]***	[0.4282]***	[0.3604]***	[0.8950]***
	3034.09	1.0865	1.0824	2.0662	2.0560	2.00235
GT	(481.10)***	(0.0525)***	(0.0528)***	(0.2250)***	(0.2203)***	(0.2628)***
	[577.78]***	[0,0530]***	(0.0520)***	[0.1960]***	[0.1845]***	[0.2515]***
	-12810.9	-0.0334	-0.4509	(-0.0777)	-0.0813	0.555934
AGE	(4169.69)***	(0.0069)***	(0.1016)***	(0.0309)**	(0.0268)***	(0.5687)
	[4047.49]***	[0.0069]***	[0.1038]***	[0.0299]***	[0.0251]***	[0.5739]
	-	-	-	-0.1494	-0.1507	-0.145207
GT^2				(0.0339) ***	(0.0268)***	(0.0337)***
				[0.0291]***	[0.0299]***	[0.0294]***
	-	-	-	0.0011	0.0011	-0.223959
AGE^2				(0.0006)*	(0.00067)*	(0.1161)*
				[0.00062]*	[0.00062]*	[0.1137]*
	-	-	-	-0.0011		0.00620675
GT*AGE				(0.0047)	_	(0.0627)
				[0.0046]		[0.0612]
	-266,610	-0.3497	-0.3084	0.0960	0.1058	0.0725587
$MAGP_{1A}$	(219,151)	(0.3507)	(0.3526)	(0.3532)	(0.3500)	(0.3523)
	[116,470]**	[0.3163]	[0.3155]	[0.3041]	[0.3075]	[0.3091]
	169,240	0.5414	0.5069	0.6315	0.6272	0.633033
$MAGP_{2B}$	(162,127)	(0.2642)**	(0.2656)*	(0.2548)**	(0.2536)**	(0.2561)**
	[79,416]**	[0.3163]	[0.3418]	[0.3415]*	[0.3359]*	[0.3429]*
	117,610	0.1497	0.1410	0.6029	0.6094	0.600905
$MAGP_{2A}$	(207,621)	(0.3303)	(0.3327)	(0.3333)*	(0.3314)*	(0.3337)*
	[161,793]	[0.4046]	[0.4104]	[0.4408]	[0.4394]	[0.4423]
	200,915	1.1809	1.1385	1.1671	1.1668	1.1912
$MAGP_{3B}$	(147,531)	(0.2412)***	(0.2422)***	(0.2316)***	0.2311***	(0.2329)***
	[63,774]***	[0.2683]***	[0.2683]***	[0.2644]***	[0.2647]***	[0.2676]***
	725,644	0.9941	0.9771	1.6162	1.6182	1.59677
$MAGP_{3A}$	(190,004)***	(0.2783)***	(0.2804)***	(0.3006)***	(0.2998)***	(0.3005)***
	[182,417]***	[0.2888]***	[0.2864]***	[0.3082]***	[0.3086]***	[0.3106]***
	261,139	1.3240	1.2924	1.3060	1.3071	1.32225
$MAGP_{4B}$	(144,648)*	(0.2362)***	(0.2371)***	(0.2267)***	(0.2261)***	(0.2279)***
	[64,041]***	[0.2502]***	[0.2470]***	[0.2436]***	[0.2431]***	[0.2517]***
	606,392	1.1692	1.1160	1.7333	1.7253	1.72128
$MAGP_{4A}$	(213,315)***	(0.3272)***	(0.3225)***	(0.3393)***	(0.3368)***	(0.3397)***
	[199,991]***	[0.3052]***	[0.2470]***	[0.3011]***	[0.2948]***	[0.3025]***
	231,166	1.3979	1.3468	1.3036	1.3046	1.3598
SUB_B	(166,266)	(0.2709)***	(0.2725)***	(0.2633)***	(0.2627)***	(0.2615)***
	[69,828]***	[0.2709]***	[0.2732]***	[0.2675]***	[0.2675]***	[0.2743]***
	1,553,830	1.4950	1.4742	1.987	1.9834	1.97449
SUB_A	(210,933)***	(0.3313)***	(0.3334)***	(0.3363)***	(0.3352)***	(0.3370)***
	[541,888]***	[0.3770]***	[0.3814]***	[0.3810]	[0.3795]***	[0.3822]***
adj. R^2	0.57	0.78	0.76	0,78	0,78	0.78
F test	28.8391***	70.2724***	69.069***	61.53***	66.56***	61.1951***
SER	491,500	0.8007	0.8061	0.7682		0.7699
AIC	6634.69	557.385	560.473	541.3	539.358	542.32
SBC	6675.84	598.537	601.625	592.74	587.37	593.76
HQC	6651.29	573.989	577.076	562.054	558.73	563.075
RESET	0.5836	7.2237***	8.6588***	0.5302	0.1525	0.3196
$RESET^R$		9.3072***	10.1092***	0.6017	0.1059	0.2724

Standard error in () and standard error robust to het. in []. † LP and LTRB (transformed) and AGE not transformed

Accordingly, the mixed semilog with quadratic but no iteration term between the numerical independent variables is the candidate for a more exhaustive analysis. Notice that the price elasticity for TRB and semielasticity for AGE are not constant and that there is no interaction among them.

Once the mixed-semilog (4^R) has been selected, we wonder if the transformation we have a priori chosen for the dependent numerical variables (i.e the price and GT in logs and AGE untransformed) has any statistical support, or in other words, if there exist and alternative transformation pattern with a superior fit to the data. Our decisions will be based on the results of the *t* test of Davidson-MacKinnon (DM) [24] and F test of Mizon y Richard (MR) [25] and the, test that are appropriate to discriminate among any two non-nested models provided that they have the same dependent variable (in our case log(P) and/or P). In order to show the complete picture and compare alternative model configurations following the structure (4^R) with alternative transformation of the dependent variable, we are also including the results of the Box-Cox (1964) (BC) [26] and Wooldridge tests (W) [22]. Tables 4(a) and 4(b) summarise the results.

For one side, both MR[4] and DK[5] are coincident when discriminating among alternative models derived from the inclusion of numerical independent variables in log or in level. Thus, based on the test carried on in order to discriminate among the alternative non-nested models included in Table 4(a), a priori accepting the log(P) transformation for the dependent variable, (4^R2) is the one that fits the data best. For another side, BC[6] and W[7]

4 The M&R test works as follows. For example, in order to discriminate between Model 2 and Model 4 M&R test is based on the joint significance tests for the coefficients (AGE), (AGE)2, log(AGE) and log(AGE)2 derived from the estimation of the joint model including both, [AGE, AGE2] and [log(AGE) y log(AGE)2]. The joint test for AGE y AGE2 is significant [F(2, 212) = 3.34649 p-value 0.0370773], which implies that MODEL 2 is preferred. However, when discriminating between Model 4 and Model 2, the joint significance test of the coefficients for log(AGE) y log(AGE)2 [F(2, 212) = 2.88147, (p-value = 0.0582)], although significant, it's not as conclusive as the previous (5,8%).

5 The D&M test works as follows. For example in order to discriminate between Model 2 and Model 4 MR test is based on the individual t statistics derived from regressing Models 2 including also the fitted values coming from MODEL 4 as an additional independent variable. Since t is not significant for this added variable [t=1.6418 , p=0.1012], Model 2 offers a best fit. When following the same procedure, one discriminates between Model 4 and Model 2, the resulting t statistics is significant [t=2.4591, p=0.0147], which constitutes a clear evidence against Model 4.

6 We are using the version of the Box-Cox test (1964) developed by Zarembka (1968) to compare the linear and log transformations of the dependent variable. The underlying idea behind the procedure is to scale the observations on dependent variable (P_i) so that the residual sum of squares in the linear and logarithmic models are rendered directly comparable. The next steps are followed in order to calculate the test statistics reported in Table 4(b): 1) Scale the observations on P_i by dividing them by the sample geometric mean of P_i ($P_i^*=P_i/GMP_i$). 2) Regress the lineal model using P_i^* instead of P_i (Model 7) and the logarithmic model using

tests carried on to compare (4^R2) and the alternative one including the same right side but the untransformed P as dependent variable (4^R7) are also coincident. The W rejects the model including the untransformed vessel price (P) as dependent variables (4^R7), and gives statistical support to accept (more precisely not to reject) the model including Log(P) (4^R2); For another side, the Box-Cox test discriminates clearly in favour of the logarithmic specification (4^R2).

Table 4(a). Testing between the log vs no-transformation of the independent variables with Log(P) as dependent.

Models	Model	F MR	Decision	t DM	Decision
4^R2 vs 4^R4	4^R2	2.88147*	$4^R2 \succ 4^R4$	1.6418	$4^R2 \succ 4^R4$
	4^R4	3.34649**	$4^R4 \prec 4^R2$	2.4591**	$4^R4 \prec 4^R2$
4^R2 vs 4^R4 HetR	4^R2	5.06363***	$4^R2 \succ 4^R4$	1.557	$4^R2 \succ 4^R4$
	4^R4	6.35335***	$4^R4 \prec 4^R2$	3.010***	$4^R4 \prec 4^R2$
4^R4 vs 4^R5	4^R4	1.6957	$4^R4 \succ 4^R5$	-0.187	$4^R4 \succ 4^R5$
	4^R5	55.57***	$4^R5 \prec 4^R4$	14.401***	$4^R5 \prec 4^R4$
4^R4 vs 4^R5 HetR	4^R4	0.083789	$4^R4 \succ 4^R5$	-0.333	$4^R4 \succ 4^R5$
	4^R5	151.928***	$4^R5 \prec 4^R4$	17.438***	$4^R5 \prec 4^R4$
4^R2 vs 4^R5	4^R2	0.0713	$4^R2 \succ 4^R5$	-0.189	$4^R2 \succ 4^R5$
	4^R5	103.28***	$4^R5 \prec 4^R2$	14.397***	$4^R5 \prec 4^R2$
4^R2 vs 4^R5 HetR	4^R2	0.083789	$4^R2 \succ 4^R5$	0.404	$4^R2 \succ 4^R5$
	4^R5	151.928***	$4^R5 \prec 4^R2$	17.674***	$4^R5 \prec 4^R2$
4^R4 vs 4^R6	4^R4	0.052906	$4^R4 \succ 4^R6$	-0.165	$4^R4 \succ 4^R6$
	4^R6	99.61***	$4^R6 \prec 4^R4$	14.141***	$4^R6 \prec 4^R4$
4^R4 vs 4^R6 HetR	4^R4	0.0642879	$4^R4 \succ 4^R6$	-0.302	$4^R4 \succ 4^R6$
	4^R6	143.846***	$4^R6 \prec 4^R4$	17.055***	$4^R6 \prec 4^R4$
4^R2 vs 4^R6	4^R2	1.4536	$4^R2 \succ 4^R6$	t=0.366	$4^R2 \succ 4^R6$
	4^R6	52.5519***	$4^R6 \prec 4^R2$	14.397***	$4^R6 \prec 4^R2$
4^R2 vs 4^R6 HetR	4^R2	2.5456**	$4^R2 \succ 4^R6$	t=0.512	$4^R2 \succ 4^R6$
	4^R6	77.6172***	$4^R6 \prec 4^R2$	17.226***	$4^R6 \prec 4^R2$

Model 4^R2: $\log(P)=\beta_0+\beta_1\log(GT)+\beta_2\log(GT)^2+\beta_3 AGE+\beta_4 AGE^2$+etc.
Model 4^R4: $\log(P)=\beta_0+\beta_1\log(GT)+\beta_2\log(GT)^2+\beta_3\log(AGE)+\beta_4\log(AGE^2)$+etc.
Model 4^R5: $\log(P)=\beta_0+\beta_1(GT)+\beta_2(GT)^2+\beta_3(AGE)+\beta_4(AGE^2)$+etc.
Model 4^R6: $\log(P)=\beta_0+\beta_1(GT)+\beta_2(GT)^2+\beta_3\log(AGE)+\beta_4\log(AGE^2)$+etc.

$\log(P_i^*)$ instead of $\log(P_i)$ (Model 2), but otherwise leaving the models unchanged. The RSS are now comparable, the model with the lower RSS (Model 2) providing the better fit. 3) To check if (Model 2) is providing a significantly better fit than the linear the $\chi^2(1)$= (n/2)log(RSSlog/RSSlinear)=231, where n=228 is the number of observations in the sample. Under the null hypothesis that there is not difference, this statistics is distributed as a $\chi^2(1)$, and accordingly the Model 2 is provides a significantly better fit that Model 7.

[7] The procedure in Wooldridge (1994) can be summarised as follows: 1) Obtain the fitted values from the primary regression (PR) $\varphi(P_i)$ on the independent variables (X_i) $\rightarrow \hat{\varphi}$. 2) Obtain the fitted values and the residuals from the inverse regression (IR) P_i on $\hat{\varphi}^{-1}(\hat{\varphi}_i) \rightarrow \hat{\varphi}$, $\hat{e}_i$ and calculate the weighted residuals $\tilde{e}_i = \hat{e}_i / \hat{P}_i^{2(1-\lambda)}$, where λ=1 for the linear model and λ=0 for the log model. 3) For the linear model (λ=1) obtain the scalar residuals $\tilde{r}_i (= \hat{e}_i)$ from $\hat{P}_i \log(\hat{P}_i)$ on X_i; For the log model (λ=0) obtain the scalar residuals from $[\log(\hat{P}_i)]^2$ on X_i. 4) Compute the sum of square residuals (SSR) from the regression 1 on $\tilde{e}_i \cdot \tilde{r}_i$. N-SSR is distributed asymptotically as $\chi^2(1)$.

Table 4(b). Testing between Log(P) vs P with the right side as 4^R.

Models	Model	χ^2 Wooldridge	Decision	χ^2 Box-Cox	Decision
4^R2 vs 4^R7	4^R2	0.0762	Accept 4^R2	231.13***	Accept 4^R2
	4^R7	30.42***	Reject 4^R7		Reject 4^R7

Model 4^R2: $\log(P)=\beta_0+\beta_1\log(GT)+\beta_2\log(GT)^2+\beta_3 AGE+\beta_4 AGE^2$+etc.
Model 4^R7: $P=\beta_0+\beta_1(GT)+\beta_2(GT)^2+\beta_3\log(AGE)+\beta_4\log(AGE^2)$+etc.

3.2 Structural Change

Based on the analysis undertaken in the previous subsection the selected functional form (4^R2) is a mixed semilog model that includes quadratic but no interaction term between the numerical independent variables (GT and AGE):

$$\log(P_{it})=\beta_0+\beta_1\log(GT_{it})-\beta_2(AGE_{it})-\beta_3\log(GT_{it})^2+\beta_4(AGE_{it})^2+\beta_5(MAGP_{1A})+\beta_6(MAGP_{2B})+\beta_7(MAGP_{2A})+\beta_8(MAGP_{3B})+\beta_9(MAGP_{4B})+\beta_{10}(MAGP_{4A})+\beta_{11}(SUB_B)+\beta_5(SUB_A)+u_1 \quad (4^R2)$$

where P_{it} represents the transaction price, GT_{it} are the gross tonnes of the vessel (a usual measure of the fishing capacity of a vessel), AGE_{it} is the years since the vessel was constructed when the transaction happens and, GT_{it}^2 and AGE_{it}^2 are their related quadratic terms. The rest of independent variables are derived from crossing the two dummies representing the SECTOR the purchased/sold vessel belongs to (artisanal, trawlers) and the MAGP under which the transaction took place ($MAGP_1$, $MAGP_2$, $MAGP_3$, $MAGP_4$, SUB). This way, vessels are classified in 10 sub-groups attending to SECTOR and TIME, being the artisan vessels sold during the $MAGP_1$ (i.e. $MAGP_{1B}$) the base case.

Table 5. Testing for Structural Change.

test*	Model	H_0	F & F^{R*}
1	4^R2'EXT	$\delta_1=0, \delta_2=0, \delta_3=0, \delta_4=0$	F(4,198)=0.2799 F^R(4, 198)=0.2393
2	4^R2'EXT	$\delta_9=0, \delta_{10}=0, \delta_{11}=0, \delta_{12}=0, \delta_{13}=0, \delta_{14}=0, \delta_{15}=0, \delta_{16}=0, \delta_{17}=0, \delta_{18}=0, \delta_{19}=0, \delta_{20}=0, \delta_{21}=0, \delta_{22}=0, \delta_{23}=0, \delta_{24}=0$	F(16,198)= 0.7430 F^R (16,198)=1.1114
3	4^R2'EXT	$\delta_1=0, \delta_2=0, \delta_3=0, \delta_4=0, \delta_9=0, \delta_{10}=0, \delta_{11}=0, \delta_{12}=0, \delta_{13}=0, \delta_{14}=0, \delta_{15}=0, \delta_{16}=0, \delta_{17}=0, \delta_{18}=0, \delta_{19}=0, \delta_{20}=0, \delta_{21}=0, \delta_{22}=0, \delta_{23}=0, \delta_{24}=0$	F(20,198)= 0.6603 F^R (20,198)=1.176
4	4^R2''EXT	$\delta_0=0, \delta_2=0, \delta_4=0, \delta_6=0, \delta_8=0, \delta_{13}=0, \delta_{14}=0, \delta_{15}=0, \delta_{16}=0$	F(9,210)=0.8239 F^R (9,210)=0.9291

F^{R*} = F robust to heteroskedasticity
Test 1: Is the effect of and additional GT and/or AGE on P the same for artisanal and trawling vessels?
Test 2: Is the effect of GT and AGE on P estable during the different MAGPs?
Test 3: Does the slope related to GT and/or AGE depend on both, sector and period?
Test 4: Are the estopes related to GT and/or AGE different for artisan and trawlers?

Although model (4^R2) contemplates structural change via changing constant term depending on SECTOR and MAGP, this subsection checks the convenience of including additional structural flexibility. In this sense, we are now interested on testing whether not only the constant term, but also the slopes of the estimated price function with respect to the numeric variables (i.e. GT and/or AGE) differ depending on $SECTOR_i$ and $MAGP_i$. If the answer was yes we should consider dividing the sample by sector and/or period and, accordingly estimate different price functions for each of the sub-samples. Attending to the resulting degrees of freedom, while dividing the sample by sector would be statistically tractable, however, fragmenting it by period would imply an insufficient sample size.

Even if (4^R2) is suitable to give answer to the questions raised in the beginning of the paper (that is to check if the European fisheries policy has influenced on the second market of fishing vessels and if this influence on prices depends on sub-sector) however is not the best choice to face the objectives of this subsection. Accordingly, we opt for an additional model (4^R2'), which, being completely equivalent to (4^R2), is however more appropriate to analyse if additional structural flexibility should be introduced. Model (4^R2') includes the numerical variables and their quadratic terms, the two dummies for $SECTOR_i$ and $MAGP_i$ and the interaction term between the dummies, that is $SECTOR_i$ * $MAGP_i$.

$$\log(P)= \beta_0+\beta_1\log(GT)+\beta_2\log(GT)^2+\beta_3 AGE+\beta_4 AGE^2+\beta_5 MAGP_2+ \beta_6 MAGP_3+\beta_7 MAGP_4+\beta_8 SUB+\beta_9 SECTOR+ \beta_{10} MAGP_2*SECTOR+ \beta_{11} MAGP_3*SECTOR+ \beta_{12} MAGP_4*SECTOR+\beta_{13} SUB*SECTOR+u \quad (4^R2')$$

$$\log(P)=\beta_0+\delta_0 SECTOR+\beta_1\log(GT)+\delta_1\log(GT)*SECTOR+\beta_2\log(GT)^2+ \delta_2\log(GT)*SECTOR+\beta_3 AGE+\delta_3 AGE*SECTOR+\beta_4 AGE^2+ \delta_4 AGE^2*SECTOR+\delta_5 MAGP_2+\delta_6 MAGP_3 +\delta_7 MAGP_4+\delta_8 SUB+ \delta_9 MAGP_2*LGT+ \delta_{10} MAGP_2*LGT2+ \delta_{11} MAGP_2*AGE+ \delta_{12} MAGP_2*AGE2+\delta_{13} MAGP_3*LGT+\delta_{14} MAGP_3*LGT2+ \delta_{15} MAGP_3*AGE+\delta_{16} MAGP_3*AGE2+\delta_{17} MAGP_4*LTRB+ \delta_{18} MAGP_4*LTRB2+\delta_{19} MAGP_4*AGE+\delta_{20} MAGP_4*AGE^2+ \delta_{21} SUB*LGT+ \delta_{22} SUB*LGT^2+ \delta_{23} SUB*AGE + \delta_{24} SUB*AGE^2+u \quad (4^R2'EXT)$$

In order to achieve the objective above mentioned we first estimate an extended version of model $4^R2'$, that is model ($4^R2'EXT$). In this extended model not only the constant terms (such as in 4^R2 and $4^R2'$) but also all the slopes are allowed to change depending on subgroups. In other words, model $4^R2'EXT$ permits testing whether the price elasticity for GT (ε_{GT}) or the price semi-elasticity of AGE (ε_{AGE}) are equal for artisan and trawling vessels (Test 1) or whether ε_{GT} or ε_{AGE} are stable (i.e. if the slope of the price function changes with time (Test 2), as wells as if the slope of the price function depend both on SECTOR and MAGP (Test 3). The F statistics for each of the tests (Table 5) are non significant. This means that the interaction terms between the numerical and dummies are irrelevant to explain prices, or to put in another words, that the slope of price respect GT and AGE are the same for inshore and offshore vessels and that they remain constant during the different MAGPs periods.

Once we have rejected the extended version of the models 4^R2 and $4^R2'$, for completeness, we are also checking if there are structural differences between artisan and trawling vessels, that is, if the slopes for the independent variables (ie. GT and AGE) are different by sector (test 4). Based on an additional model ($4^R2''EXT$) the F test is performed. Since the resulting F statistics is not significant there is not evidence against working with the pooled sample. This allows working with more degrees of freedom.

$$\log(P)=\beta_{0+}\delta_0 SECTOR+\delta_1 LGT+\delta_2 LGT*SECTOR+\delta_3 LGT^2+\delta_4 LGT^2*SECTOR +\delta_5 AGE+\delta_6 AGE*SECTOR+\delta_7 AGE^2+\delta_8 AGE^2*SECTOR+\delta_9 MAGP_2+ \delta_{10} MAGP_3+\delta_{11} MAGP_4+\delta_{12} SUB+\delta_{13} MAGP_2*SECTOR+ \delta_{14} MAGP_3C*SECTOR+\delta_{15} MAGP_4C*SECTOR+\delta_{16} SUB*SECTOR \quad (4^R2''EXT)$$

3.3 Alternative Estimation Methods

The specification of the functional form of hedonic regression models, the configuration of models suitable to test for the structural break, and the discussion of the appropriate estimation method (often OLS *vs* WLS) have been the subject of considerable attention in the hedonic literature. This subsections deals with the third issue by presenting the results derived from using three alternative estimations methods to estimate the mixed semi-logarithmic model selected in the previous subsections (4^R2). These methods are: ordinary least squares (OLS), weighted least squares (WLS) and trimmed least squares (TLS).

Table 6. Font sizes of headings. Table captions should always be positioned *above* the tables.

Test	Potential Origin	Statistics	P-value
t test	LGT	t=-0.5215	(0.6025)
t test	LGT^2	t=-0.7432	(0.4581)
t test	AGE	t=1.590	(0.1132)
t test	AGE^2	t=1.274	(0.2041)
t test	$MAGP_{1A}$	t=-0.6970	(0.4865)
t test	$MAGP_{2B}$	t=2.867	(0.0045)***
t test	$MAGP_{2A}$	t=1.438	(0.1519)
t test	$MAGP_{3B}$	t=0.7320	(0.4649)
t test	$MAGP_{3A}$	t=-0.7111	(0.4778)
t test	$MAGP_{4B}$	t=-2.084	(0.0382)**
t test	$MAGP_{4A}$	t=-0.9452	(0.3456)
t test	SUB_B	t=-0.7335	(0.4640)
t test	SUB_A	t=0.3266	(0.7442)
F tets	$MAGP_{2B}$ $MAGP_{4B}$	F(2, 225)=5.3900	(0.0051)**
F test	LGT, LGT^2	F(2, 225)=0.8599	(0.4245)
F test	AGE AGE^2	F(2, 225)=1.8508	(0.1594)
F tets	GT, LGT^2 AGE AGE^2	F(4, 223)=0.4644	(0.7616)
F test	$MAGP_{ij}$ (i=1…5) (j=1,2)	F(9, 218) = 1.7645	(0.0763)*
F tets	LGT, LGT^2 AGE AGE^2 $MAGP_{ij}$	F(13, 214) = 1.8883	(0.0327)**
LM Koenker (BP)	LGT, LGT^2 AGE AGE^2 $MAGP_{ij}$	LM(χ^2(13))=23.4629	(0.0364)**
White	LGT, LGT^2 AGE AGE^2 $MAGP_{ij}$	χ^2(57)=69.6047	(0.1220)
Reduced White	$\hat{y}$, $\hat{y}^2$	F(2, 225) = 1.6039	(0.2233)

In order to judge the convenience of using WLS instead of OLS to remove heteroskedasticity of variances, alternative test have been carried on to detect it. Table 6 summarises the results including also the respective potential origin. For one side, both the F and Breusch-Pagan test are significant, which implies that het might bias the inference based on OLS standard errors. However, for another, White and reduced White tests do not detect it. Thus, since the results of the tests are inconclusive, we are also reporting the WLS estimates. The approach summarised in Woldridge (2003, pag. 306) has been followed to calculate the weighted factors.

Last but not least, the regression diagnostic has been carried out in order to see if there are atypical or/and influential observations in the data set with a powerful influence on the estimated parameters and/or predictions of the model. Once selected these will be candidates to be omitted to deal with robust regression techniques. Usual measures in regression diagnostic (i.e. the leverage (ht), Cook's distance (CD), the standardised residual (e*), DFBETAs and DFFITS are reported in Table 7. All the data points exceeding any of the rule-of-thumb cut-offs of the above-mentioned measures have been market with an asterisk. Six data points (market with double asterisk (0bs coded: 12, 112, 145, 244, 246 and 294)) either with a moderate leverage and/or outliers or a significant contribution on the values of the estimated parameters and/or the model's predictions have been detected, which represents the 2.63% of the sample data[8]. The trimming proportion that guaranties the elimination of all

[8] While not necessarily undesirable, influential observations are those observations that make a relatively large contribution to the values of the estimates, that is, observations whose inclusion or exclusion may result in substantial changes in the fitted model. The most common measures for the degree of influence are the *leverage* (ht) and to some degree *Cook's distance* (CD). As a general rule, data points satisfying [0.2>ht>0.5] are considered moderately influent, while those in which ht>0,5 should be especially kept watch. The sample size corrected rule of thumb suggested by Belsey et al. (1980) is h>2p/N, where p is the number of estimated parameters and N the sample size. Similarly, the general criterion stands to watch out for observations where CD>1, although in large samples some authors suggest a sample corrected rule of CD>4/N. Applying these rules to our case study, hardly 2.19% of the observations are moderately influent attending to ht, while the 8.3% does go beyond the sample corrected rule relative to CD. Thus, it may be concluded that none of the observations are riskily influent according nor to the leverage, nor the CD. Together with influential observations, it is also convenient to include measures designed to detect large errors. In a model which fits in every cell formed by the independent variables, no absolute standardized residual will be e*>2 (0,05 level) (or e*> 1.96(0.01 level)). Cells not meeting this criterion indicate combinations of independent variables for which the model is not working well. In our model about 94 % of the observations fit the specified rule of thumb, and consequently regarded as acceptable in term of the model specification. Thus, about 6 % of the observations may be considered outliers. Outliers and high leverage points can be an indication of exceptional data points that are worthy of further study. What is likely to be of more importance however is whether these points significantly contribute to the values of the

the influential outliers and high leverage observation is 0.05, which implies the consideration of the residuals associated with the 0.05 and 0.95 quartiles. In addition to all the influential outliers and high leverage observations, the TLS procedure has picked up some others of moderate size. Therefore, those observations where the residuals are non-positive for ?=0.05 and non-negative for ?=0.95 have been discarded. Subsequently, least squares have been applied to the remaining observations.

Table 7. OLS Regression Diagnostic.

Obs.	e.stand.	e.stud.	CD	h	DFFITS	DFB_6	DFB_7	DFB_8	DFB_{10}	DFB_{12}	DFB_{13}
1	-1,6350	-1,9697	0,0248*	0,0721	-0,5945*	0,1095	0,0895	0,1117	0,11319	0,1066	0,0892
12**	-1,3683	-1,6456	0,0177*	0,0736	-0,5010*	0,0937	0,1116	0,0893	0,09149	0,0872	0,1138
15	2,0696*	2,5028	0,0380*	0,0686	0,7395*	-0,132*	-0,1227	-0,135*	-0,134*	-0,138*	-0,117
46	-2,0289*	-2,5196	0,0240*	0,0436	-0,5881*	-0,0837	0,0159	-0,0027	0,0000	-0,0036	0,0172
50	-3,1957*	-3,9196*	0,0742*	0,0554	-1,0584*	-0,1289	-0,0535	0,01517	0,0181	0,0110	-0,0420
52	-1,6789*	-2,0806	0,0171	0,0456	-0,4941	-0,0681	0,0184	-0,0015	0,0008	-0,0016	0,0215
57	0,5777	0,6499	0,0055	0,1332*	0,2792	0,0238	0,0024	-0,0020	0,0012	-0,0049	0,0022
83	-2,665*	-3,2896*	0,0467*	0,0497	-0,8294*	-0,1103	-0,0407	0,00766	0,0105	0,0029	-0,0368
86	2,1231*	2,6289	0,0278*	0,0464	0,6339*	0,0870	-0,0024	-0,0022	-0,0054	-0,0046	-0,0092
109	-4,1726*	-5,2766*	0,0648*	0,0262	-1,0214*	0,0005	-0,0355	-0,0907	0,0094	-0,0062	-0,0350
112**	-1,7315*	-2,0736	0,0298*	0,0775	-0,6523*	-0,0090	-0,0276	-0,0391	-0,0073	0,0160	-0,0331
129	1,0793	1,3358	0,0072	0,0468	0,3194	-0,0035	-0,0003	0,02235	-0,0011	0,0039	-0,0001
136	1,1319	1,3937	0,0087	0,0517	0,3507	-0,0049	-0,0009	0,0225	-0,0029	0,0046	-0,0021
145**	-1,6473*	-2,0312	0,0180*	0,0504	-0,5072*	0,0034	0,0177	-0,0339	0,0057	0,0100	0,0292
217	1,0577	1,05644	0,0318*	0,2299*	0,6687*	-0,0028	0,0259	-0,0135	-0,0131	0,0261	0,0098
222	-1,9126*	-2,3132	0,0324*	0,0685	-0,6814*	0,0056	0,0439	-0,0043	-0,0005	-0,1017	0,0468
244**	-2,0432*	-2,4039	0,0498*	0,0937	-0,8458*	-0,0014	-0,209*	0,00199	0,0034	-0,0008	-0,0250
246**	-2,0529*	-2,4166	0,0500*	0,0932	-0,8477*	-0,0002	-0,2081*	0,00289	0,0048	-0,0002	-0,020
250	1,3143	1,5544	0,0196*	0,0890	0,5260*	-0,0017	0,1134	-0,0001	-0,0010	0,0023	-0,0071
251	-0,8134	-0,8915	0,0128	0,1555*	-0,4242	-0,0032	-0,071	-0,0012	-0,0047	0,0077	0,0018
265	0,2249	0,2539	0,0008	0,1304*	0,1075	-0,0004	-0,0094	0,00104	0,0017	0,0002	-0,0092
271	-2,3670*	-2,9650	0,0270*	0,0354	-0,6280*	0,0018	0,0021	0,00057	0,0020	-0,0030	0,0033
289	-0,2830	-0,3207	0,0012	0,1270*	-0,1336	0,0011	0,0096	-0,0007	-0,0008	-0,0014	0,0100
294**	-2,1198*	-2,5071	0,0510*	0,0890	-0,8572*	0,0015	-0,0077	0,00327	0,0047	0,0023	-0,1966*
298	1,3083	1,53689	0,0207*	0,0951	0,5405*	0,0029	0,0121	0,00168	0,0020	0,0025	0,1357*
299	1,3083	1,53689	0,0207*	0,0951	0,5405*	0,0029	0,0121	0,00168	0,0020	0,0025	0,1357*

The estimations of the mixed semi-log (i.e model 4^R2) using the three alternative methods are reported in Table 8. The comparison of OLS, WLS and TLS estimators allows one to conclude that the differences are not highly significant. This in turn may demonstrate that the estimated parameters by

coefficient estimates and the model predictions. Diagnostics respectively designed for these two purposes are DFBETAS and DFFITS (Belsey et al., 1980). The general cut-off criterion for cases to be considered forceful to the values of the coefficients is $|DFBETAS_{kt}| > 1.0$ (Menar, 1995), while Belsey et al. recommend further investigation of observations where $|DFBETAS_{kt}| > 2/N^{(1/2)}$, specially in big samples. Regarding the predictions, the general rule stands that an observation is considered forceful to the predictions when $|DFFITS_{kt}| > 1$, while the sample corrected rule is $DFFITS_{kt}| > 2/(p/N)^{(1/2)}$. All the data points exceeding the rule of thumbs have been market with an asterisk.

OLS are robust to using additional procedures. Nevertheless the elasticity estimation and price patterns using the alternative estimated functions will be also compared.

Table 8. Regression Results Using OLS, WLS and TLS.

Variable	OLS	WLS	TLS*
constant	6.7621 (0.4204)***	6.63155 (0.3713)***	6.3885 (0.3265)***
LGT	2.0560 (0.2203)***	2.13523 (0.1634)***	2.2181 (0.1714)***
AGE	-0.0813 (0.0268)***	-0.0790 (0.0166)***	-0.046780 (0.0049)**
LGT^2	-0.1507 (0.0268)***	-0.1621 (0.0233)***	-.18333 (0.0208)***
AGE^2	0.0011 (0.00067)*	0.0012132 (0.0004)****	0.0049039 (0.0052)
$MAGP_{1A}$	0.1058 (0.3500)	0.116813 (0.3425)	.22671 (0.2715)
$MAGP_{2B}$	0.6272 (0.2536)**	0.796769 (0.3290)**	.66758 (0.1964)***
$MAGP_{2A}$	0.6094 (0.3314)*	0.364523 (0.5856)	1.10247 (0.2571)***
$MAGP_{3B}$	1.1668 0.2311***	1.04569 (0.2550)***	1.1595 (0.1793)***
$MAGP_{3A}$	1.6182 (0.2998)***	1.65537 80.2795)***	1.8134 (0.2326)***
$MAGP_{4B}$	1.3071 (0.2261)***	1.2601 (80.2410)***	1.1481 (0.1754)***
$MAGP_{4A}$	1.7253 (0.3368)***	1.6832 (0.2820)***	1.7903 (0.2612)***
SUB_B	1.3046 (0.2627)***	1.14844 (0.2522)***	1.3037 (0.2038)***
SUB_A	1.9834 (0.3352)***	1.98734 (0.3631)***	1.9934 (0.2600)***
adj. R^2	0.78	0.85	0.79

*Number of observations after trimming= 189

4 Interpreting the Results

Based on the analysis carried out in section 3, the OLS estimations for the mixed semilog function (4^R2) will be used to answer the researching questions raised in the beginning. Mainly, if the European Fisheries Structural Policy has influenced on the second hand market price of Basque fishing vessels and/or if the influence differs according to the fishing subsector (i.e. artisanal, trawlers).

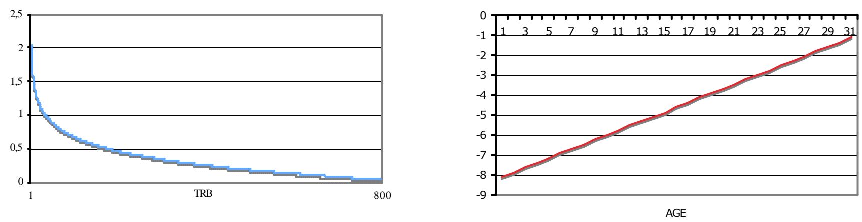
One of the main advantages of using a quadratic functional form such as (4^R2), is that since it doesn't assume constant elasticities and semi-elasticities for GT (ε_{GT}) (7) and AGE (s-ε_{AGE}) (8), it allows capturing increasing or decreasing marginal effects on vessel prices. When introducing the quadratic term for GT (β_3) and AGE (β_4) we are in fact allowing their respective price elasticity and semi-elasticity to change with GT and AGE values. Notice also that, since the TRANSLOG and semi-TRANLOG structures have been rejected, there is no interaction term between GT and AGE. Accordingly, ε_{GT} and s-ε_{AGE} are independent of the values of each other. To put in other words, ε_{GT} only depends on the values of GT and ε_{AGE} on its own values.

$$\varepsilon_{GT} = [\beta_1\text{-}2\beta_3\log(GT)] = [2{,}02\text{-}0{,}28*\log(GT)] \quad (7)$$

$$\varepsilon_{AGE} = \%\Delta price/\Delta AGE \approx 100*\{[\beta_2+2\beta_4]AGE\}=(-8{,}13+0{,}23*AGE) \quad (8)$$

Figure 2 illustrates the ε_{GT} relative to the range for GT values for the Basque fleet. Taking into account that the range of GT for the artisan and trawlers is respectively between GT_B=[2.15, 153] and GT_A=[240-793], the estimated ranges for the price elasticity with respect GT are: ε_{GTB}(B)=[2,15-0,53] for the artisan vessels and ε_{GTA}(A)=[0,40-0,04] for the trawlers.

Figure 2. Price elasticities and semielasticities related to GT (eTRB) and AGE (eAGE).



ε_{TRB} ε_{AGE}

Since s-ε_{AE} is a semi-elasticity, notice that it represents the approximated perceptual change on the vessel price as a result of an additional unit in AGE. Just like for GT, when including a quadratic term for AGE, the perceptual chance on the price of a year older second hand vessel, instead of being constant depends on the values of AGE. Notice that since the coefficient for AGE (β_2) is negative while the coefficient for the quadratic term (AGE^2) (β_4)

is positive, it may indicate that for small AGE values (almost new vessels) the fact that the vessel has an additional year has a negative effect on log(price). For AGE exceeding a critical value ($\beta_2/2\beta_4$ = 0,00004), this effect turns into positive. The shape of the quadratic form related to AGE means that the semielasticity of price with respect to AGE is increasing as AGE does. Thus, for example an increase of AGE from 5 to 6 years would decrease the price of a second hand market vessel in 6.73%. Taking into account that the sample average AGE is AGE=18, a one year older vessel would reach a price 3.69 % lower. Accordingly, it seems that the perceptual chance on prices as a result of a perceptual chance in AGE is sensibly higher for the newer vessels.

As well as analyzing the performance of the numerical variables (GT and AGE), the estimated model allows capturing the differences on prices related to the ten categories resulting from crossing the two dummy variables (i.e. $SECTOR_i$ and $MAGP_i$). This modeling approach, not only possibilities searching the price differences among the resulting ten categories, but also allows making significance test about the estimated differences in order to see if they are statistically significant or not.

For dealing with this, the subgroup of artisan vessels sold during $MAGP_1$ has been set up as the base category (i.e. $MAGP_{1B}$). Hence, the estimated coefficients for the rest of the $MAGP_{ij}$ measure the proportional difference on transaction price of a vessel sold during the $MAGP_{ij}$ (i?1, j?B) with respect to an artisan vessel sold during $MAGP_1$, keeping the same levels for GT and AGE. Table 9 includes all the estimated proportional differences among the categories and the results of the significance test carried on to determine if the differences are statistically significant.

The artisan vessels sold during $MAGP_2$ reached 62% higher prices than the ones sold during $MAGP_1$. The trawlers sold during the validity of $MAGP_2$ were approximately 10.5% more expensive than the artisan vessels during the same period. Likewise, the prices of the artisan vessels sold during the $MAGP_2$ were %53 higher than the ones sold during the previous period. At a first glance, the raising on price for the artisan vessels happened during $MAGP_2$ stands out, a period in which the trawlers were sold at 100% higher prices.

Table 9. Estimated Proportional Price Differences among Sub-groups.

Difference	Variation	Std. Error	t-statistic	p-value
$\Delta\log(p)[MAGP_{2B}-MAGP_{1B}]$	0,6272	0,2536	2,4733	0.0141**
$\Delta\log(p)[MAGP_{3B}-MAGP_{2B}]$	0,5395	0,1964	2,7468	0,0065***
$\Delta\log(p)[MAGP_{4B}-MAGP_{3B}]$	0,1403	0,1559	0,9003	0,369
$\Delta\log(p)[SUB_{B}-MAGP_{4B}]$	-0,0025	0,2020	0,0125	0,9900
$\Delta\log(p)[MAGP_{2A}-MAGP_{1A}]$	0,5036	0,3449	1,4602	0,1457
$\Delta\log(p)[MAGP_{3A}-MAGP_{2A}]$	1,0087	0,2794	3,6096	0,00038***
$\Delta\log(p)[MAGP_{4A}-MAGP_{3A}]$	0,1071	0,2701	0.3965	0,6921
$\Delta\log(p)[SUB_{A}-MAGP4_{A}]$	0,2581	0,3211	0,8037	0,4224
$\Delta\log(p)[MAGP_{1A}-MAGP_{1B}]$	0,1058	0,3500	0,3024	0,7626
$\Delta\log(p)[MAGP_{2A}-MAGP_{2B}]$	-0,0177	0,3055	-0,0580	0,9536
$\Delta\log(p)[MAGP_{3A}-MAGP_{3B}]$	0,4514	0,2614	1,7260	0,0857*
$\Delta\log(p)[MAGP_{4A}-MAGP_{1B}]$	0,4181	0,2935	1,4240	0,1557
$\Delta\log(p)[SUB_{A}-SUB_{B}]$	0,6788	0,3249	2,0890	0,0378**

The calculation of the standard errors for the difference on prices between groups (ij) needs further explanation. Notice that the estimated equation ($4^{R}2$) cannot be used to test for the statistical significance of such differences. The easiest way to execute this issue is by re-estimating the equation changing the base category in favour of one of the two categories whose differences one aims to check. Substantially nothing relevant changes, and this way, the required estimated values for the differences and the standard errors are directly obtained to conduct the related t tests. For example, focusing on the transactions of the artisan vessels taking place during $MAGP_2$, the *t* statistics to test the nil hypothesis H_0 that there is not difference on prices between the artisan vessels sold during $MAGP_{2B}$ and $MAGP_{1B}$ is t=0,6272/0,2536=2,47 (0,01417**), implying evidence against H_0.

It is worth pointing out that the differences on the second hand market of fishing vessels prices found to be statistically significant are $MAGP_2$ and $MAGP_3$ for the case of artisan vessels, and $MAGP_3$ for the trawlers. So there seems to be a link between the effective adjustment pattern happening in each sub-sector and the market prices of the second hand market vessels, because precisely, in the periods when the adjustments for each fleets have been most radical (i.e. MAGP2 and MAGP3 for the artisan fleet and MAGP3 for the trawlers) the price variations has been also higher, not only in magnitude but also in statistical significance. What all of this may be indicating? Since the fishing rights are concentrated in the hands of a lower number of hands, or to put in another words, since the remaining vessels increase their share in potential access rights, the resulting transaction prices my be force to increase.

For one side the shortage may induce price to move up. For another the gains in market power of the vessel owners may have also plaid a roll.

5 Conclusion and Economic Policy Recommendations

The result of this study suggests that there is a link between the evolution of the second hand market of fishing vessels and the European Fisheries Structural Policy. Effective capacity adjustments joint with a progressive tighten up of the requirements to access to European fishing grounds seems to have increased the hedonic price of a GT unit. Since building a new vessel requires the withdrawal of another with al least the same capacity, the second hand market of vessels stops being a mere market to buy-sell an asset and it in fact becomes in a market were fishing rights are exchanged. Evidence of this is that based on the applied hedonic model developed for the second hand Basque fishing vessels, the higher and statistically significant increases of prices precisely happens under the MAGP with major capacity adjustment: $MAGP_2$ and $MAGP_3$ in the case of inshore or artisan vessels and $MAGP_3$ in the case of offshore vessels (trawlers). This gives support to accept our hypothesis. Concretely our model deduces that: a) The inshore vessels sold during $MAGP_2$ reached 62%*** higher prices than the ones sold during $MAGP_1$. b) The inshore vessels sold during $MAGP_3$ reached a 53%*** higher price than the ones sold during $MAGP_2$. F) The offshore vessels sold during MAGP3 reached a 100%*** higher price than the ones sold during $MAGP_2$. K) The offshore vessels sold during $MAGP_3$ reached a 45%* higher price than the inshore ones sold during $MAGP_3$. M) The offshore vessels sold during SUB reached a 67%** higher price than the ones sold during $MAGP_1$. Thus taking into account that there is a narrow link between fisheries policy and the second hand market of vessels, policy makers should take into account the extra surplus that is being transferred to the vessels owners via second hand market when calculating the amount of decommissioning grant per gross tonnage. This way they may succeed in considerable budget savings.

References

1. Lancaster, K. (1966): Change and innovation in the technology of consumption. *American Economic Review* (1966).
2. Griliches, Z.: Hedonic price indexes for automobiles: an econometric analysis of quality change, Cambridge (MA). Harvard University Press (1971).
3. Rosen, S. (1974): Hedonic prices and implicit markets: production differentiation in pure competition. *Journal of Political Economy*. 82, 34-5 (1974).

4. Bayley, M.J., Muth, R.F. and Nourse, H.O.: A regression method for real estate price index construction. *Journal of the American Statistical Association*. 58(304), 933-942 (1963).
5. Boskin, M.J., Dulberger, E.R., Gordon, R.J., Griliches, Z. and Jorgenson, D.W.. Towards a more accurate measure of the cost of living. Final report to the Senate finance committee from the advisory Commission to study. The consumer price index, December 4). Senate Finance Committee. Washinton, DC (1996).
6. Van Dalen, J. and Bode, B.: Quality corrected price indexes: the case of Dutch new passenger car market, 1990-1999. Applied Economics. 36, 1169-1197 (2004).
7. Reis, H.J. and Silva, S.: Hedonic price indexes for new passenger cars in Portugal (1999-2001). Economic Modelling 23, 890-908 (2006).
8. Yu, K. and Prud'homme, M.: Econometric issues in hedonic price indixes: The case of Internet service providers. Paper presented at the Brookings Workshop on communications output and productivity (2007).
9. Williams, B. (2008): A hedonic model for Internet access service in the Consumer Price Index. Monthly Labour Review, July 2008, 33- 48 (2008).
10. Chow, G.: Technological Change and the Demand for Computers. *American Economic Review*. 57: 1117–30 (1967).
11. Berndt, E. R. and Neal J. R.: *Hedonics for Personal Computers: A Reexamination of Selected Econometric Issues*, presented at "R&D, Education and Productivity", an international conference in memory of Zvi Griliches. Paris, France (2003).
12. Leishman, 2001: House building and product differentiation: an hedonic price approach. Journal of Housing and the Built Environment. 16:131-152 (2001).
13. McCluskey, J.J. and Rausser, G.C.: Hazardous waste sites and housing appreciation rates. *Journal of Environmental Economics and Management*. 45, 166-176 (2003).
14. Bourassa, S.C., Hoesli, M. and Sun, J.: A simple alternative house price index method. *Journal of Housing Economics*. 15, 80-87 (2006).
15. Shimizu, C. and Nishimura, K.G.: Pricing structure in Tokyo metropolitan land markets and its structural changes: pre-bubble, bubble, and post-bubble periods. *Journal of Real Estate Financial Economics*. 36, 475-496 (2007).
16. Li, W., Prud'homme, M. and Yu, K.: Studies in hedonic resale housing price indexes. Paper presented to the Canadian Economic Association 40th Annual Meetings. Concordia University, Montréal (2006).
17. Triplet, J.: *Handbook on hedonic indexes and quality adjustments in price indexes.* OECD Publishing (2006).
18. Smith, B.A. and Tesarek, W.: House Prices and Regional Real Estate Cycles: Market Adjustments in Houston. *Real State Economics*. Volume 19 Issue 3, Pages 396 – 416, (2001).
19. Hidano, N.: The economic valuation of the environment and public policy: a hedonic approach. Northampton, MA: Edward Elgar (2003).
20. Kiel, K.A., McClain, K.T.: House prices during siting decision stages: the case of an incinerator from rumor through operation. *Journal of Environmental Economics and Management*. 28, 241-255 (1995).
21. Barzyk, F.: Updating the hedonic equations for the price of computers. Working paper of Statistics Canada. Prices Division. November.
22. Wooldridge, J.M. (1994): A simple specification test for the predictive ability of

transformations models. *Review of Economics and Statistics*. 76, 59-65.
23. Malpezzi, S.: Hedonic pricing models: a selective and applied review. In: O'Sullivan, T., Gibb, L. (Eds.). Housing Economy and Public Policy. Blackwell, Malder, MA (2003).
24. Davidson, R. and MacKinnon, J.G.: Several tests of model specification in the presence of alternative hypothesis. *Econometrica*. 49, 781-793 (1981).
25. Minzon, G.E. and Richard, J.F.: The encompassing principle and its application to testing non-nested hypotheses. *Econometrica*. 54, 657-678 (1986).
26. Box, E.P. and Cox, D.R.: An analysis of transformations. *Journal of the Statistics Society Series*. 26(2): 211-243 (1964).