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Measuring the economic efficiency of a crew share remuneration system: a case study of the Basque purse seiner-live bait fleet

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Abstract – Crew share remuneration systems are extensively used in fisheries as a way to tackle the moral hazard problem caused by asymmetric information distribution between the capital owner and the crew. To conduct a principal-agent analysis of such a system, it is important to know how it deals with fuel costs. This paper is based on economic efficiency indicator calculations and a number of simulations for the Basque purse seiner-live bait fleet to shed light on the crew-capital owner relationship in this principal-agent problem. We conclude that the share remuneration system can protect crewmembers from variations in fuel prices, which might be one of the factors explaining its popularity. However, some profit indicators are affected by the remuneration system and, thus, cannot be used for the comparisons of economic efficiency of the fleets.

Keywords: Purse seiner-live bait / fleet / crew remuneration / fuel price / profit

1 Introduction

A key motivator for commercial fishermen is profit. Profit is essentially driven by revenue, which is calculated by subtracting the cost of fishing from the price of the harvest. Revenue is determined by the total catch, whose price, once on the market, might differ depending on the fish species and size, fishing gear, handling, supply, demand, marketing efforts and freshness, among other factors (McConnell and Strand 2000; Guillen and Maynou 2014).

The dominant cost component depends on the fleet analysed (Daurès et al. 2013). Two of the main components are crew remuneration and fuel costs. The most extensively used type of crew remuneration is crew share (Zoeteweij 1956). In this system, the crews are paid a percentage of the catch value, after subtracting some costs. These costs depend on the country, region and/or fleet analysed. They might even change from vessel to vessel. The rationale behind the share remuneration system is to reduce the costs of obtaining the desired labour effort from the crew (Sutinen 1979).

Fuel costs are determined by the fuel price and consumption. Fuel consumption depends on the structure and size of the vessel, the engine condition and use patterns, the fishing gears used, the fishing and trip patterns, the distance to the fishing ground, the target species and their migration routes, and the established onboard traditions (Basurko et al. 2013).

Different crew remuneration systems can affect the fishery objectives and rent distribution in different ways (Guillen et al. 2015). Vestergaard (2010) reports a moral hazard problem caused by private information about the effort level of the crew. Crew remuneration systems are based on subtracting several cost elements from the total value of the catches. When the fuel cost is one of these elements, the rationale of the skipper for, e.g., selecting the fishing ground, is not based on just fish stock abundance but also on economic factors (Sampson 1991). Instead of considering the catch per unit of effort, the skipper considers the total revenue to be shared (after subtracting the fuel costs). This is good for the skipper and for the owner; in other words, the moral hazard problem is mitigated.

In the Basque Country (North-west of Spain), there is a traditional purse seiner-live bait fleet fishing the small pelagics using purse seine, and large pelagics (tuna) using hooks and live bait. This fishery is based on very old traditions (Astorkiza et al. 1998). The fleet has a share remuneration system where the fuel costs are not subtracted from the revenue to be shared. That is, fuel cost is paid by the vessel owner and not by the crew and the owner.

The objective of this paper is to explore the relationship between the two cost components fuel and crew wages in terms of the remuneration system in the special case of the Basque purse seiner-live bait fleet. The paper will also discuss the implications of the remuneration systems in the evolution of value-added distribution.

The relationship between the two highlighted components of fishing costs is of special interest in the concept of fishery

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sustainability. The total fishing costs determine the economic exploitation status, and hence, how the fleets will use the ecosystem to meet their needs. Additionally, the crew costs determine, at least partially, the social sustainability of the fishing activity. Our study shows the links between the ecological and social aspects of this activity and that any assessment of fisheries should consider this relationship.

To achieve this, changes in labour remuneration under different effort costs are analysed. We look at the changes in capital remuneration (profit) and the ways of measuring it, avoiding the problems caused by the link between the ecological and social aspects.

2 Materials and methods

2.1 Background on the Bay of Biscay Basque purse seiner-live bait fleet

The Basque purse seiner-live bait fleet is a surface fleet, centred on harvesting pelagic species. In the first half of the year, the fleet uses a purse seine to fish small pelagics like horse mackerel (*Trachurus mediterraneus*), mackerel (*Scomber scombrus*) and anchovy (*Engraulis encrasicolus*). In the second half of the year, they shift to poles and lines with live bait to harvest large pelagics like albacore tuna (*Thunnus alalunga*) and bluefin tuna (*Thunnus thynnus*), the North Atlantic stocks that migrate cyclically for feeding purposes. Using poles and lines is a matter of tradition. Currently, regional and national regulations prohibit fishing these stocks using the other dominant gear (in the Bay of Biscay), pelagic trawlers (Astorkiza et al. 1998).

The purse seiner-live bait fleet is considered an inshore fleet; however, the fishing area extends over the whole Cantabrian Sea and the Bay of Biscay (Fig. 1). When vessels of this fleet are fishing using a purse seine, they make trips of 1 or 2 days. When they work using live bait and especially when tunas are not close to the shelf, they take longer trips, of approximately one week.

The management of this fleet is based on a licence list system in which a list of vessels that can operate in the fishery is determined yearly by the Spanish authorities. This list is based on the historical operation of the vessels; it ensures that no other type of vessel enters the fishery. The number of vessels on this list is limited by a *numerus clausus* (Aranda and Murillas 2015).

As in many other Atlantic fisheries, there are output limits, including Total Allowable Catch (TAC), quotas and vessel quotas, for both types of tuna, anchovy, mackerel and horse mackerel. Bluefin tuna has been under the recovery plan regulation since 2007 (EC 2007) and a temporal individual transferable quota system (ITQ) is in place (Aranda and Murillas 2015; Prellezo and Curtin 2015). Mackerel is subject to a daily quota, while anchovy fishing is restricted by season (spring-season fishing is exclusive to the purse seiner fleet due to an agreement between French and Spanish fishermen (Lazkano et al. 2013). Anchovy fishing was forbidden (TAC equal to 0) from 2006 to 2009 (Andrés and Prellezo 2012).

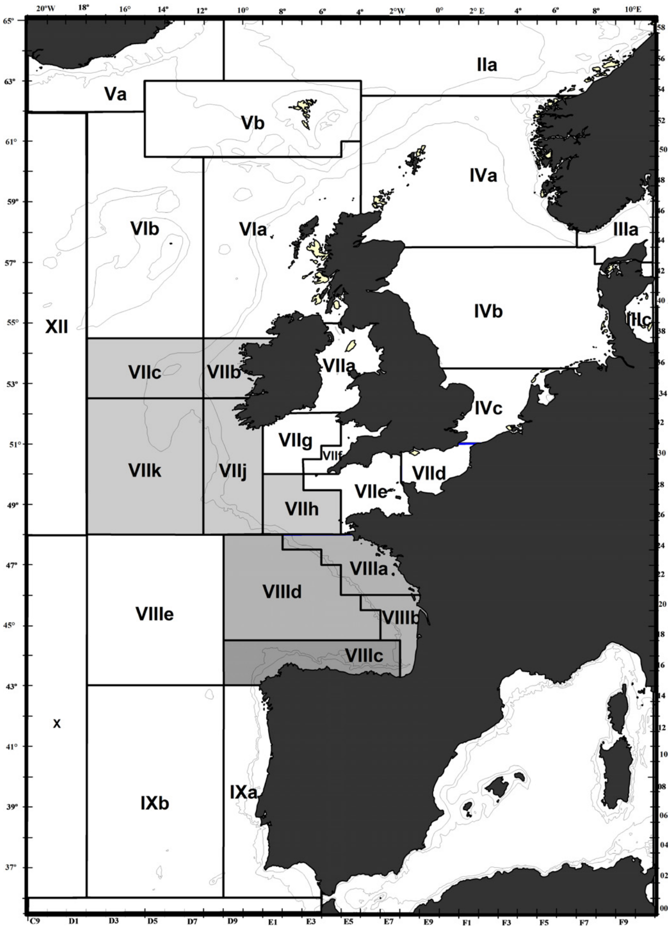

Fig. 1. Fishing area of the Basque purse seiner-live bait fleet.

2.2 Data used

The purse seiner-live bait fleet is registered as the North-West Cantabrian Purse Seiner Fleet in the Spanish Ministry of Agriculture, Food and Environment (MAGRAMA) fleet census.

Data were obtained from two different sources. Fleet information was compiled from the AZTI database. This database is maintained by the Spanish fleet monitoring system based on the Data Collection Framework of the European Union (EC 2008). There is full coverage of the landings of this fleet, using sale sheets. The number of vessels, crew members, vessel lengths and revenue by species are obtained annually at a métier level to distinguish the purse seine métier and the live bait métier. The period analysed was from the year 2010 to 2013.

Costs structure and cost data were provided by OPPEGI, the producer organisation to which this fleet belongs. Using a survey, all vessels of this fleet were sampled with a response rate of around 80%. From this survey, the gross value of landings and the main cost components for the period from 2010 to 2013 were obtained.

2.3 Capital value estimation

Capital value was estimated using the Perpetual inventory method (PIM). This method produces an estimate of the stock

Table 1. Scenarios tested.

	Crew remuneration system 1 Fuel is paid by the boat owner.	Crew remuneration system 2 Fuel is paid by the boat owner and the crew.
Fuel Scenario 1	The price of fuel is: 470, 640, 718 and 690 €/ton, for year 2010 to 2013, respectively.	
Fuel Scenario 2	The price of fuel is: 630 €/ton equal to the average of the years 2010 to 2013.	

of fixed assets in existence and in the hands of producers. This is done by establishing the number of surviving fixed assets, installed as a result of gross fixed capital formation undertaken in previous years (Lange 2004). This method is considered an adequate way of estimating the capital value by the Scientific, Technical and Economic Committee for Fisheries (STECF; see, for example, STECF 2011).

2.4 Selection of indicators

Profit indicators used are the economic indicators used by the STECF to evaluate the balance between capacity and fishing possibilities defined in the European Commission Guidelines (COM 2014). To be more precise, the particular profit indicator used in the analysis is the full equity profit, i.e., the profit that the boat owner would have obtained if there were no debt. The full equity profit is calculated by subtracting the variable and fixed costs from the income. The income, in this case, has two components. Overall, it could be considered the gross value of landings. However, as the quota of bluefin tuna for the years 2011 to 2013 has been sold, it also includes this income. Variable costs are those changing with the value of landings, such as the landing fee and crew remuneration, and those changing with the fishing effort, such as fuel cost and other variable costs. Other variable costs are the sum of expenses for motor oil, bait and ice. Fixed costs change from year to year but are independent of the effort expended. They include repairs, maintenance, insurance premiums, and administration costs.

The full equity profit indicator is chosen because the interest paid is not a true economic cost. This full equity profit divided by the invested capital (the stock of capital calculated in Sect. 2.4) provides the Return on Investment (ROI). ROI should ideally be compared with a risk-free rate of return on investment coming from outside the fishery. A safe approach is to use the average long-term Treasury Bond Rate (TBR) (see, for example, Cambiè et al. 2012). According to the Central Bank of Spain (www.bde.es), these bonds have given the rates of 3.97, 4.14, 4.47 and 4.78 (for the years 2010 to 2013, for Spain). When ROI is lower than the TBR, investment elsewhere is more profitable and it would be inefficient to invest in that particular fleet segment (and for TBR lower than the ROI, vice versa).

In terms of labour productivity, the selected indicator was the average gross wage of the crew, as in the study of Wagner (2002). It is important to note that this wage differs depending on the role of each crew member on the vessel; there are crewmembers with wages higher and lower than the average. The average wage was compared (as a reference) with the general average salary in Spain in 2013, 25824 €/year, according to the Central Bank of Spain (www.bde.es).

Table 2. Purse seiner-live bait fleet characteristics from 2010 to 2013. Including number of vessels, total fishing days, total gross registered tonnage (GRT), gross tonnage (GT), total horse power (HP) and mean length in meters.

Purse seiner-live bait	2010	2011	2012	2013
N° vessels	43	43	43	39
Total fishing days	5676	5590	5504	4485
Total GRT	6179	6229	6003	5655
Total GT	7418	7543	7194	6771
Total CV	27 694	28 066	26 936	25 377
Mean length (m)	32	33	32	32

Source: AZTI-Tecnalia.

2.5 Simulations performed

The following scheme was set up to analyse the relationship between different remuneration systems and changes in fuel costs.

Firstly, two remuneration systems were defined as described in Figure 2. Remuneration System 1 is the one used by the Basque purse seiner-live bait fleet, and Remuneration System 2 is the system used in the rest of Spain.

Secondly, fuel costs change. In Fuel Scenario 1, the values observed during the studied period were used, and in Fuel Scenario 2, the average value for the period of 2010–2013. The scenarios were selected to examine the effects of the crew remuneration system under different fuel prices. Table 1 presents all the combinations of scenarios.

3 Results

3.1 Evolution of the fleet

Table 2 shows that the number of vessels remained quite stable during the last four years (43 vessels), with a decrease to 39 vessels in the year 2013. Total gross registered tonnage (GRT) and gross tonnage (GT) of the fleet decreased by 8% and 9%, respectively. The mean vessel length remained stable. There were, on average, 15 people per vessel.

The average fishing days per vessel decreased to protect profitability against fuel cost increases.

3.2 Income structure

The fishing activity of this fleet is split into two métiers: purse seiners and live bait. For years 2010–2013, purse seiners

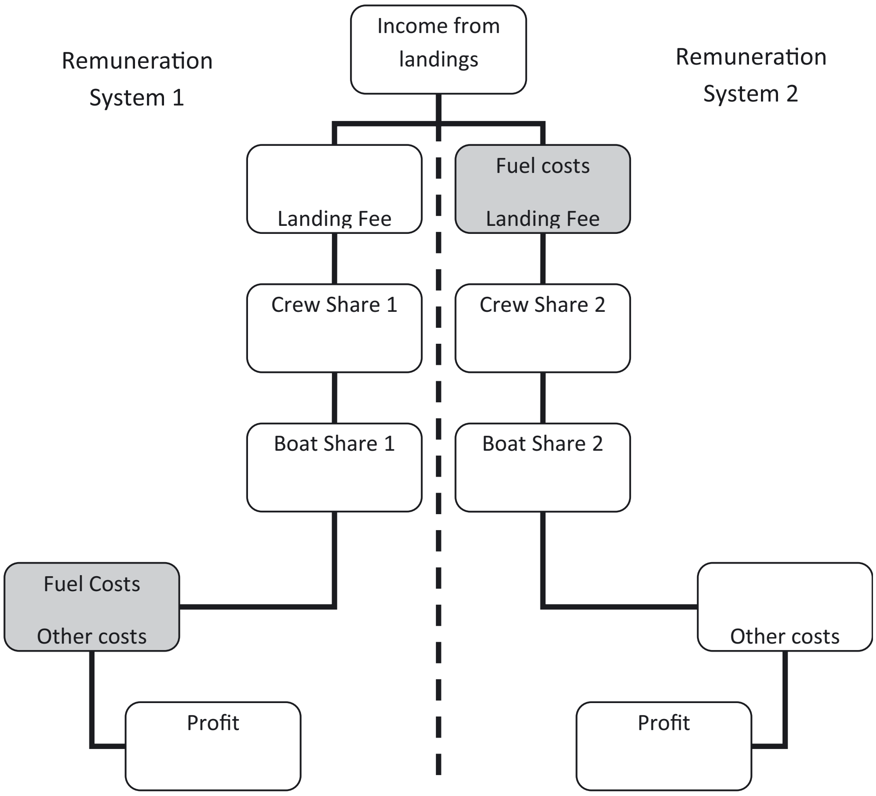

Fig. 2. Scheme of the simulation.

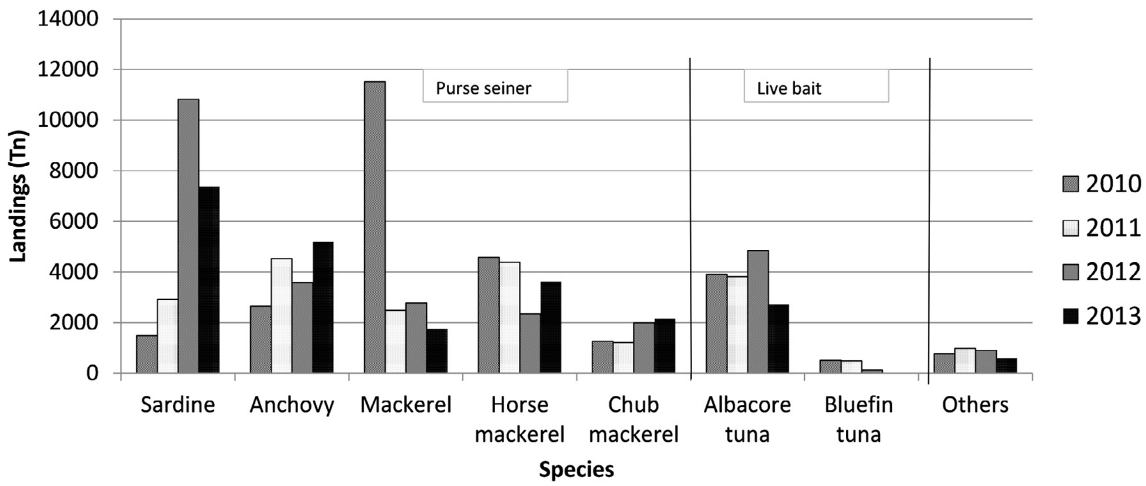

Fig. 3. Landings in tonnes by species and métier of purse seiner-live bait fleet from 2010 to 2013.

obtained larger total landings than live-bait activities (approximately 85% vs. 15% of total weight and 61% vs. 39% of the value). The landing composition by species was completely different in the two métiers (Fig. 3). For the purse-seine métier, the main species were sardine, anchovy, mackerel and horse mackerel, and for the live-bait métier, albacore tuna and bluefin tuna.

When the data is presented as value (€) instead of weight (Fig. 4), we can see a change in the importance of species. Considering income by species, anchovy was the most important for purse seiners and albacore tuna, for the live-bait métier.

3.3 Cost structure

The fleet consists of single-vessel companies where the owner of the vessel is one of the crew.

The cost structure of this fleet is different from many other fleets. Only the landing fee (3.1% of the gross landing value) is subtracted from the revenue to determine the crew share (50%) and the boat share (50%). The fuel is paid by the boat share. Nevertheless, this is not the only remuneration obtained by the capital owner; as a skipper, he also receives a part of the crew share. The remaining costs are subtracted from the boat share,

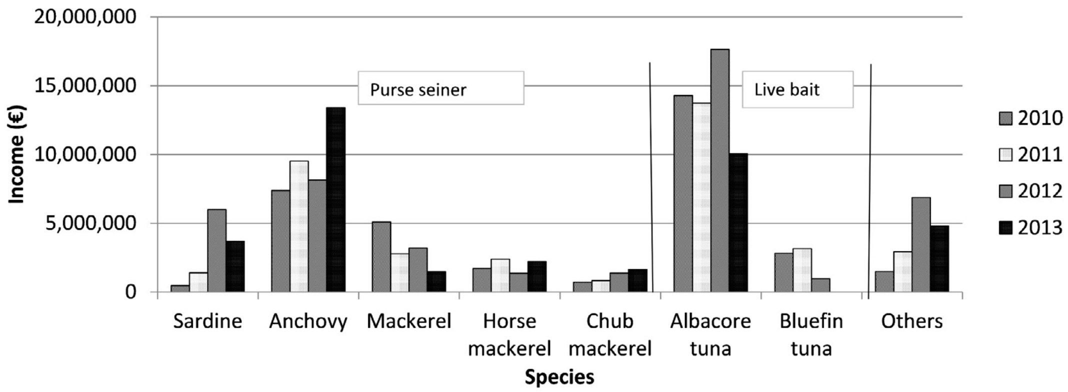

Fig. 4. Income in euros by species and métier of purse seiner-live bait fleet from 2010 to 2013.

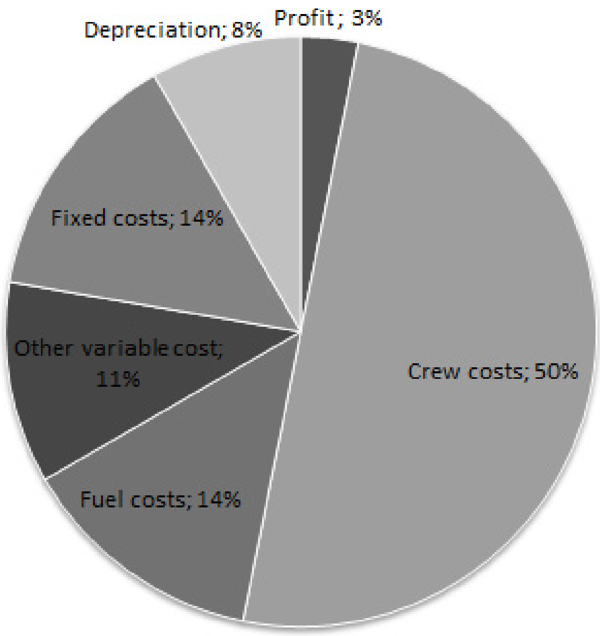

Fig. 5. Cost structure and composition of the value-added of the purse seiner-live bait. average values from 2010 to 2013.

including fuel costs. This cost structure was the same for all vessels of this fleet.

Apart from crew remuneration, the cost of fuel is one of the largest expenditures. In 2013, fuel costs represented between 28% and 41% of the boat share, depending on the vessel. On average, these costs are approximately 14% of the value of gross landings (Fig. 5). The fixed costs represent the same value percentage. Other variable costs account for 11% of the value of landings (Fig. 5). Finally, depreciation of the capital value accounts for approximately 8% of the gross landing value (Fig. 5).

Figure 5 shows how the value-added is divided between capital remuneration (6%) and labour remuneration (94%).

3.4 Capital value

The average capital value by vessel for the years 2010 to 2013 (inflated to 2013 using the Spanish inflation rate) using PIM was estimated. PIM calculates the gross capital stock as the sum of gross fixed capital formation in the previous years, whose service life has not expired yet. The average values obtained were 1 056 816 €, 1 121 457 €, 1 156 720 € and 1 151 441 € per year and vessel for the 2010–2013 time series.

It was found that the average capital value per vessel increased while the number of vessels decreased by 9% in the last two years. This implies that either some low capital-intensive vessels left the fishery or the remaining ones intensified their investment activities.

3.5 Capital and labour productivity under Crew Remuneration System 1

Under crew remuneration system 1 (CRS 1), the fuel cost is not deducted from the crew share, as is the case in the Basque purse seiner-live bait fleet (see Fig. 2).

The ROI (top-left of Fig. 6), except for the year 2012, was well below the Spanish bond interest rate, implying that there were alternatives providing better returns on investment of this capital. Average wages (bottom-left of Fig. 6) did not change significantly (an increase of less than 1.5%) and they were above the Spanish average salary (except for the year 2011).

If a fixed fuel price (the average price in the 2010–2013 period) is assumed, it gives a situation close to the year 2011. Figure 6 (top right) shows that this assumption has a major effect on the ROI indicator. The ROI decreases if the benchmark (the year 2010) is lower and increases if the benchmark is higher (years 2012 and 2013). However, wages remain constant (bottom-right of Fig. 6). This is because, in Remuneration System 1, wages are protected against the variations in fuel price; at least if there are no tactical reactions of the fleet to these changes.

3.6 Capital and labour productivity under Crew Remuneration System 2

In this case, the capital and labour indicators were simulated assuming that the Basque purse seiner-live bait fleet would have used Remuneration System 2 (see Fig. 2). To achieve this, the crew share had to be calibrated to match the

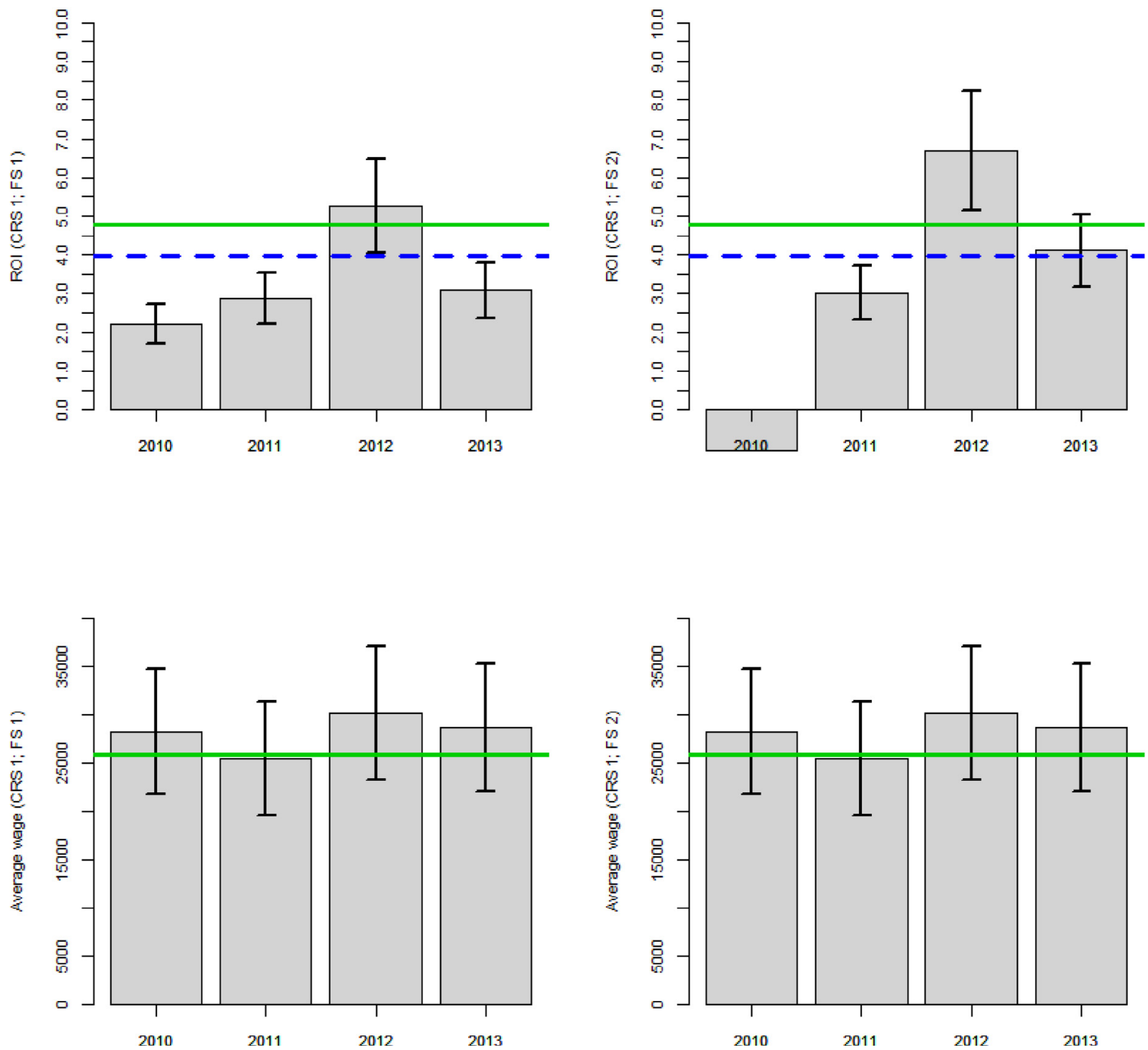

Fig. 6. Differences between the Return of Investments (ROI) and average wages in the crew remuneration dystem (CRS) 1 (see Table 1) under the two different fuel scenarios (FS). The continuous line in ROI graphs shows the highest Treasury Bond Rate (TBR) and the dotted line in the ROI graphs, the lowest TBR of the analysed period. The line in the average-wage graphs represents the average wage in Spain.

salaries of 2011. The crew share had to be increased by 0.5% to 0.581%.

Figure 7 shows that, in contrast to CRS 1, wages would vary. For example, in the year 2010 when the fuel cost was lower than the average value, the average wage would be 5% lower.

The results shown in Figures 6 and 7 can also be compared. The comparison showed that using CRS 1, the change in the value-added caused by a variation in the fuel price was absorbed only by capital remuneration (changing the ROI, but not the wages). In the case of a remuneration system with the fuel cost deducted from the crew share (CRS 2), a change in the fuel cost affected both the capital and labour remuneration.

In this context, the gross value-added (GVA) does not make a distinction between the crew and capital remuneration. This is important as an indicator of economic efficiency. Figure 8 shows that even though the shares differ depending on the crew remuneration system, the overall GVA remains the same.

4 Discussion

Share systems are examples of the principal-agent problem, where the agents (crew) are paid by the principal (owner of the vessel) using a share of the revenue obtained by selling the catch. These types of contracts are used by vessel owners to pass some of the risks to the crew, reducing the cost of risk. The principal-agent problem arises when the agents know or will know more than the principal, creating a moral hazard problem (Mas-Colell et al. 1995), or when their interests conflict in some way (Sappington 1991). The share system used in the purse seiner-live bait Basque fleet is a type of principal-agent system where the moral hazard problems are reduced as the principal is one of the crew. However, there is a conflict because the crew has incentives to maximise the revenue at any cost; the fuel is paid for by the vessel owner. At the same time, the vessel owner as a crewmember is more interested in the profitability of any additional fishing effort unit. The share system used in this type of vessels is used to spread the risk

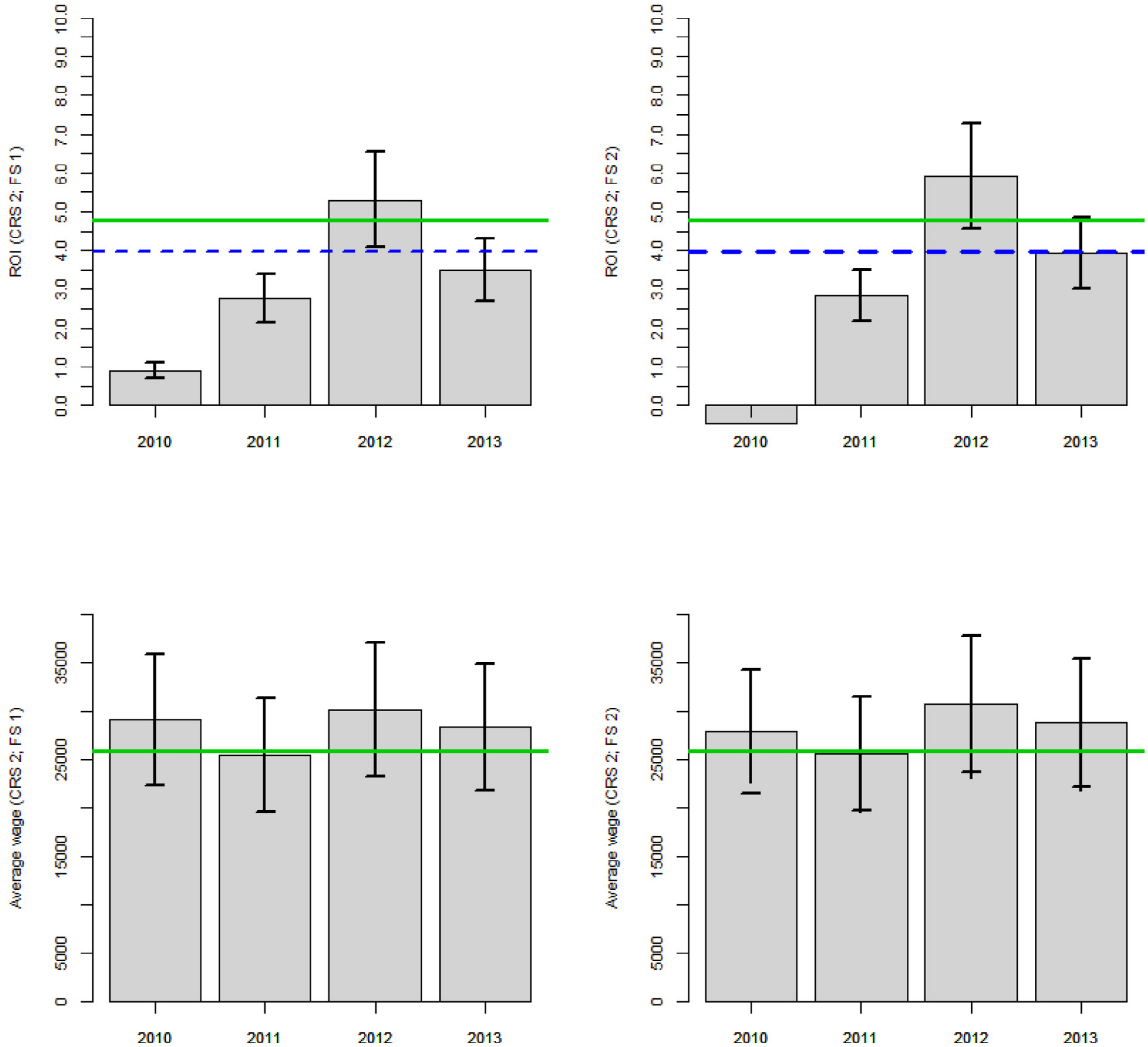

Fig. 7. Differences between the Return of Investments (ROI) and average wages for the crew remuneration system (CRS) 2 (see Table 1) under two different fuel scenarios (FS). The plain line in ROI graphs represents the highest Treasury Bond Rate (TBR) and the dotted line in the ROI graphs, the lowest TBR of the analysed period. The line in the average wage graphs shows the average wage in Spain.

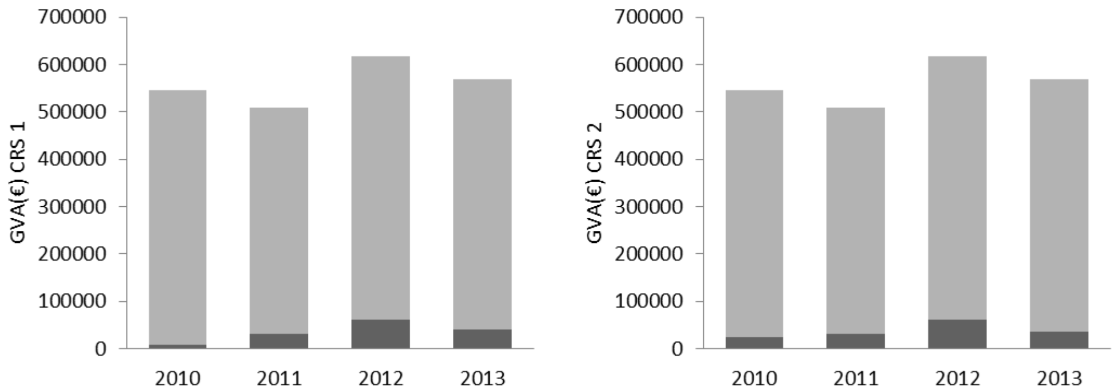

Fig. 8. Gross value added (GVA) composition for CRS 1 (left) and CRS 2 (right) under the same fuel scenario (FS1). The dark bar represents the capital remuneration and the light bar, the crew remuneration.

between the owner and the crew. The risk comes in the form of either variation in the availability/accessibility of the stocks or changes in the cost of additional effort to catch the fish. In the fleet analysed here, the main costs are salary and fuel costs. The latter is paid by the owner, which implies that the wages are only affected by the variations in the availability/accessibility of fish resources. Thus, a share system provides a link between the ecological and social dimensions of fishery sustainability.

This crew protection might be broken down by the ITQ system approved by the Spanish government (see Prellezo and Curtin (2015) or Aranda and Murillas (2015) for further details) for the bluefin tuna. The fleet sold a part of their quota of this species in the year 2011 and the whole quota in the years 2012–2013. The sale of this quota represented between 10% and 20% of the yearly income, depending on the vessel and year. In principle, this sale should go against the crew given that the quota belongs to the vessel. However, even in this case, there was an agreement between the owner and the crew and the value of the quota was shared on a 50–50 basis.

This type of protection creates incentives to retain the crew; however, the total number of crew in the fleet decreased. The number of crewmembers per vessel has remained stable for the last 20 years, but the number of vessels has been reduced. According to the Basque Statistical Office (www.eustat.es), from 2005 to 2015, the number of Basque purse seiner-live bait vessels decreased by 30%. There are many reasons for this decrease (see, for example, Cordón Lagares and García Ordaz 2015); one of them is the share system. When capital remuneration, as shown, depends on the share system used, the return on investment is also affected. If the share system protects crew remuneration during periods of increasing fishing costs, capital remuneration will be reduced. This implies that the economic activity of fishing will be less attractive and capital owners will reinvest less and/or leave the fishery.

Considering the regional fleet evolution of the overall Spanish fleet during the period of 2003–2007, the number of vessels in the Basque fleet decreased by 11.47% while, in the Galician fleet, it increased by 19.5% (Garza-Gil et al. 2011). The share system does not explain this differential evolution completely. However, since capital remuneration is so different, and the remuneration is affected strongly by fuel costs for the Basque fleet and only partially for the rest of Spain, the capacity of this capital remuneration to cover the depreciation of the capital was (and is) more limited.

In addition, the analysis of capital remuneration using a single indicator such as profit (or full equity profit in this case) could be misleading. Profit (actual or expected) is a key factor in investment decisions. However, with no clear separation between labour and capital, the results might be misunderstood. In this case, there is a problem of mixed rents, i.e., it is difficult to see whether the remuneration is derived from the labour performed or from the capital invested (Guyader et al. 2013).

Literature has failed to use profit as a main component of entry/exit decisions. The reason is that the computation of individual surplus usually requires detailed cost data, which are difficult to obtain and often confidential. In the absence of profit data, revenues have been used as a proxy for economic viability in some studies (Tidd et al. 2011; Cordón Lagares and García Ordaz 2015). The results obtained from our analysis propose the mixed rent problem as an additional reason for not using profit even if the data for calculations are available. As pointed out by Boncoeur et al. (2000), an estimate of the value of owner/operator labour is important when assessing the ROI. For the Basque purse seiner-live bait fleet, this labour is implicit in the crew cost as the owner is one of the crew. However, when this is not the case, an estimate is required. Another example of this mixed rent problem can be seen in the STECF report of the balance between fleet capacity and fishing opportunities (STECF 2015). In this report, one can see the values of 30% and 70% for ROI in the same period and for the segment of 24-m to 40-m long purse seiners, which is the fleet segment studied here. These values are very different from 3% and 4% obtained in our analysis. There could be many reasons for this difference, but one of these is that profits of this segment, as measured in the STECF report, could include part of the labour remuneration, increasing the ROI indicator value.

5 Conclusions

Fuel costs and crew remuneration are two important cost items in many fisheries. When a share remuneration system is used, there is a clear link between the two items. In the Basque purse seiners-live bait fleet, the system protects crew remuneration against changes in fuel costs. However, it also affects capital remuneration and, hence, fleet evolution.

To follow this argument, economic indicators based on profits can be misleading. The GVA could be used as the main economic indicator; it does not make any assumptions of how the value-added is shared between labour and capital. This indicator might be less useful in the analysis of fleet investment dynamics. However, it avoids the mixed rents problem in comparisons of the economic performance of the fleets.

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References

Andrés M., Prellezo R., 2012, Measuring the adaptability of fleet segments to a fishing ban: the case of the Bay of Biscay anchovy fishery. Aquat. Liv. Resour. 25, 205–214.

Aranda M., Murillas A., 2015, Allocation of fishing possibilities, incentives and outcomes: Insights from Basque fishermen's organisations in Spain. Marine Policy 61, 171–178.

Astorkiza K., del Valle Erkiaga I., Ikazuriaga I.A., 1998, Fisheries policy and the Cofradias in the Basque country: the case of Albacore and Anchovy. Universidad Pública de Navarra, Departamento de Economía.

Basurko O.C., Gabiña G., Uriondo Z., 2013, Energy performance of fishing vessels and potential savings. J. Clean. Prod. 54, 30–40.

Boncoeur J., Coglan L., Gallic B.L., Pascoe S., 2000, On the (ir)relevance of rates of return measures of economic performance to small boats. Fish. Res. 49, 105–115.

Cambiè G., Ouréns R., Vidal D.F., Carabel S., Freire J., 2012, Economic performance of coastal fisheries in Galicia (NW Spain): case study of the Cíes Islands. Aquat. Liv. Resour. 25, 195–204.

COM, 2014, 545 final. Communication from the Commission to the European Parliament and the Council. Guidelines for the analysis of the balance between fishing capacity and fishing opportunities according to Art 22 of Regulation (EU) No 1380/2013 of the European Parliament and the Council on the Common Fisheries Policy.

Cordón Lagares E., García Ordaz F., 2015, Factors influencing the decision to leave a fishery and the effects of fishery subsidies: The case of the Spanish purse seine fishery. Ocean Coastal Manage. 116, 248–256.

Daurès F., Trenkel V.M., Guyader O., 2013, Modelling the fishing costs of French commercial vessels in the Bay of Biscay. Fish. Res. 146, 74–85.

EC, 2007, Council Regulation (EC) No 643/2007 of 11 June 2007 amending Regulation (EC) No 41/2007 as concerns the recovery plan for bluefin tuna recommended by the International Commission for the Conservation of Atlantic Tunas, OJ L 151, 13.6.2007.

EC, 2008, Council Regulation (EC) No 199/2008 of 25 February 2008 concerning the establishment of a Community framework for the collection, management and use of data in the fisheries sector and support for scientific advice regarding the Common Fisheries Policy.

Garza-Gil M.D., Varela-Lafuente M., Caballero-Miguez G., Álvarez-Díaz. M., 2011, Analysing the profitability of the Spanish fleet after the anchovy moratorium using bootstrap techniques. Ecol. Econ. 70, 1154–1161.

Guillen J., Macher C., Merzereaud M., Boncoeur J., 2015, Effects of the Share Remuneration System on Fisheries Management Targets and Rent Distribution. Marine Resource Economics 30, 123–128.

Guillen J., Maynou F., 2014, Importance of temporal and spatial factors in the ex-vessel price formation for red shrimp and management implications. Mar. Policy 47, 66–70.

Guyader O., Berthou P., Koutsikopoulos C., Alban F., Demaneche S., Gaspar M., Eschbaum R., Fahy E., Tully O., Reynal L., 2013, Small scale fisheries in Europe: A comparative analysis based on a selection of case studies. Fish. Res. 140, 1–13.

Lange G.-M., 2004, Wealth, Natural Capital, and Sustainable Development: Contrasting Examples from Botswana and Namibia. Environmental and Resource Economics 29, 257–283.

Lazkano I., NØstbakken L., Prellezo R., 2013, Past and future management of a collapsed fishery: the bay of Biscay Anchovy. Nat. Res. Model. 26, 281–304.

Mas-Colell A., Whinston M.D., Green J.R., 1995, Microeconomic theory. Oxford University Press New York.

McConnell K.E., Strand I.E., 2000, Hedonic prices for fish: tuna prices in Hawaii. Am. J. Agr. Econ. 82, 133–144.

Prellezo R., Curtin R., 2015, Confronting the implementation of marine ecosystem-based management within the Common Fisheries Policy reform. Ocean Coastal Manage. 1–9.

Sampson D.B., 1991, Fishing tactics and fish abundance, and their influence on catch rates. ICES Journal of Marine Science: Journal du Conseil 48, 291–301.

Sappington D.E., 1991, Incentives in principal-agent relationships. J. Econ. Perspectives, 45–66.

STECF, 2011, Review of economic data collected in relation to the DCF and harmonisation of sampling strategies.

STECF, 2015, Scientific, Technical and Economic Committee for Fisheries (STECF) Ű Assessment of balance indicators for key fleet segments and review of national reports on Member States efforts to achieve balance between fleet capacity and fishing opportunities (STECF-15–15). 2015. Publications Office of the European Union, Luxembourg, pp. 160.

Sutinen J.G., 1979, Fishermens Remuneration Systems and Implications for Fisheries Development. Scottish J. Political Econ. 26, 147–162.

Tidd A.N., Hutton T., Kell L.T., Padda G., 2011, Exit and entry of fishing vessels: an evaluation of factors affecting investment decisions in the North Sea English beam trawl fleet. ICES Journal of Marine Science: Journal du Conseil 68, 961–971.

Vestergaard N., 2010, Principal-agent problems in fisheriesHandbook of Marine Fisheries Conservation and Management. Ed. R. Quentin Grafton, Ray Hilborn, Dale Squires, Maree Tait and Meryl Williams. Oxford University Press, pp. 563–571.

Wagner J., 2002, The causal effects of exports on firm size and labor productivity: first evidence from a matching approach. Econ. Lett. 77, 287–292.

Zoeteweij H., 1956, Fishermen's remuneration. In: Turvey R., Wiseman J. (Eds.) The economics of fisheries. Rome, FAO.