

**Benito ARRUÑADA**  
Pompeu Fabra University  
Department of Economics and Business  
Trias Fargas, 25. E-08005-Barcelona (Spain)  
Tel. +34 3542 2572; Fax +34 3542 1746  
E-mail: Benito.Arrunada@econ.upf.es

**Manuel GONZÁLEZ**  
University of Oviedo  
Department of Business Administration  
Av. del Cristo, s./n. E-33071-Oviedo (Spain)  
Tel. +34 8510 2807; Fax +34 8523 6670  
E-mail: mgonzale@hp845.econo.uniovi.es

# **How Competition Controls Team Production: The Case of Fishing Firms**

JEL codes: J33, J41, L14, L20, Q22

**November, 1997**

## **How Competition Controls Team Production: The Case of Fishing Firms\*\*\***

### **Abstract**

Under team production, those who monitor individual productivity are usually the only ones compensated with a residual that varies with the performance of the team. This pattern is efficient, as is shown by the prevalence of conventional firms, except for small teams and when specialized monitoring is ineffective. Profit sharing in repeated team production induces all team members to take disciplinary action against underperformers through switching and separation decisions, however. Such action provides effective self-enforcement when the markets for team members are competitive, even for large teams using specialized monitoring. The traditional share system of fishing firms shows that for this competition to provide powerful enough incentives the costs of switching teams and measuring team productivity must be low. Risk allocation may constrain the organizational design defined by the use of a share system. It does not account for its existence, however.

**Keywords:** Theory of the Firm, Team Production, Share Contracts, Profit Sharing, Remuneration Systems, Self-Enforcement, Fishing Firms.

---

\* Professor of Business Organization, Pompeu Fabra University, Barcelona (Benito.Arrunada@econ.upf.es).

\*\* Assistant Professor of Business Organization, University of Oviedo (mgonzale@hp845.econo.uniovi.es).

\*\*\* The research assistance of Begoña López and comments by participants at workshops held at the Universities of Maastricht, Carlos III and Pompeu Fabra, and the annual meetings of ACEDE and ISNIE, as well as by Harold Demsetz, Alberto Fernández, Dean Lueck, Eloy Martín Corrales, Scott E. Masten, Claude Ménard, Jackson Nickerson, Mancur Olson, Cándido Paz-Ares and Eduardo Rodes are gratefully acknowledged. Usual disclaimers apply. Work on this project has been supported by the DIGES, a research agency of the Spanish Government, through grant PB95-0989.

## 1. Introduction: Team Production and the Organizational Structure of the Firm

What is so rare about fishing that makes residual claim labor contracts so prominent and fixed wage labor contracts so rare? A wide variety of crews ranging in size from two to one hundred and using all kinds of fishing technologies have for ages been paid in a unconventional way by receiving shares in the catch. The main purpose of this paper is to explain this apparent anomaly. In so doing we also expect to learn about the conditions that make the conventional structure of the firm prevalent, featuring a labor contract with wages unrelated to the firm's product.

Alchian and Demsetz (1972) characterized team production by two features. First, the production of the team is greater than the aggregation of individual products. Second, it is costly to ascertain the contribution of every team member to the team product. Thus, assuming utility-maximizing individuals, it is necessary to put in place mechanisms to avoid shirking or free riding, which we will refer to as *control* systems.

From the point of view of the contractual costs involved in team production, the main design problem consists of finding the minimum of a total cost with two components: (a) First, the *cost of collective action*, caused by the proclivity of team members to shirk when their compensation does not vary with individual productivity (this is a residual loss in comparison with the ideal collective optimum). (b) Second, the *cost of control*, derived from the fact that in order to contain the collective action cost, mechanisms must be put in place to estimate individual contributions and pay team members in accordance with these estimations. The objective is to internalize in each individual the consequences that his behavior has for the performance of the whole team. This is achieved by means of different control systems that are more or less cost-effective depending on the level of internalization they can achieve. Additionally, organizations structure teams in terms of size and hierarchy and carefully assign decision rights among teams and team members.<sup>1</sup> These decisions make up the problems of

---

<sup>1</sup> See, on this, Jensen (1983) and, mainly, Jensen and Meckling (1992).

internal divisionalization of the organization. We will assume, however, that these solutions as well as bonding activities by team members are not important in our context.

Under the Alchian and Demsetz conditions of team production —i.e., when the marginal productivity of each individual is costly to ascertain—, an organizational pattern that pays a residual only to the party who controls individual productivity tends to be optimal as a way of motivating him to perform this control function efficiently. This party has the right to renegotiate all contracts and holds an exclusive right to the residual claim to the firm's value. Under such conditions, profit sharing is thought to be efficient only for small teams and when specialized monitoring is ineffective.<sup>2</sup>

This paper studies a case where, even if these conditions do not hold, a compensation pattern based on profit or revenue sharing is efficient. The empirical evidence and the analysis made in the paper show that under certain conditions (mainly low costs of switching teams and measuring the team's product) a solution might be optimal in which the residual-claimant status of the controller *seems* to be diluted. Making team members residual claimants in the short run better ensures that all kinds of underperforming conduct is promptly penalized. Competition for good team members amongst teams thus secures optimal performance levels in the long run.<sup>3</sup> This result indirectly suggests that the conventional structure of capitalist firms is connected to the prevalence of conditions that are substantially different from those we observe in the fishing industry.

The problem of fishing firms is closely related to but different from that of share contracts. The terminology here might be confusing. In a share contract there is also more than one

---

<sup>2</sup> See, e.g., Alchian and Demsetz (1972, pp. 785-786).

<sup>3</sup> Alchian and Demsetz (1972, p. 781) already mentioned that strictly market-based competition may act as a monitor of team performance. They focussed on competition exerted by potential team members offering to replace shirking members. (See also Alchian and Allen, 1983, p. 171.) We will see that in the fishing industry competition takes place through the departure of the most productive workers to the best performing teams, which motivates efficient monitoring even under profit sharing. To the extent that there are also dismissals, the fishing system might be seen as not completely market-based. However, this would be incorrect, as incentives to dismiss underperformers are mainly provided by the possibility that, otherwise, the best performers leave the team.

residual claimant.<sup>4</sup> However, the standard problem in a share contract has to do with bilateral relations, whereas the distinguishing feature of fishing firms is that a kind of profit-sharing is applied to teams which range from two to close to a hundred direct contractual parties (or more than that in some non-fishing but similar activities, like privateering). This defines a substantially different problem.<sup>5</sup> One way of looking at this difference is to consider both the share contract and “teamsharing” as enforcement devices. Share contracts are generally thought to provide self-enforcement through the direct effect that sharing has on the incentives of the parties (e.g., motivating work effort or discouraging opportunistic renegotiation or exit). However, these effects either become trivial when the number of parties increases enough (work effort),<sup>6</sup> or are thought to be irrelevant in fishing (renegotiation being controlled by repetition and premature exit being simply impossible in the vast majority of cases). The presence of indirect effects the effectiveness of which is independent of team size is needed for sharing to provide effective enforcement of team contracts in general, of which bilateral sharing is only the simplest case. This paper focus on these indirect effects, connected as mentioned to market competition.

The paper is structured as follows. Section 2 firstly describes a cross-section sample of fish sharing systems and then presents historical evidence of the prevalence of sharing not only in fishing but also in piracy. Section 3 shows that fish sharing may be explained as a way of

---

<sup>4</sup> There is a huge literature on sharecropping. Initial analyses by Cheung (1969) and Stiglitz (1974) focused mainly on risk-allocation. Later on, transaction costs explanations played the main role. Among the latter, Hallagan (1978); Alston, Samar and Nugent (1984); Allen (1985); Eswaran and Kotwald (1985); and Allen and Lueck (1992, 1993 and 1996); among many others.

<sup>5</sup> The literature on fishing firms nevertheless parallels that of sharecropping. The share system in the fishing industry has mainly been considered as a mechanism for dealing with uncertainty and for spreading out the risk among all fishery members [see Sutinen (1979), Bodvarsson (1987, pp. 424-7), Plourde and Smith (1989, pp. 181-4) and Platteau and Nugent (1992, pp. 390-8)], even if some moral hazard and adverse selection arguments have been advanced to explain some features of the arrangements [see Platteau and Nugent (1992, pp. 398-408), Gifford (1993, pp. 143-145), and Matthiasson (1997, pp. 11-18)]. Both arguments are also present in anthropological works, although the risk argument is more explicit: see, e.g., Firth (1966, pp. 256-7), Forman (1970, p. 83), McGoodwin (1979, pp. 331-4) and Acheson (1981, p. 278).

<sup>6</sup> This is also the reason for another difference. Share contracts are thought to substitute for direct supervision of effort (e.g., Alston and Higgs, 1982). However, fish sharing does not eliminate the need for monitoring, which is one of the crucial roles played by captains, skippers and other officers.

generating powerful incentives by means of competition amongst teams for the best productive resources. It focuses on the role that low switching costs play in allowing this competition to play an effective role. Section 4 shows the role of measurement costs in allowing different share solutions focussing on two issues. First, how the low cost of measuring team product is necessary for team-sharing to be used. Second, how cost-sharing similarly depends on the costs of measuring specific inputs. The role of risk allocation is analyzed in Section 5. First, the simple risk-spreading argument is rejected as a rationale for the share system. It is shown that risk allocation might play a constraining role however. Thus, some contractual patterns might be understood as risk allocation instruments, although explanations based on incentives and measurement costs seem equally plausible. Exceptions to the share system are explained in Section 6 as adaptations to specific circumstances. Finally, Section 7 presents a summary and some concluding remarks.

## **2. Types of Sharefishing Systems**

Three main systems must be considered when analyzing the organizational variations in firms in the fishing industry from the point of view of their compensation patterns: full profit sharing in small boats, partial profit sharing in medium-sized boats and revenue sharing in the largest vessels (Table 1). These structures are relatively consistent across different countries and branches of the fishing industry.<sup>7</sup> They are therefore related by their consequences rather

---

<sup>7</sup> Our data comes from a large number of intensive case studies and two statistical samples, mainly refers to vessels physically based in the North of Spain which are registered and fish all over the world. Their compensation structures are similar to those used in other countries and in earlier times, however. Perhaps the most comprehensive survey on this topic is a report by the International Labor Office (1952), which shows that the share system is the dominant practice all around the world. This coincides with a more recent survey of the Food and Agriculture Organization (1992, section on “Fisheries Data”). Acheson (1981) also offers relevant references in countries as diverse as Canada, Sweden, Mexico, Sri Lanka, Ecuador or Ghana. For other specific areas, see Firth (1946, pp. 235-57), Zoetewij (1956), Forman (1970, pp. 81-92), Gaur (1970), Pollnac (1978), McGoodwin (1979), Sutinen (1979), Barandiarán (1982), Bodvarsson (1987), Lleonart (1988), Plourde and Smith (1989), and Craig and Knoeber (1992). We also have evidence of its existence in Spain at least as far back as the XVIII century (Sáñez, 1791-1795, pp. 321-322).

than by their origins, and are probably the result of parallel evolution — an efficient answer to common environmental pressures. Let us firstly look more closely at what is considered the most traditional and sophisticated system, characterized by partial profit sharing.

### 2.1. Partial Profit Sharing in Medium-Sized Boats

This compensation structure applies to vessels fishing in deep-sea grounds for periods of 2 to 14 weeks, with 11 to 13 crewmen and boats ranging from 25 to 150 tons. In the Bay of Biscay, these vessels use two main fishing techniques, “trawling” and “long-line fishing”. Trawling consists in simply throwing a large enclosing net and trawling it along the ocean. It is a capital-intensive technique because it is based on powerful engines that drag a large net. “Long-line fishing” or simply “lining” is more labor-intensive since it uses a long fishing tackle with 4,000 to 14,000 hooks that must be prepared by hand.

Participants in this traditional fishing firm include: the *shipowner*, who can be an individual, a partnership or a company; the captain or *fishing skipper*, who is responsible for the vessel and handles navigation while fishing; the *coast skipper*, who substitutes the skipper as the second in command, shares fishing information with him, keeps an eye on the crew, communicates disputes, performs administrative tasks relating to both the vessel and the crew and also steers the vessel when it is not fishing; the *machinist*, who looks after the engines and the freezing and the electrical systems, sometimes assisted by a *greaser* or *second machinist*; the *cook*, whose task obviously is to prepare the food; and, finally, the *common crewmen*, it being understood that in addition to their specialized functions as coast skippers, machinists, greasers or cooks these crew members work also as fishermen.

These medium-sized boats adopt the most standard version of the “share system”, according to which fishermen’s earnings vary greatly with the value of the catch and with some, but not all, of the expenditures incurred for each specific sailing. The difference between the ordinary and skilled fishermen (the two skippers and the machinist) is that the latter are paid larger shares. The shipowner earns the remaining income (Figure 1). The distribution of rewards begins with the monetary value of the catch obtained in each trip or

voyage, which is established in open auction amongst industrial consumers and intermediaries in the highly organized and competitive fish markets that exist in all large fishing ports.

Sharing follows a convoluted procedure. Firstly, a small quantity of fish is distributed as compensation in-kind among crewmembers. Gross revenue obtained from selling the rest of the catch is then reduced by the commission paid to the market (between 3.5 and 4.5%). Next to be paid are *common expenditures*, which are collectively supported, such as food provisions, Social Security charges, fishing tackle (nets, rods, lines, etc.), bait, salt and ice. The shipowner finances these common expenditures, recovering them only after the catch is sold. If the value of the catch is lower than the expenditures, the difference is accumulated and deducted from future catches.

At this time, a fixed compensation is also paid to the crew. Fishermen thus receive a small wage coming directly from the catch value, as do common expenditures before the main partition of net revenue between capital and labor is made. This is not strictly a fixed compensation since it is defined most commonly as a percentage of gross revenue or as a fixed amount per month whichever is lower, and fishermen do not earn it if the catch is not valuable enough to meet all the common expenditures. In practice, however, it can be considered as a fixed wage given that catches small enough not to recover such expenditures are very rare and even in this case payment of expenses might be postponed.

Once the common expenditures and this fixed compensation are deducted,<sup>8</sup> the resulting net revenue is divided into two parts, one for the ship-owner (the “ship’s part”) and the other for the crew (“the people’s part”). In traditional wooden boats, this division is made more or less on equal terms. Thus, most commonly 49% is shared out by the crew and the remaining 51% is set apart for the shipowner, although the latter percentage increases with the cost and

---

<sup>8</sup> There are descriptions in the literature of a variation in which common expenditures are deducted *after* splitting the gross revenue between the owner and the crew. See, on this, Doeringer, Moss and Terkla (1986, p. 52) and Sutinen (1979, p. 149, n. 4).



productivity of the vessel. These percentages change substantially with fishing technology and particularly with the age and value of the vessel.<sup>9</sup>

The 49% allotment received by the crew is then allocated among crewmen according to a previously agreed formula. Frequently, it is divided by the number of fishermen plus 1.5 (so that the value of one share is  $0.49 [CV-SE] / [n+1.5]$ , where  $n$  is the total number of people in the boat,  $CV$  is the catch value and  $SE$  the total shared expenditures). Every crewman earns one of these shares except for the fishing skipper who receives two and the coast skipper who takes one and a half. Traditionally, the sharing is made openly, so that every crewman can monitor the prices and the shares earned by others. From his 51% participation in net revenue the shipowner pays two additional shares, one to the fishing skipper and another one to the machinist, as well as one half or one quarter of a share to the cook, and another quarter to the greaser, if there is one. After all these latter payments, the more skilled crewmen are thus compensated more than the common crewmen. Moreover, the shipowner has to pay other expenditures, most of them of a fixed nature (ship's insurance, financial charges and fishing licenses). The residual income, if any, compensates him for the cost of capital.

## 2.2. Full Profit Sharing in Small Boats

Smaller boats generally adopt a full-profit sharing arrangement. This is, for instance, the case of boats of between 3 and 9 tons that fish along the coast and return home daily. They divide net revenue as follows. If there are two crewmen, the skipper receives one and a half shares and his companion one; the boat owner, who is usually also the skipper, receives the remaining half. If there are three crewmen, net revenue is divided in seven shares, three for the boat owner and four for the crew. Many of these smaller boats use the "hand-lining" technique in which the work of the skipper and one or two fishermen is limited to loosen and haul a long set of hooks. Slightly bigger boats begin to deviate from strict profit sharing. This is the case in the Bay of Biscay with boats of between 10 and 50 tons and fishing with crews of no more

---

<sup>9</sup> See, also, Sutinen (1979, p. 159) and Platteau and Nugent (1992, p. 405).

than 10 for periods lasting from three days to three weeks. The skipper, who usually owns the vessel, meets all oil expenditure and pays a Christmas and a summer stipend to crewmen. Fuel and food provisions are paid out of the gross catch value, however. Most of these boats use the most common and traditional fishing technique, known as “seining”. This consists of surrounding a school of fish with a net and pumping or brailing it aboard.

### 2.3. Revenue Sharing in the Largest Vessels

For the largest vessels in the industry, the sharing system generally transforms itself into a bonus system. However, it departs notably from bonus systems in conventional firms. Firstly, fishing bonuses are linked to the total revenue or production of the vessel instead of assessments of individual productivity. Secondly, they form the bulk of labor compensation instead of being a minor part.

These bigger vessels (up until 2000 tons) have crews of up to 100, although most commonly around 30-50, sail for longer periods (three to five months) and fish in remote seas, far away from their bases. They are typically owned by firms that operate several vessels around the world, from just a few up to 143 (in our sample). These vessels have production processes that are somewhat more complex. Many of them not only catch the fish but also clean it and freeze it. For instance, the leading Spanish firm processes 80% of its total catch itself and sells it under its own brand names. As a consequence, there is substantial specialization of resources — e.g., some workers only do a particular job such as cooking, sorting, processing (cleaning, cutting, freezing and storing fish) and extracting oil.

In some cases, crews do not stay in these vessels for the whole sailing season, work shifts are adopted when fishing and most of the catch is sold to either internal divisions, intermediaries or in foreign fishing markets. Many of these vessels do not even enter port to unload the catch, which is landed by cargo or factory vessels. In these cases, recruiting decisions are land-based. Ships’ captains retain and exert close to discretionary firing rights, however.

There is also some variety in compensation structures within these vessels. For instance, in large freezer-trawlers crewmen are paid a percentage of the estimated *daily* value of the catch. Interestingly, some firms which in the past ran both kinds of vessels, freezers and fresh trawlers, used different compensation systems, compensating trawlers' crews under the standard share system and paying freezers' crews a variable bonus. When the catch is unusually low, they are guaranteed a relatively small fixed salary representing 40-50% of the average total wage. For small freezer-trawlers, the shares range from 0.8 to 1% of catch value for a common seaman depending on his skill up to 7% for the best skippers (who in these large ships are professional captains without ownership claims on the ships). However, compensation for crew members of large vessels using the line fishing technique in the deep waters of Chile is derived from multiplying specific prices by the catch weight instead of value.

#### 2.4. Historical Variety in the Share System

Sharing has been the standard organizational pattern of all kinds of fishing firms through history, in both primitive societies (a) and more modern times (b) and (c), and taking in some closely related activities such as piracy (d).

a) *Primitive and collectivist societies.* Written records of a share system are found in Roman Law, alluded to in the *Lex Rodhia de iactu*.<sup>10</sup> More primitive societies also used shares in fishing, however. This is shown by the anthropological descriptions of primitive cultures, including contemporary but isolated ones. For instance, in a study of a Malay fishing community in Rusembilan in South Thailand, Fraser (1966) relates how the share system is so ingrained that even technological innovations tended to be shared until it became clear that better solutions were available. (In that case, new motor boats were initially used to tow several boats, which then shared out their total catches.) Finally, the compensation structure of fishermen in the former Soviet Union, where all workers (including fishermen) received a salary is also worth mentioning. Fishermen also received a premium linked to their ship's catch

---

<sup>10</sup> See *Digesto*, book 14, title 2 (from García del Corral, 1988, pp. 762-6).

however. This bonus could be quite high, up to ten times their fixed wage.<sup>11</sup> It seems that Soviet fishermen were paid under a system closely resembling that used by large Western vessels, which seems coherent considering that they were among the largest in the World.

b) *The lay system of whalers.* Traditional whaling during 18th and 19th centuries involved very long voyages, of up to four years, land-based financing, specialization of ownership and control and large teams, with an average crew of 30.<sup>12</sup> They were compensated under the share or “lay” system with a percentage of the net value of the catch. This was the amount that remained after paying common expenditures that included pilotage to and from port, wharfage for the vessel, gauging the catch and coopering, commissions for cargo handlers, security and insurance.<sup>13</sup> Crewmen received equal shares or “lays”. Captains and officers were paid larger shares, with the captain receiving between 6 and 8%. Additional bonuses were also paid to those spotting the whales. This lay system was thus quite similar to the system of partial profit sharing currently used in medium-sized fishing boats.

c) *Biscayan fishing in the 19th Century.* Given that a good part of our empirical evidence comes from current practices in the Bay of Biscay, it is worth mentioning that historical accounts of customary uses in the same geographical area reveal a similar pattern of sharing, even though different technologies were used at the time. For instance, in the middle of the 19th Century crews of 18 were common in the Basque Country.<sup>14</sup> They were paid under a share system, although land-based specialized ownership was common. Shares were obtained after paying common expenditures, including a fixed subsistence wage paid in kind. Twenty four shares were given one to each of the 18 crewmen, 4 to the shipowner, 1/4 to the skipper, 1/4 to each of the three seamen who saw to the cleaning, 1/2 to the ship’s woman and 1/2 to the ship’s boy. Probably to avoid conflicts, the division of shares was performed at that time by

---

<sup>11</sup> We thank Yuri Yegorov for the information on this case.

<sup>12</sup> See Ellickson (1989), Craig and Knoeber (1992), Gifford (1993, p. 138) and Whipple (1995a).

<sup>13</sup> See Craig and Knoeber (1992, pp. 608-9). <sup>14</sup> See Saint-Léger and Delbet (1876) who describe standard practices in the port of San Sebastian in 1856.

a specialized agent working for the fishing market. In less developed ports, shares were divided by the skipper in a port tavern in the presence of the crew.

d) *The share system of pirates.* The organization of pirate enterprises for centuries followed a pattern of sharing not very different from the one used in fishing firms. Interestingly, sharing was used by both privateers commissioned by Governments and by independent pirates who operated without the protection of any public authority. In both cases, following each expedition the gross loot was sold on land or in open auction to the crewmen. The amount thus obtained was shared among the crew according to their jobs in the vessel after paying the “common expenditures.” For buccaneers raiding Spanish colonies and the American seas in the XVII Century, these common expenses included compensation for seamen crippled in combat as well as the additional fixed remuneration paid to the surgeon and carpenter. The remaining lot was shared out as follows: the ship’s captain, 2 parts; the warrant officer, 1.5 parts; other officers and specialists, 1.25 parts; regular pirates, 1 part; and aspirants, 0.5 parts. These shares and other rules were explicitly formalized in a written contract *ex ante*, probably to facilitate self-enforcement given the absence of judicial authority. At the same time shares were also used by Mediterranean corsairs based on the Barbary Coast, even though they were subject to a higher degree of State intervention and taxation. Custom and State rules, including a so-called Ancient Law, as well as frequent litigation, were common features used in defining the shares.<sup>15</sup> Regular navies also paid bounty shares to their crews in addition to small salaries, but the sharing was much more unequal, with the officers receiving larger and sailors much smaller shares. For instance, in the British Navy during the XVIII Century captains received 2/8; commanders, 1/8; officers, 3/8, and the rest of the crew only 2/8 (Whipple, 1995b, p. 81). This might help to explain why recruitment was frequently by press-gang, the need for punishments to enforce discipline and the high incidence of desertion.

---

<sup>15</sup> For information on Mediterranean pirates, see Manca (1982) and Bono (1993) and, for American pirates, Exquemelin (1678), Gall and Gall (1957) and Botting (1995). Fontenay (1988, pp. 1334 and 1339) refers to the frequency of litigation in the island of Malta.

### 3. The Controlling Role of Market Competition

The compensation structure of fishing firms is characterized by the fact that participants are paid under a share system, linking individual compensation to team performance even for large teams. In the short-term, i.e., per each trip, individual compensation does not vary with individual performance.<sup>16</sup> Our argument for explaining the optimality of this kind of sharing relates to the automatic long-term incentives it provides in terms of team composition (“long-term” meaning a setup of repeated trips). Remunerating team members with shares in the team’s net product usually motivates shirking because of free riding — all team members, including the controller, enjoy the whole benefit of reduced effort but do not suffer the whole reduction in productivity. Shirking behavior may be prevented however if there is enough competition amongst teams in the resource market so that eventual underperformance is promptly penalized by changes in the composition of the teams. This is the case with fishing boats, in which corrective sanctions may be easily implemented if necessary by means of firing and switching decisions that lower the reputation of individuals and force them to work in less productive crews.

What seems to make this share system viable is then a market-driven mechanism of self-enforcement, in which all kinds of individual and team underperformance are disciplined through separation decisions which are either explicit (firing) or implicit (switching). These separation decisions are possible either way, with skippers dismissing underperforming seamen —especially recent recruits— and better seamen moving to work in the most reliable and productive vessels —frequently the newest ones. Recruiting of fishing vessels, skippers and crewmen is highly competitive. It is usual in different fishing environments for crewmen to leave underperforming skippers and for the best vessels and skippers to require higher

---

<sup>16</sup> Except, obviously, for the effect individual performance has on collective performance and, therefore, on individual shares, which decreases with team size. Only in cases of gross underperformance (e.g., drug addicts, seamen skipping unloading duties) may withdrawal of the total share or of a part of it accompany the dismissal decision. Moreover, specialized workers (the skipper, the machinist, etc.) are paid more, but these differential wages take also the form of larger shares. They go with the job and are not linked to the individual productivity of specific workers.

performance from their crews, in exchange for earning greater wages and exerting more effort.<sup>17</sup> Furthermore, as a consequence of competitive pricing, the allotment of the vessel and the differences in compensation among crewmen are well explained as equilibrium prices that are consistent with the special skills required in some tasks, specially those of the skipper, work ability and effort and the characteristics of the vessel.<sup>18</sup>

The practices of firing underperformers and switching boats discipline and reward not only crewmen but also skippers and shipowners. Under widespread conditions, remunerating team members with a share in the team's net product would reduce the incentives of the residual decision maker to discipline team members and, more generally, to control. However, this dilution of incentives crucially depends on the costs other members of the team incur if they opt to leave the team. If these costs are low, underperforming controllers may be easily "fired" by team members by their signing up with a different team. This is again the case in the fishing industry, where the skipper seems to have the right incentives not to shirk his duties. Otherwise, he himself would be implicitly dismissed, as the better crewmen would leave the boat to work under better skippers. This possibility therefore reduces the perverse effect of the loss of residuality that is caused by having the crewmen sharing in the catch.<sup>19</sup> Likewise, those land-based shipowners who underperform in terms of failing to invest in their vessels will lose their best skippers and crewmembers unless they accept lower shares.

In the fishing industry, firing and switching costs are low for two main reasons related to the contractual and physical technology: the positive effect sharing has on the verification of labor contracts by third-parties (a) and the relative unimportance of specific assets (b). These

---

<sup>17</sup> This fact has been pointed out by many authors dealing with fishing practices in different countries. See, mainly, Firth (1946, p. 257), Acheson (1981, p. 278) as well as Bodvarsson (1987, p. 422), Lleonart (1988, p. 327), Platteau and Nugent (1992, p. 393) and Sánchez (1992, p. 43).

<sup>18</sup> A previous version of this paper included quantitative evidence on this point, which is available on request from the authors.

<sup>19</sup> Switching decisions by crewmen resemble those of corporate shareholders when they "vote with their feet" by selling their shares. However, in corporations, remaining team members do not suffer a penalty in terms of lower productivity, as happens in fishing.

two factors facilitate the use of separation decisions as disciplinary devices and greatly reduce the cost of these decisions in fishing compared with other activities:<sup>20</sup>

a) Contractual factors are decisive in firstly reducing the cost of firing underperformers and, secondly, increasing the sanction for underperformance. Share wages provide incentives for good crewmen not to support shirking colleagues when the later are sanctioned or dismissed. This not only reduces potential conflicts related to dismissals but converts crewmen into informers and instigators of disciplinary actions against shirking colleagues. In principle, sharing should not be necessary to generate intense incentives. On the contrary, salaries that differ across vessels would do so, even if they were fixed in the short-term (e.g., if they pay a certain amount for each trip, agreed in advance and independent of the catch). Moreover, these would not incur measurement costs and would provide a more efficient allocation of risks. Such an arrangement would impose high transaction costs, however, in one crucial dimension. Firing decisions would then be more costly to implement because of additional difficulties in verifying underperformance. In all systems, bad performers are paid above their marginal productivity. They have the incentives to spend resources in rent seeking, e.g., contesting dismissals.<sup>21</sup> Individual performance cannot be verified by third parties in the

---

<sup>20</sup> If the connection between switching costs and a share system is sound, one would expect to see a correlation between both variables across industrial sectors. Several hints show that this correlation holds for other activities: (1) Professionals like auditors of financial statements, investment bankers and business consultants, all of them partially remunerated on a share basis, are frequently recruited by competing firms, which amounts to them dismissing their former employer. (2) Teams in the construction industry are organized along lines not very unlike those shown here for fishing ships, also using dismissal of underperforming workers and team-leaders (González Díaz, 1994).

<sup>21</sup> On the contrary, we would not expect that either efficiency wages or individual incentives would face high renegotiation costs because of the repeated and durable character of fishing contracts. In line with the works by Goldberg and Erickson (1987) on petroleum coke contracts; a Masten and Crocker (1991) on natural gas contracts; and, more generally, Klein (1996) and Klein and Murphy (1997), the sharefishing arrangements we observe could be considered as mere price adjustment mechanisms. From this perspective, the advantage of sharing would not be in providing incentives but in assuring that the *ex post* distribution of net income does not result in one or other party attempting to evade the agreement and forcing a renegotiation. We see two problems with the application of this view to fishing. First, the renegotiation problem does not arise for two reasons: the repeated nature of the transactions and the easy verifiability of this kind of default in fixed-priced agreements. Second, those fish sharing contracts with fixed or advance payments by the shipowner would suffer this renegotiation problem, being subject to opportunism in the absence of repeated transactions.



vessel, although verification is necessary to enforce the contract.<sup>22</sup> Crewmembers can observe individual performance at low cost. They are in a privileged position to help enforce the labor contract. Under fixed salaries, crewmen would have fewer incentives to observe and disclose the underperformance of their peers and to attest, eventually, to the propriety of the firing decision. The share system thus helps the verification process by motivating crewmembers to exploit their observational capabilities in the verification of labor contract.<sup>23</sup> (The argument can be also applied to salaries linked to individual performance, which would also incur measurement costs and potential risk misallocation.)

Secondly, firing and switching decisions constitute sanctions that are more effective when contracting decisions are based on parties' reputations. Verifiability of performance then plays another important role: by aiding reputations to develop, it indirectly increases the sanctioning power of separation decisions. The essential data for captains' reputations to evolve (the catch value of their vessels) is relatively easy to verify, especially if a well functioning fish market exists. On the other hand, their behavior as contract enforcers (mainly in the labor contract when deciding dismissals — less so in the ship-renting contract) as well as the performance of the crew are more difficult to ascertain by the participants in markets for team-mates (future shipowners and crewmen). To this end, the most important source of information is provided by the crew. The fact that crewmen share the costs and benefits of these firing decisions probably helps in conveying this information. Reputations are also preserved by keeping the recruitment on a local basis, which is common practice even nowadays except for the largest

---

<sup>22</sup> These concepts come from the incomplete contract literature initiated by Grossman and Hart (1986). For an introduction, see Hart (1995, pp. 37-38 and Ch. 4).

<sup>23</sup> This might explain the observation that discipline under the fixed-wage system of traditional shipping was stricter than under the share system of whaling. Gifford (1993, p. 147) sees this as a consequence of sharing being a substitute for monitoring. However, disciplinary actions (e.g., flogging) are not monitoring but sanctioning activities. Lesser discipline in this sense says nothing about the extent of monitoring. Our framework provides a different explanation. Fixed wages would call for more disciplinary action because monetary sanctions are contractually costly: the captain would be accused of expropriation. On the other hand, physical punishments do not suffer from this drawback. Under sharing, however, monetary sanctions (dismissal, either during or after the voyage) are automatically controlled by the fact that the captain would have to share the benefits of unfair dismissals.

vessels.<sup>24</sup> Reputational mechanisms were also important in whaling, pirate and merchant ships. Unsatisfied whaling crews even ran advertising campaigns against bad officers (Whipple, 1995a, p. 81). Pirate captains with good reputations were able to get bigger shares and easy recruitment.<sup>25</sup> Reputation was also crucial with cargo traffic (Gifford, 1993, p. 140-1).

b) The main physical factor in reducing switching costs is that fishing technology uses *relatively* little specific capital. Switching boats or switching crews is not so costly therefore as similar decisions in other industries.<sup>26</sup> Physical assets (ships and fishing tackle) are specific to the technique and in some cases the fishery, but are not specific to the crew. This is shown by the frequency of geographical reallocation and sales.<sup>27</sup> With respect to human capital, workers' experience is important but not specific to the vessel, being applicable to different vessels and even to different fishing techniques.<sup>28</sup> The insignificance of compensation differences across crewmen according to seniority or age (e.g., Sánchez, 1992, p. 43) is coherent with this lack of specificity. Another kind of labor specificity might develop, however. Given the peculiar working conditions at sea, crewmembers may suffer some degree of specificity to their shipmates in relation to the living-together dimension of their work. The

---

<sup>24</sup> For multiple evidence in this regard, see McGoodwin (1976, pp. 378 and 386), Platteau and Nugent (1992, p. 399), Gifford (1993, pp. 140-141) and, in particular, the references in Acheson (1981, pp. 279-280). In Spain, individual reputations are enhanced by the existence of an official Marine ID card in which all kinds of incidents, such as signing on, promotions or dismissals, are recorded and signed by the skipper or captain, specifying the reason (e.g., missing the time of departure, refusal to sail in bad weather, drunkenness, unpunctuality, absence from work, etc.). In smaller ports with a close-knit fishing community, dismissals are well known to everybody. For this reason, they are not registered in the ID card, allowing dismissed seamen to eventually sign on other ships. In these cases, the threat of recording the incident acts as a disciplinary device so powerfully that fired seamen do not suite for or even claim their legally mandated severance pay.

<sup>25</sup> Exquemelin relates how Captain Morgan received up to five or six parts, much more than the two parts usually allocated to captains of pirate vessels (1971, p. 57).

<sup>26</sup> Fishing boats are thus closer to "primitive" teams than to "relational" teams, using the terms proposed by Williamson (1985, pp. 246-247).

<sup>27</sup> The mobility of the fleet is shown by the fact that shipowners consider local prices when deciding where to unload the catch, independently of the location of their base. In addition, firms react very fast to the introduction of quotas and incentives by creating joint ventures in foreign countries, which allow them to redeploy their ships in other countries.

<sup>28</sup> Seamen were fully standard resources during the 18th century, when seamen moved easily from merchant vessels to the Navy and piracy (Rediker, 1987, p. 83).

real importance of this variable is difficult to establish, but a reason to think it unimportant is that this specificity probably develops faster in the friendly atmosphere of the most productive teams, in which switching is less necessary.

It has also been claimed that “specificity” caused by back-loaded compensation was an important feature of shipping and whaling in the 18 and 19th centuries (Gifford, 1993, p. 141). However, this kind of hold-up threat disappears at the end of each voyage, then allowing a complete switch of resources. It might thus only pose a serious problem for very long trips (such as those of old time whalers). In any case, it loses importance when the length of the voyage shortens, as has happened with all kinds of sea voyages during the 20th century. Furthermore, it affects only one kind of switching decision — exit decisions by the crew — but not dismissals of crewmen.<sup>29</sup> Deferred compensation in whalers should then be seen as a safeguard,<sup>30</sup> more than as a source of conflict, given that decision rights were allocated in a way that facilitated self-enforcement (the potential reputational losses were surely higher for shipowners and captains than for common crewmen.<sup>31</sup>) Furthermore, another physical factor attenuates a similar problem, caused by friction in the labor market. This is the seasonal and discontinuous character of many fisheries,<sup>32</sup> that provides a natural pattern for the sequence of performance evaluation and crew renewal and recontracting which is followed by most vessels in those fisheries. This probably reduces the duration of switching-induced unemployment and, therefore, switching costs.

---

<sup>29</sup> This is exemplified by the practice of 19th century New England whalers who replaced their less productive recruits with more experienced Portuguese seamen on their first stop in the Azores (Whipple, 1995a, p. 102).

<sup>30</sup> Even Gifford (1993, p. 140) points out that it served to prevent crewmen from deserting when touching ports where labor was scarce. Nowadays, long term contracts (lasting two and three years) seem to be common only in Asian fisheries both for skippers and crews. Crews are paid a stipend for three years and only receive the full value of their share at the end. (We thank Mike A. McCoy for information on the existence of these contracts).

<sup>31</sup> The analysis in terms of a “self-enforcement range” developed by Klein (1992 and 1996) and Klein and Murphy (1997) seems applicable here.

<sup>32</sup> See Ferris and Plourde (1982, p. 427).

The role played by market competition in controlling team production in fishing does not mean that the typical features of a firm are not present. Control in these organizations is market-driven, but work is organized by chains of command and hierarchy and most teams are durable. Firstly, one of the main functions of skippers is to monitor individual performance.<sup>33</sup> This is understandable because in all fishing firms he is always the only decision-maker in relation to crew dismissals. These decisions cannot be made without reliable information. The skipper uses many different devices to assess individual productivity. In small boats, this has always been easy given their size and the nature of the tasks. In large vessels, a simple hierarchy with one or two levels exerts mainly monitoring functions. Nowadays it is also common to install television cameras that extend the skipper's view to the holds. Recording systems are then occasionally used to verify underperformance. Secondly, and more revealing, the team structure is durable despite the strong competition for resources and the short-term character of formal contracts.<sup>34</sup> Traditionally, crews in all kinds of vessel renew slowly and the two main causes for changes are the different requirements of each kind of vessel. Ocean fishing, being more demanding, usually attracts younger fishermen who in their later years move to coastal fishing. In addition, the best seamen tend to move to the newest and most productive boats, in what would probably be explained by the efficiency of "matching" resources of similar productivity.

---

<sup>33</sup> See, for instance, Bodvarsson (1987, p. 422), Platteau and Nugent (1992, pp. 398 and 407). It has only rarely been claimed that skippers do not monitor individual performance. For instance, Lleonart (1988, p. 324). In addition, some of the anthropological studies claim that skippers act *mainly* as coordinators (Acheson, 1981, pp. 278-9). However, these assertions do not fit most of the descriptions in the literature nor our evidence.

<sup>34</sup> Data on contract length and the effective duration of contractual relationships both support our view. Firstly, the ratio of workers under unlimited length labor contracts in the Spanish fishing industry (69.47%) is even higher than that of the economy as a whole (64.76%). These contracts involve mandatory indemnities for dismissal of as much as 42 months wages. Secondly, the effective length of the relationships are slightly greater in fishing, as judged from the distribution of workers according to seniority: in fishing, 21.09% of workers have been in their current job for less than a year; 28.12% between one and six years; and 50.64 for more than six years. For industries generally these figures are 28.60%, 21.25% and 50.10% respectively. Data for these calculations comes from the Spanish *Encuesta de Población Activa* (Labor Force Survey), 3rd quarter, 1995.

Basically, we have argued that team production is controlled here by means of market competition for resources, which is induced by teamsharing and which is made possible by low switching costs and reinforced verifiability. However, two other facilitating factors are necessary to explain the viability of the share system in general and the deviations from pure profit sharing in particular. These are firstly the costs of measuring different dimensions of team performance such as team output (catch value or volume) and specific inputs and, secondly, the cost that sharing may cause in terms of risk misallocation when participants hold different preferences towards risk bearing. These are the topics of the next two sections.

#### **4. Measurement Costs**

We focus now on measurement problems in order to explain firstly how knowledge of team output is necessary to make a share system viable and the role of the fish market and other practices in safeguarding this measurement. Secondly, we show how different measurement costs may be driving the adoption of particular varieties of sharing in the product and the costs of fishing vessels.

##### **4.1. Team Output Measurement**

Collective remuneration is facilitated by the very fact that team product is easy to measure. This is true both in absolute and relative terms. Absolute performance is almost perfectly known at low cost, avoiding one of the conflicts that make share systems difficult to implement in other technological environments.<sup>35</sup> Absolute and relative performance are easy to measure

---

<sup>35</sup> The cost of verifying team output provides an alternative explanation for the difference observed in compensation patterns between fishing and shipping. Gifford (1993) shows how in the 18th and 19th centuries crews in shipping vessels were paid monthly wages and end-of-voyage lump-sum amounts, which did not vary with the profits of the voyage. However, crews in whalers were paid under a share system, what has been explained as a substitute for monitoring crewmen effort (Gifford, 1993, pp. 145-7). He claims, first, that whaling output is more linked to crew performance while shipping output is affected mainly by the decisions made by the owner and the captain and, second, that the share system is more needed in whalers to motivate performance. Both claims seem, however, unwarranted to us.

because production cycles are well delimited: costs are easy to allocate to every fishing voyage and the revenue obtained is generally certified by the fish markets. Similarly, teams' relative performance is easy for all their members to ascertain. Fishermen regularly exchange information about their earnings, a practice that probably serves to monitor both team productivity and the ship-owner's trustworthiness. Furthermore, when catches are sold in the open market, a good indication of earnings is already provided by the gross value of the catch, which is publicly known. We have observed that, by the time they return home to unload and sell their catch to intermediaries after 5 or 6 months of sailing, they have collected enough information from other vessels to predict their earnings correctly.

Revenue and cost accounts are customarily audited by crewmen. In many vessels, copies of cost invoices are made available for examination on the bridge by all crewmen. In some cases, trusted friends help crewmen in checking these accounts. When the boat is based and staffed on a local basis, a trusted third-party expert takes care of the accounts. The presence of these monitoring activities shows that measurement problems are important. However, they also show that they are solvable. The latter is a distinguishing feature of fishing relative to conventional firms.

The role of fish markets should be emphasized. They play more than the standard neoclassical functions, acting as contract-safeguarding institutions. This explains firstly that, in our case, prices of fresh fish are reached through sophisticated public auctions. (Interestingly, frozen fish poses lesser problems because it presents lower price variability.) Secondly, the market takes care of the payments and, crucially, it also provides each seller with a voucher certifying the proceeds from the sale. It is not by coincidence that the market is financed and run by a *Cofradía*, a kind of association or cooperative in which all relevant contractual parties

---

First, the performance of fishing boats crucially depends on the captain's ability (see, for all, Acheson, 1981, pp. 289-91). Also, shipping performance also depends on the crew's behavior (e.g., in handling cargo). Second, the reduction in free riding induced by a sharing rule would be minimal in the environment described by Gifford (teams of over 30 people, unobservable effort). Our argument provides a different explanation that does not need specific assumptions about monitoring technology and free-riding. This is that measurement of net output was and still is much more costly and prone to conflicts in shipping. Keep in mind that, at the time, shipping was closely related to trading, further complicating measurement of net output.

—shipowners, skippers and seamen— participate. Thirdly, these cooperatives also achieve economies of scale in the provision of frozen storage and bait and in the performance of some administrative tasks for the port’s vessels. In Spain, historical records on these organizations date back to the XI Century.<sup>36</sup> The safeguarding role of the market has been more generally described even in primitive fishing communities.<sup>37</sup>

The safeguarding role of the fish market is also indirectly revealed by the policies adopted for out-of-market transactions covering that part of the catch which is sold privately, frequently to evade paying taxes. In this case, specific and additional arrangements are used. In the Bay of Biscay, fish by way of wages in kind is now systematically cashed-in individually. When sold collectively, underground buyers tend to be well known to several crewmen. If this is not the case because the vessel is far from home, two seamen accompany the ship-owner during the sale. In any case, fish for these transactions is put aside at sea in the presence of some crewmen. In a similar vein, the fish market does not provide any protection against the risk that crewmembers could cheat land-based shipowners by means of hidden sales, as mentioned by Platteau and Nugent (1992, p. 403). This does not seem to be a serious problem, however. Collusion by large crews would be easy to break down. For small crews, collusion would be more sustainable, but concealing sales would be more difficult, as they

---

<sup>36</sup> According to the Cofradía de Pescadores “Virgen de las Mareas” (1990, p. 3).

<sup>37</sup> See, e.g., Firth (1946, pp. 193-5). It seems that in less developed fishing communities, two kinds of problems arise in the direct relationship between ship-owners and intermediaries, both on them exacerbated by the high price volatility of fresh fish. Firstly, anthropologists have studied the problems between intermediaries and ship-owners in relation to the informational advantage of the former, leading in some cases to a solution in which fishermen’s wives take care of fish distribution. They have also collected evidence on a large number of initiatives all over the world to develop what they call fishermen’s co-operatives in order to solve these problems. See, for references on this issue, Acheson (1981, 282-285) as well as Wilson (1980, pp. 496-498) for an economic analysis. Secondly, we argue that direct contracting would also cause trouble in the contract between the crew and the ship-owner, because of the possibility of side payments between the ship-owner and the intermediary. Two pieces of evidence support our claim: additional safeguards are used for underground sales, as explained in the main text; and many large ships selling directly pay their crew in terms of the *standard* value or the volume of the catch, instead of its *real* value. See, however, Gallick (1996) for a case in which exclusive contracts for the catch may reduce a type of transaction cost: that relating to sorting catches to be canned instead of consumed fresh. Interestingly, in this case the valuation problem might be also easier to solve for the crew, given the absence of product and price variation.

would take place closer to their base. Furthermore, specialized ownership is rare for small boats, perhaps to avoid this kind of cheating. In fact, the only case we know in which this was a real problem was that of corsairs subject to a high degree of taxation in the Mediterranean (Fontenay, 1988, p. 1337).

Net product measurement is more difficult for larger vessels in multi-vessel firms. These usually sell their catches at transfer prices to internal divisions for further processing and commercial distribution. However, even in these cases team product is easier to evaluate than for other industries, because clear physical references are available in relation to the time spent sailing and the volume of the catch. It is noteworthy that the largest firms calculate the catch-linked bonuses they pay to crewmen as percentages of catch value or volume, not of net revenue, as smaller firms do. Even if this linkage of variable compensation to *gross* output impedes crewmen in larger firms from internalizing common expenditures, it offers the advantage of being less subject to “gaming” and manipulation by the shipowner. Furthermore, in many of these vessels crewmen sail for shorter periods than the vessel. Profit sharing would then require a proper allocation of costs amongst crews in order to provide efficient incentives. (In addition, departures from full profit sharing, in which some or all costs are paid by the shipowner, may have some effect on risk allocation, as we will analyze below.)

The different costs of measuring the several factors or dimensions of vessel production are also sufficient to explain the variety of bonus systems observed in large vessels. Firstly, when the vessels sail for longer periods than their crews, bonuses are calculated and accumulated on a daily basis by measuring the daily catch. This is necessary to avoid the kind of lengthy voyages typical of old-time whalers. Secondly, bonuses are defined in terms of value or volume according to the different incentives and measurement costs they give rise to. Catch value is used by freezer-trawlers, in which the value of the daily catch is estimated through standard or market-based prices, which are frequently updated (even during a trip). This method suffers from higher measurement costs but provides better incentives for crews fishing several species of diverse value. In particular, it avoids gaming behavior, consisting of a bias to heavier species, which would be easily brought about by using a single average price or a



volume-linked bonus. On the contrary, Chilean longliners fishing only one species base their bonuses on catch volume. It is also worth mentioning that crews in medium sized boats, who are customarily paid according to catch *value* and not to catch *volume*, are able to affect the value of the fish to a higher degree than the crews of freezers. For instance, these boats sell fresh fish, whose appearance is more important to obtain higher prices in the market.

All in all, one characteristic of fishing is that team output is relatively easy to measure. On the other hand, contracting labor in terms of individual productivity seems to be as costly as in other activities, which might explain why an alternative arrangement to the share system, based on incentives linked to individual short-term performance would not do so well. Unlike team performance, individual productivity is difficult to evaluate in terms of both observability by managers (here, the skipper) and verifiability by third parties. Firstly, it requires a more continuous measurement of performance. More information is thus required than that necessary to make discontinuous decisions, such as dismissals. Furthermore, individual incentives would motivate gaming behavior by crewmembers, also making real performance more difficult to measure. Second, adjustments in individual compensations would be subject to high contractual costs as opportunism could easily emerge since it is difficult for third parties to verify individual performance. We are thinking of the problem of distinguishing sanctions for underperformance from opportunistic decisions. On the one hand, as the residual earner, the skipper would have an incentive to underrate crewmen performance. On the other hand, other crewmembers have no incentive to demand sanctions or lower pay for underperforming co-workers. Furthermore, both of these difficulties are exacerbated if this kind of economically rational sanctioning decision is costly to produce. Under the share system, however, all crewmen have a monetary interest in the sanctioning decisions (which take the form of dismissals) and also, one would expect, in verifying the performance of their teammates. We have gathered some casual evidence that workers are willing to act as witnesses against fellow workers in judicial procedures hearing claims for unfair dismissal.

## 4.2. Cost Measurement

Measurement costs also account for the detailed pattern of differential cost sharing, the contracting patterns in relation to vessel ownership and the specific payments that the shipowner makes. The pattern of cost sharing differs mainly with the nature and incentive properties of the costs involved. In most medium-sized vessels, several expenses are traditionally divided almost equally between the shipowner and the crew. These include bait, fishing tackle and food provisions.<sup>38</sup> In contrast, expenditures on fuel oil, fishing licenses, vessel insurance, major repairs and financial charges are paid in full by the shipowner. Crewmembers are probably more able efficiently to affect the level of the first group of expenses. Consequently, making them pay part of them induces cost containment. Conversely, sharing in the other types of cost would induce inefficiently low levels of expenditure, most clearly in vessel repairs and all kinds of durable investments, given the ownership patterns described below. Renegotiations and adjustments around this pattern confirm such an explanation. Crews in several ports began to pay for fuel consumption after abandoning their traditional fishing grounds in EU waters for Moroccan seas. It seems that longer distances induced higher variability in fuel consumption, which needed to be controlled. In some other cases, fuel and oil are separated. E.g., in small boats, the crew shares in the cost of fuel, but the shipowner pays the whole consumption of oil. The rationale behind this selective pattern is a high variability of fuel consumption, which might give rise to disputes between the two or three fishermen in these boats, combined with the desire to motivate an optimum use of oil and engine maintenance.

Patterns of ownership of physical assets and the allocation of all capital-related expenditures in general (such as repairs, insurance, financial charges) can also be explained by the difficulties in measuring the performance of those making decisions regarding such assets. In fishing, most decisions on the use of assets are allocated to the captain (with the exception of a few which are within the scope of the machinist). Given that it is not easy to control or

---

<sup>38</sup> An exception to this general pattern is found in the largest ships. For them, cost sharing would be too costly in terms of measurement, given the need to allocate many costs on a daily or even shift basis.

measure the consequences of these decisions, a simple way of providing efficient incentives is to make the captain the owner of the vessel. This solution presents some financial difficulties however when the value of the vessel increases. Therefore, specialization or “separation” of ownership and control (not in the sense of *disperse* ownership but of *land-based* ownership) increases with vessel value: it is very rare for small boats but total for the largest vessels, with intermediate degrees for medium-sized boats.<sup>39</sup> When separation of ownership and control is present, several control devices are used to align the incentives of captains and land-based owners. For medium-sized boats, intermediate levels of specialized ownership are common by means of partnerships, making the skipper a part owner. Furthermore, in these cases call options are frequently granted to the skipper in order for him to hold the residual claim on the vessel and, consequently, motivate him to maximize its value. In addition, in many of these vessels, the owner pays one additional share each to the machinist and the skipper and between a half and a quarter to the greaser. This practice probably induces them to maintain the vessel in good condition, because of the possibility of withholding or renegotiating these shares. Finally, as a general point for all types of vessel but mainly for the bigger ones, mention should be made of an old tradition of professional norms motivating the captain to care for the vessel.

## 5. The Role of Risk Allocation

When there is substantial variability in the net value of production, risk allocation may be an objective or a constraint in the design of compensation systems. In our case, in which participants are compensated with a share of net product, risk allocation may play different

---

<sup>39</sup> Specialization of ownership and control has also been shown to increase with mechanization in primitive fishing communities (Epple, 1977, as reported by Pollnac, 1978, pp. 3 and 7). Ships provide an interesting case of separation of ownership and control, as the whole of the value invested in the vessel and its cargo will occasionally depend on single decisions taken by the captain. On the other hand, investment decisions are unique and easy to monitor. For a very interesting study of what they call “manager shareholding”, see Craig and Knoeber (1992). Studying 19th Century whalers, these authors conclude that manager shareholding was part of an incentive contract between owners and managers or masters (who we have called “skippers”).

roles depending on the structure of the participants' preferences toward risk bearing. When these preferences are homogenous, sharing may produce the optimal allocation of risk. On the other hand, while some participants are more risk averse than others, i.e., preferences are heterogeneous, the best solution would be, *ceteris paribus*, for the less averse to bear the additional risk. In these circumstances, sharing imposes a cost in term of "inefficient" risk allocation.

The second situation seems the most plausible in fishing firms, discarding a naive explanation of the share system as simply a way of spreading risks. On the contrary, the evidence is compatible with an explanation of sharing as an incentive mechanism, one of the costs of which may be some degree of inefficient risk allocation. This evidence comes mainly from the use of a share system even in large vessels where risk preferences may be confidently assumed to differ substantially between ship-owners and the crew. Owners of larger vessels are closer to risk neutrality than seamen with respect to catch-related risks. For instance, the largest multi-vessel firm in our sample has 143 large vessels and is controlled by a diversified family group, with 30% of the shares freely floating in the Stock Exchange and more than 10% owned by financial institutions. Historical evidence is also provided by 19th century whalers and Mediterranean corsairs. In both cases, the enterprises were financed by land-based ship-owners and entrepreneurs (including, in the case of corsairs, the religious order of Saint John of Jerusalem and the Barbary States) who were clearly less risk-averse than their crewmen. However, the latter were paid always with shares, as explained above.

It then seems that risk allocation is not a cause but a constraint in the design of the share system. The function of this system is not to spread risks among participants in the firm but to provide them with efficient incentives. In so doing, it eventually incurs some cost, amongst many others, of risk misallocation. In fact, some of the regularities we commented on may be explained as a way of reducing this cost. These are connected to (a) cost sharing, (b) fixed or guaranteed wages, (c) saving arrangements and (d) bonus design:

a) The variety of sharing structures described in Section 2 relates mainly to different degrees of cost sharing. Under the pure profit sharing regime of small boats, more risks are

shared that under the gross revenue sharing system of large vessels. This would be consistent with the structure of risk preferences argued previously.

b) Guaranteed minimum wages have similar properties in terms of risk allocation and their use follows the same pattern. We find that the use of these fixed wages — independent of catch value — increases with the size of the boat: It begins at zero for small boats, takes the form of remuneration in kind and its monetary substitute for medium-sized vessels and, finally, larger firms guarantee a minimum monthly salary whatever the value of the catch. Furthermore, fixed wages are usually adjusted upwards when the risk increases, as when the vessel has to search for a new fishing ground. These fixed wages may then show the existence of differences in risk preferences between the crew and the shipowner.

c) In many boats mechanisms also exist in order to accumulate savings and smooth the expenditure possibilities. In some small boats, a share from each voyage is reserved and accumulated for distribution at Christmas and summer holidays, as well as to pay Social Security contributions in months of poor catches. In some larger vessels, shipowners have also agreed to pay two stipends to crewmen around holiday times. Furthermore, providers of inputs traditionally postpone debt collection in times of scarce catches, allowing fishermen to obtain some subsistence wage. These arrangements do not speak directly of different risk preferences, but it seems reasonable that workers assessing such formulas have different wealth than their employers, who do not value them and even finance them occasionally.<sup>40</sup>

---

<sup>40</sup> Two other kinds of insurance practices are also common, although they are not relevant to our argument. Firstly, as mentioned earlier, some boats form “clubs” or “clusters” to exchange information about fishing grounds and even to share the total catch among their members. Economies of scale in the production of information probably play a part in the practice of sharing it. Bartering information within clubs seems to be the predominant arrangement when fishing for highly mobile species that live in large shoals, especially when the capacity of the boats is smaller than the shoals and they fish far from their home port (Wilson, 1990). Secondly, within each boat arrangements also exist to reduce the cost of individual bad luck. Thus, in some ports, when a crewman is sick he keeps earning his share, in return handing over his Social Security payments, which are much smaller. Similarly, when a crewman dies, his family continues to receive his share for one year. These patterns diversify risks within a group of boats or within boat members, but they are compatible with equal risk preferences, thus providing no hint on the impact of risk on the share system.

d) Risk avoidance may also explain the structure of bonuses in large vessels as devices for minimizing the influence of exogenous variables on crewmen's compensation. In our sample of cases, the high variability suffered by market prices (e.g., it fluctuated in the 1995-1996 season between 1,800 and 7,000 US\$/ton) of catches by longliners might explain the use of volume-linked bonuses, given that it isolates seamen against short-term variability in fish prices. (However, measurement and incentive effects are also present, as explained above. Furthermore, verifiability of prices might be negatively correlated with variability. On the other hand, large trawlers link their bonuses to the *estimated* value of the catch, using certain standard prices for different species. This was explained previously as a way of inducing efficient incentives in terms of catch mix. However, risk allocation might also be playing a role: those vessels that use relatively fixed prices are able to simultaneously allocate the risk of price movements efficiently without inducing gaming behavior on the part of the crew. Nevertheless, the sparseness of standard price adjustments may also be explained as a result of measurement costs.

The role of risk allocation should not be overemphasized, even as a contractual constraint. Some of these contractual practices make sense even under homogenous risk preferences. Thus, minimum wages in vessels sailing for long periods and saving devices may be understood as self-commitment instruments,<sup>41</sup> a rationale that fits neatly with sociological descriptions of the proclivity of fishermen to overspend. In addition, we have shown above that the observed

---

<sup>41</sup> Self-commitment has been dealt with by, among many others, Schelling (1978, 1980), Thaler and Shefrin (1981) and Hirschman (1982). This rationale could be applied more generally. Under costly rationalizing, crewmen compensated with salaries that were totally fixed in the short-term might fail to make consistent choices in terms of both their own effort and their support for disciplinary action taken in respect of their companions. In our particular case, short-term variability might help to reduce the cost of self-control with respect to situations in which there is a need to apply extreme effort (e.g., 20-hour workdays to make the most of good luck). The seaman considering whether to keep working during the 20th hour might be helped in his decision by having a share in the catch. Short-term variable compensation thus provides a way of pre-committing himself to make substantial efforts. Furthermore, when judging or supporting disciplinary decisions regarding teammates, crewmen might also be less prone to fall prey to forgiveness under variable than under fixed compensation.

differences in cost sharing and bonus design can be easily explained by differences in measurement costs. Overall, risk allocation seems to play a secondary role.<sup>42</sup>

## 6. Summary and Conclusions

The main argument of this paper is that repeated team production can be organized efficiently under a profit sharing regime. Using the fishing firm as a case study, we identify which unusual circumstances are necessary for this to happen: low costs of switching teams and low costs of measuring team output.

Fishing firms present a puzzle. On the one hand, their physical technology is that of team production with specialized monitoring (the skipper or captain is the main element in this monitoring activity). It is well known that the standard *contractual* solution for this *physical* technology is the conventional firm, in which the controller receives all the residual income. On the other hand however, we systematically observe that real fishing firms do not adopt this conventional pattern. On the contrary, all kinds of fishing boats, in all times and countries, and even with crews of up to 100 people, follow slightly different variations of a so-called “share” system. Under this share system, all members of the team (which includes at least the skipper, the seamen and the ship-owner) receive a certain share of the boat’s income.

We explain the use of the share system as a mechanism for providing powerful incentives connected to team membership. These incentives are based on three kinds of lay-off or firing decisions. Firstly, the explicit dismissal of under-performing crewmen by the skipper. Secondly, the explicit dismissal of under-performing skippers by ship-owners. Thirdly, and maybe most importantly, the implicit dismissal of the whole team by any team member who

---

<sup>42</sup> Thus supports the viewpoint made explicit by, among others, Williamson (1985, pp. 389-390), Rubin (1989, p. 162) and Barzel (1989, pp. 12 and 31, n. 1). See, for empirical analyses, Allen and Lueck (1992, 1993, 1995) regarding agricultural contracts and their references.

decides to quit for a more productive boat. Sharing has been shown to provide strong motivation for these separation decisions.

In other words, we identify competition amongst teams for productive resources, made possible by low costs of switching teams, as the fundamental force behind the share system. Low switching costs are connected to contractual and physical conditions. On the contractual side, sharing increases the net benefit of disciplinary decisions (it simultaneously reduces the cost of these decisions to the performing party and increases the cost these decisions cause to the underperforming party.) On the physical side, specific assets are relatively unimportant. It is in fact the case that in fishing most resources are of the general-purpose kind.

This competition for resources benefits also from very low costs of measuring team product, for several reasons: production cycles are well defined; products are auctioned in open markets with clear contractual functions; inputs are easy to monitor; and, finally, there are no common costs to allocate among products or teams. Consequently, team productivity is easy to verify. It is noteworthy that the physical technology of the largest fishing firms implies that they suffer higher measurement costs. To avoid having to allocate costs across catches, boats or crews, we observe that shares are then defined in terms of *gross* income, instead of *net* income. It is also the case that in smaller vessels, the crew shares in the costs that are more likely to be subject to moral hazard, such as food and maintenance, but not in those costs which are not affected by the crew's behavior, for instance, the cost of licenses or oil and fuel consumption in coastal fishing.

Sharing is not driven by risk allocation. On the contrary, risk seems to be constraining the use of a sharing system. Sharing has been explained on occasions simply as a way of spreading risks. We reject this claim on empirical grounds because the share system is used even when risk preferences are heterogeneous. We argue that precisely the opposite may happen, with some inefficient allocation of risks being accepted as a cost to achieve powerful incentives. This argument is consistent with some regular patterns in relation to partial sharing, minimum wages, savings instruments and price risk. However, alternative explanations have also been



delineated for all of these patterns based on self-control and measurement costs, without any reliance on risk allocation. Risk thus seems to play a relatively minor role.

Finally, we have also tried to show why the share system is superior, under these conditions, to the two main alternative arrangements. Firstly, individual incentives linked to individual performance would suffer higher costs in terms of verification and, therefore, contract enforcement. Secondly, efficiency wages, which would pay the crewmen a fixed premium salary per trip and would sanction under-performance with dismissal, could provide a better solution in terms of risk allocation. However, the contract would also be more difficult to enforce because of verification problems. Under the share system on the other hand, workers frequently testify against their under-performing partners when the latter dare to litigate their dismissal. Costly rationality related to self-control problems also reinforces our arguments in this regard.

Summing up, we claim that profit sharing enjoys a substantial advantage over other forms of compensation (pay per performance and efficiency wages): it facilitates verification and, therefore, enforcement of the labor contract. It is a superior form, however, only when two relatively rare conditions are present: low costs of switching teams and low costs of measuring the team's product. These conditions are absent in most non-fishing firms, and this explains why the share system is not the prevalent form of organization of the firm. However, some of the features of this system of implicit control might be spread more widely than it seems at first sight. We consider that, under different compensation structures, a similar phenomenon occurs when any type of highly productive workers decide to leave their employer. Their departure puts pressure and forces changes in all kinds of organizations. Switching-driven automatic control also takes place within multidivisional organizations. Our understanding of fishing firms suggests that managers should pay attention to competition within the organization in the design of profit-sharing plans and group incentives. Further research into which are the relative weights of and connections between the required conditions is necessary, however, before conclusions might be eventually reached and managerial applications developed.

## 7. References

- ACHESON, J. M., "Anthropology of Fishing," *Annual Review of Anthropology*, vol. 10, 1981, 275-316.
- ALCHIAN, A. A., and H. DEMSETZ, "Production, Information Costs, and Economic Organization," *American Economic Review*, vol. 62, no. 5, December 1972, 777-795.
- ALCHIAN, A. A., and W. R. ALLEN, *Exchange and Production: Competition, Coordination, and Control*, (3rd ed.), Wadsworth, Belmont, CA, 1983.
- ALLEN, F., "On the Fixed Nature of Sharecropping Contracts," *Economic Journal*, vol. 95, 1985, 30-48.
- ALLEN, W. D. and D. LUECK, "Contract Choice in Modern Agriculture: Cash Rent Versus Cropshare," *Journal of Law and Economics*, vol. 35, October, no. 2, 1992, 397-426.
- ALLEN, W. D. and D. LUECK, "Risk Sharing and Agricultural Contracts," *mimeo*, June 24, 1996.
- ALLEN, W. D. and D. LUECK, "Transaction Costs and the Design of Cropshare Contracts," *Rand Journal of Economics*, vol. 24, no. 1, spring, 1993, 78-100.
- ALLEN, W. D., and D. LUECK, "Risk Preferences and the Economics of Contracts," *The American Economic Review*, vol. 35, no. 2, May 1995, 447-451.
- ALSTON, L. J., D. SAMAR and J. NUGENT, "Tenancy Choice in a Competitive Framework with Transaction Costs", *Journal of Political Economy*, vol. 92, no. 6, 1984, 1121-1133.
- ALSTON, L. J., and R. HIGGS, "Contractual Mix in Southern Agriculture since the Civil War: Facts, Hypotheses, and Tests," *Journal of Economic History*, vol. 42, no. 2, June 1982, 327-353.
- BARANDIARÁN, F., *La comunidad de pescadores de bajura de Pasajes de San Juan (ayer y hoy)*, Oyárzun, 1982.
- BARZEL, Y., *Economic Analysis of Property Rights*, Cambridge University Press, Cambridge, 1989.
- BODVARSSON, O. B., "Monitoring with No Moral Hazard: The Case of Small Vessel Commercial Fishing", *Eastern Economic Journal*, vol. 13, no. 4, October-December 1987, 421-34.
- BONO, S., *Corsari nel Mediterraneo. Cristiani e musulmani fra guerra, schiavitù e commercio*, Arnoldo Mondadori Editore, Milan, 1993.
- BOTTING, D., *Los piratas*, Folio, Barcelona, 1995.
- CHEUNG, S., *The Theory of Share Tenancy*, University of Chicago Press, Chicago, 1969.
- COFRADÍA de Pescadores "Virgen de las Mareas", "Reseña histórica y evolución de las cofradías de pescadores," *Revista de la Cofradía de Pescadores Virgen de las Mareas*, Avilés, 1990.
- CRAIG, L. A., and C. R. KNOEBER, "Manager Shareholding, the Market for Managers, and the End-Period Problem: Evidence form the U.S. Whaling Industry," *Journal of Law, Economics, and Organization*, vol. 8, no. 3, October 1992, 607-627.

- DOERINGER, P. B., P. I. MOSS and D. G. TERKLA, "Capitalism and Kinship: Do Institutions Matter in the Labor Market?" *Industrial and Labor Relations Review*, vol. 40, no. 1, October, 1986, 48-60.
- ELLICKSON, R. C., "A Hypothesis of Wealth Maximizing Norms: Evidence from the Whaling Industry," *Journal of Law, Economics, and Organization*, vol. 5, no. 1, spring, 1989, 83-97.
- ESWARAN, M. and A. KOTWALD, "A Theory of Contractual Structure in Agriculture," *The American Economic Review*, vol. 75, no. 3, 1985, pp. 352-367.
- EXQUEMELIN, A. O., *De Americaensche Zee-Roovers*, Amsterdam, 1678. The Spanish edition has been used here: *Piratas de América*, Barral Editores, Barcelona, 1971 (translation by Dr. De la Buena Maison and C. Barral).
- FERRIS, J. S., and C. G. PLOURDE, "Labour Mobility, Seasonal Unemployment Insurance, and the Newfoundland Inshore Fishery," *Canadian Journal of Economics*, vol. 15, no. 3, 1982, 426-441.
- FIRTH, R., *Malay Fishermen: Their Peasant Economy*, Routledge and Kegan Paul, London, 1946.
- FONTENAY, M., "La place de la course dans l'économie portuaire: l'exemple de Malte et des ports barbaresques," *Annales, Économies, Sociétés, Civilisations*, vol. 43, no. 6, November-December, 1988, 1321-1347.
- FOOD AND AGRICULTURE ORGANIZATION, "Marine Fisheries and the Law of the Sea: A Decade of Change," Special Chapter, FAO, *The State of Food and Agriculture (SOFA)*, Rome, 1992.
- FORMAN, S., *The Raft Fishermen*, Bloomington, Indiana University Press, 1970.
- FRASER, T. M., *Fishermen of South Thailand*, New York, Rinehart and Winston Inc., 1966.
- GALL, J. and F. GALL, *L'Essai Anarchiste des "Frères de la Côte"*, Paris. The Spanish edition has been used here: *El Filibusterismo*, Fondo de Cultura Económica, Mexico D. F., 1957 (translation by Á. Custodio).
- GALLICK, E. C., "Exclusive Dealing and Vertical Integration: The Efficiency of Contracts in the Tuna Industry," in S. E. Masten, (ed.), *Case Studies in Contracting and Organization*, Oxford University Press, New York and Oxford, 1996, 203-223.
- GARCÍA DEL CORRAL, I. L., *Cuerpo del Derecho Civil Romano*, Jaime Molinas Editor, Barcelona, 1889, (The following facsimile edition is used here: Lex Nova, Madrid, 1988).
- GAUR, S. C. I., *La pesca de superficie en Guipúzcoa y Vizcaya: Análisis y perspectivas*, Elkar, Bilbao, 1970.
- GIFFORD Jr., A., "The Economic Organization of 17th-through Mid 19th-Century Whaling and Shipping," *Journal of Economic Behavior and Organization*, vol. 20, no. 2, 1993, 137-150.
- GOLDBERG, V. P., and J. R. ERICKSON, "Quantity and Price Adjustment in Long-Term Contracts: A Case Study of Petroleum Coke," *Journal of Law and Economics*, vol. 30, no. 2, 1987, 369-98.
- GONZÁLEZ DÍAZ, M., "Organización de la empresa constructora: Influencia de la regulación y la tecnología," *Unpublished Doctoral Dissertation*, University of Oviedo, 1994.

- GROSSMAN, S. J., and O. HART, "The Costs and Benefits of Ownership: A Theory of Lateral and Vertical Integration", *Journal of Political Economy*, vol. 94, no. 4, 1986, 691-719.
- HALLAGAN, W., "Self-Selection by Contractual Choice and the Theory of Sharecropping," *Bell Journal of Economics*, vol. 9, no. 2, 1978, pp. 344-354.
- HART, O., *Firms, Contracts and Financial Structure*, Oxford University Press, Oxford, 1995.
- HIRSCHMAN, A. O., *Shifting Involvements. Private Interests and Public Action*, Martin Robertson, Oxford, 1982.
- INTERNATIONAL LABOUR OFFICE, *Conditions of Work in the Fishing Industry*, ILO, Geneva, 1952.
- JENSEN, M. C., "Organization Theory and Methodology," *Accounting Review*, vol. 50, no. 2, April 1983, 319-339.
- JENSEN, M. C., and W. H. MECKLING, "Specific and General Knowledge, and Organizational Structure," in L. Werin, and H. Wijkandere, (eds.), *Contract Economics*, Blackwell, Cambridge, MA, 1992, 251-274. Revised Version: *Journal of Applied Corporate Finance*, vol. 8, no. 2, summer, 1995, 4-18.
- KLEIN, B., "Contracts and Incentives: the Role of Contract Terms in Assuring Performance," in L. Werin and H. Wijkandere, (eds.), *Contract Economics*, Blackwell, Cambridge, MA, 1992, 149-72.
- KLEIN, B., "Why Hold-ups Occur: The Self-Enforcing Range of Contractual Relationships," *Economic Inquiry*, vol. 34, no. 3, July 1996, 444-63.
- KLEIN, B., and K. MURPHY, "Vertical Integration as a Self-Enforcing Contractual Arrangement," *American Economic Review*, vol. 87, no. 2, May 1997, 415-420.
- LLEONART, J., *La Pesquería de Valencia*, Instituto de Ciencias del Mar de Barcelona (CSIC), Barcelona, 1988.
- MANCA, C., *Il modello di sviluppo economico delle città marittime barbaresche dopo Lepanto*, Giannini Editore, Naples, 1982.
- MASTEN, S. E., "Minimum Bill Contracts: Theory and Policy," *The Journal of Industrial Economics*, vol. 37, no. 1, September 1988, 85-97.
- MASTEN, S. E., and K. J. CROCKER, "Efficient Adaptation in Long-Term Contracts: Take-or-Pay Provisions for Natural Gas," *American Economic Review*, vol. 75, no. 5, December 1985, 1083-1093.
- McGOODWIN, J. R., "Pelagic Shark Fishing in Rural Mexico: A Context for Co-operative Action," *Ethnology*, vol. 18, no. 4, October 1979, 325-336.
- McGOODWIN, J. R., "Society, Economy, and Shark-Fishing Crews in Rural Northwest Mexico," *Ethnology*, vol. 15, no. 4, October 1976, 377-391.
- PLATTEAU, J. Ph., and J. NUGENT, "Share Contracts and Their Rationale: Lessons from Marine Fishing," *Journal of Development Studies*, vol. 28, no. 3, April 1992, 386-422.
- PLOURDE, C., and J. B. SMITH, "Crop Sharing in the Fishery and Industry Equilibrium", *Marine Resources Economics*, vol. 6, no. 3, 1989, 179-193.
- POLLNAC, R. B., "Technological Change and Social Organization among Small-Scale Fishermen", International Center for Marine Resources Development, University of Rhode Island, *Anthropology Working Paper*, no. 21, January, 1978.

- REDIKER, M., *Between the Devil and the Deep Blue Sea Merchant Seamen, Pirates, and the Anglo-American Maritime World, 1700-1750*, Cambridge University Press, Cambridge, 1987.
- SAINT-LÉGER, A. DE, and E. DELBET, “Pêcheur-côtier de Saint Sébastien (Pays Basque): ouvrier chef de métier dan le système du travail sans engagements, d’après les renseignements recueillis sur les lieux, en 1856, par MM. A de Saint Léger et E. Delbet,” in F. Le Play, *Les ouvriers européens*, (2nd ed., tome IV, Chapter V, 291-335), Paris, 1876. The Spanish translation has been used here, entitled “Familia pescadora de San Sebastián (Guipúzcoa), 1856,” in J. Sierra Álvarez (ed.), *Campesinos y pescadores del norte de España*, Ministerio de Agricultura, Pesca y Alimentación, Madrid, 1990, 117-169 (translation by M. Rivero from the second French edition).
- SÁNCHEZ FERNÁNDEZ, J. O., *Ecología y estrategias sociales de los pescadores de Cudillero*, Siglo XXI, Madrid, 1992.
- SÁÑEZ REGUART, A., *Diccionario histórico de las artes de la pesca nacional por el Comisario Real de Guerra de Marina*, Viuda de Ibarra, Madrid, 1791-1795. (Last Ed.: Secretaría General Técnica del Ministerio de Agricultura, Pesca y Alimentación, Lunweg Editor, Madrid, 1988).
- SCHELLING, T. C., “Economics, or the Art of Self-Management,” *American Economic Review*, vol. 68, May 1978, 290-294.
- SCHELLING, T. C., “The Intimate Contest for Self-Command,” *Public Interest*, vol. 60, summer, 1980, 94-118.
- STIGLITZ, J., “Incentives and Risk Sharing in Sharecropping,” *Review of Economic Studies*, vol. 41, no. 2, 1974, pp. 219-257.
- SUTINEN, J. G., “Fishermen’s Remuneration Systems and Implications for Fisheries Development,” *Scottish Journal of Political Economy*, vol. 26, no. 2, 1979, 147-162.
- THALER, R., and H. M. SHEFRIN, “An Economic Theory of Self-Control,” *Journal of Political Economy*, vol. 89, no. 2, April 1981, 392-406.
- WHIPPLE, A. B. C., *Los balleneros*, Folio, Barcelona, 1995a.
- WHIPPLE, A. B. C., *Navíos de guerra*, Folio, Barcelona, 1995b.
- WILLIAMSON, O. E., *The Economic Institutions of Capitalism: Firms, Markets, Relational Contracting*, The Free Press, New York, 1985.
- WILSON, J. A., “Adaptation to Uncertainty and Small Numbers Exchange: The New England Fresh Fish Market,” *Bell Journal of Economics and Management Science*, vol. 11, no. 2, 1980, 491-504.
- WILSON, J. A., “Fishing for Knowledge,” *Land Economics*, vol. 66, no. 1, February 1990, 12-29.
- YNGVESSON, B., “Leadership and Consensus: Decision-Making in an Egalitarian Community”, *Ethnos*, vol. 43, Nos. 1-2, 1978, 73-90.
- ZOETEWIJ, H. “Fishermen’s Remuneration”, in R. Turvey and J. Wiseman (eds.), *The Economics of Fisheries*, FAO, Rome, 1956, 18-41.

Table 1. Stylized Summary of Sharefishing Systems

Type of share system	Pure profit sharing	Standard sharefishing	Gross revenue sharing
Shared outcome variables	Share of profits, excluding some costs of capital	Shares of revenue minus some but not all costs	Bonuses linked to the value or the volume of the catch
Kind of fishing	coastal	shallow waters	deep-sea
Standard crew size	3-4	5-16	30-70
Average fixed monthly wage (Pta)	0	40,000	75,000
Average variable monthly wage (Pta)	160,000	145,000	250,000
Fishing trip duration	1 day	3 days to 3 months	3-6 months
Shipowner(s) preferences towards catch-related risks	similar risk-aversion than seamen	less risk aversion than seamen	close to risk neutral, less risk aversion than seamen

Figure 1. The share system in a medium-sized fishing boat

