



# Social network mechanisms of price formation in an artisanal fishing community in Chile

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## Abstract

Local fish markets play a crucial role in meeting local and regional demand for seafood. However, the underlying social and local processes determining price formation in these markets still need to be clarified. Through ethnographic research of an artisanal fishing community in central Chile focused on the common hake catching (*Merluccius gayi gayi*), we found that mutual observation and negotiation are the two key social processes of the local economic order. These processes produce two local structures: (a) the fishers' maritime cliques in the sea and (b) the chain structure in the cove, which combines commercial and community relationships to determine market prices.

**Keywords** Price formation · Small-scale artisanal fisheries · Hake · Network mechanisms · Ethnography

## Introduction

Traditionally, academic literature refers to fishers' catch sales in the bay or port as the *first sale price*, *ex-vessel price*, *beach price*, or *wharf price*. These local prices are typically explained as an outcome of (a) the total quantity landed in tons (Barten and Bettendorf 1989; Maynou 2022; Reglero and Morales-Nin 2008; Sjöberg 2015), (b) the marine resources characteristics (Lee 2014; Smith 2012; Sogn-Grundvåg et al. 2020), or (c) the formal buyer–seller relationship, such as the number of transactions (Fluvià et al. 2012; Vignes and Etienne 2011; Weisbuch et al. 2000). However, the abundant stream of research on fish markets fails to identify the local processes that underpin price formation mechanisms from a socio-cultural perspective.

Fishing communities have complex relationships with markets (Jentoft 2020): adaptive capacity and resilience (González-Mon et al. 2019, 2023), the impact of market changes on fishing (Drury O'Neill et al. 2019), relationships between fishers and buyers (Elsler et al. 2023), community integration dynamics (Gómez-Andújar et al. 2022),

client-patron systems (Miñarro et al. 2016), networks of support, recognition, and ecological information (Maya-Jariego et al. 2017), and, finally, illegal trade (Oyanedel et al. 2021) along with a variety of distribution chains (Penca et al. 2021; Gómez et al. 2023). Particularly, small-scale fishing communities operate as local arenas of interaction (Brint 2001; Fine 2012) where markets are embedded in the fishing social networks (Granovetter 1985; Harrington and Fine 2006; Jentoft 2020).

In this regard, local institutions define how buyers, sellers, and producers must interact, providing the cultural frames to understand how the market works (Fligstein 1996). Each community applies these cultural frames to define how fishers should compete and cooperate in fishing and trading, how they understand the market operation (e.g., how to price the product), and how they interpret the actions of others. These local structures provide fishers stability and control over uncertainty, community capital (Jackson 2020), and local identity (White 2008).

In this light, the network approach is crucial to address the interplay between the social, cultural, and economic dimensions widely represented in small-scale fisheries (Alexander et al. 2018; González-Mon et al. 2019; Kriegel et al. 2022; Marín et al. 2023). This approach shows that markets and economic exchanges are not isolated entities but embedded into different social and community relationships (Granovetter 2005; Jentoft 2020). Thus, understanding these relationships is critical to adequately describe the

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organization, order, pricing, performance, and market competition (Beckert 2011; Uzzi 1997). Ultimately, the cultural categories and schemata influence transactional expectations and the shared understanding of the market dynamics (Beckert 2011; Bottero and Crossley 2011; Fuhse 2009).

Therefore, our research questions are as follows: How are fish prices formed locally? And, how is the local market socially and culturally organized? These questions call for ethnographic research on the mechanisms behind price formation (Busse 2021; Timmermans and Tavory 2018). This research delves into the local processes of the market embedded in a small-scale artisanal fishing community from the Central Coast of Chile in the region of Valparaíso, which specializes in common hake catches. Based on an ethnographic approach and social network analysis, we unveil the embeddedness of markets in the fishing community social relations, the relational structures that emerge from these interactions (Martin 2009), and the network mechanisms involved (Bunge 2004; Fuhse and Gondal 2022; Jerolmack and Khan 2018).

## Materials and methods

### Study area and case selection

The few studies on common hake have mainly focused on local, national, and international market integration (e.g., Quezada and Dresdner 2014). However, as we already mentioned, these studies do not explain the formation of ex-vessel prices in local fishing coves sufficiently (see Young et al. 2020 for an exception). In Chile, small-scale artisanal fishing operates in 558 communities located in coves (called *Cale-tas*) (SUBPESCA and SERNAPESCA, 2022), each with its own specificity. Some coves are large, with many fishers, and have a settlement next to a large city (*urban coves*), while others are more isolated and far from urban centers (*rural coves*, SERNAPESCA 2023).

We conducted this study in the Valparaíso Region in Central Chile (see Fig. 1), where 28 small-scale artisanal fishing coves operate (Leiva Cortés, 2014). In this region, there are also government institutions such as the National Fisheries Service (SERNAPESCA), the Undersecretariat for Fisheries and Aquaculture (SUBPESCA), as well as some historic coves that play a crucial role in the field of artisanal fishers (Escribano 2014). The artisanal sector of the Valparaíso Region holds the largest demersal common hake (*Merluccius gayi gayi*) quota (SERNAPESCA 2020). However, among the region's coves, only a small group achieves a high level of *development* (Montoya 2002; Leiva Cortés, 2014), understood as a permanent activity next to an urban location, connected to other markets, and with efficient commercialization channels.

For our case study, we selected a small-scale artisanal cove (called *Caleta Portales*: with about 135 fishers; only one woman; 60 boats approximately, 7–8 m in length) for its *high development* level, historical trajectory, its significant recognition by other stakeholders (scientists, fishers, public officials) (see Montoya 2002; Leiva Cortés, 2014), and, for its low carbon footprint (Naranjo et al. 2021). The community organization (Union) is associated with an Artisanal Extraction Regime (RAE), a type of cooperative catch quota system that ensures that the cove has a specific allocation of hake based on its capture history and mean vessel size.

In Caleta Portales, fishers primarily engage in the common hake fishery, but occasionally they go out to sea for other fisheries, such as red squid and crabs. They work every day, six days a week (Tuesday to Sunday), starting early, around 3:00 am. They gather at the cove to organize the departure, usually between 4 and 6 am. As they have only one crane for sea access, they must wait for their turn. The most used fishing gear is the gillnet which does not require bait. However, they prefer to use the longline to catch better quality hake.

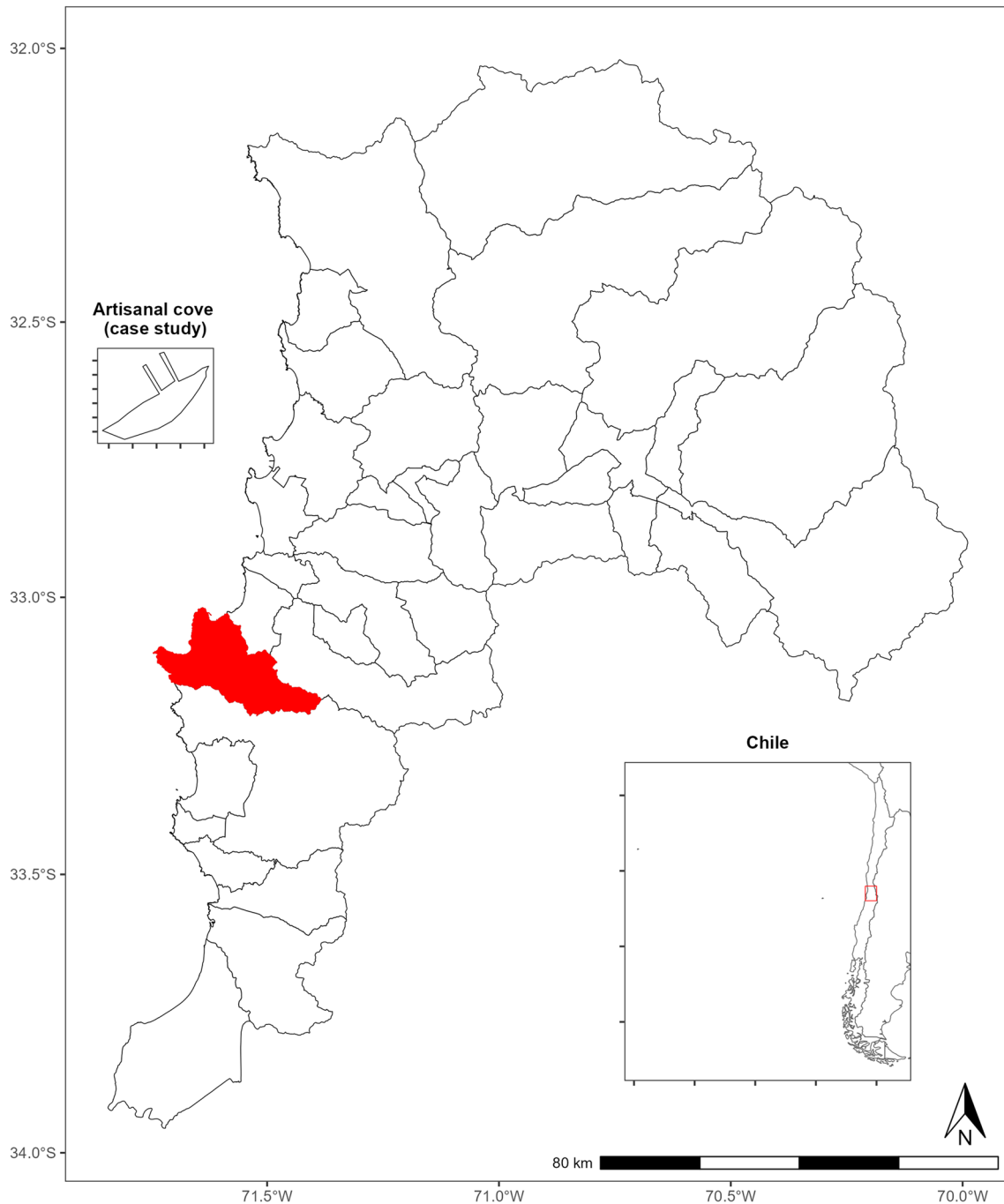
Usually, between 8 and 11 am –upon returning– fishers contact their assistants to set the initial (ex-vessel) prices and sell their catch by the dozen, using a local size category system: large (*maltona*), medium (*acuenta*), small (*vallico*), and very small (*merlucilla*). Many people contribute to the fishing activity and the local marketing of fish, including fishers (mostly men), *encarnadoras* (who put the bait on the hooks, mostly women), assistants (*oficiales*, who help sell the fish and set the prices, mostly men), and other workers.

Figure 2 shows the average ex-vessel prices in Chile (in constant Chilean Pesos per kilogram) and the average quantities of common hake in kilograms per boat from 2012 to 2021 compared with Caleta Portales (IFOP 2022). The national data reveal common patterns in fishing markets with daily and annual variability. The average price is CLP 1,737/kg (Fig. 2-a), with an average daily catch of 112 kg per boat (Fig. 2-b). In contrast, the average price in Caleta Portales is CLP 1,933/kg (Fig. 2-c), and the average daily catch is 97 kg per boat (Fig. 2-d).

### Ethnographic methods and network analysis

We adopted a network-informed ethnographic approach (Cf. Lubbers and Molina 2021) to understand the process of local market formation. The first author conducted extensive fieldwork between September 2020 and May 2022. He conducted an initial ethnographic exploration to build an analytical framework based on initial observations and a literature review (see Table 1). His research involved direct observations and informal or semi-structured interviews to enquire about the price formation mechanisms. He made weekly visits to the cove and held conversations with fishers, assistants,

## Valparaíso Region (Central Chile)

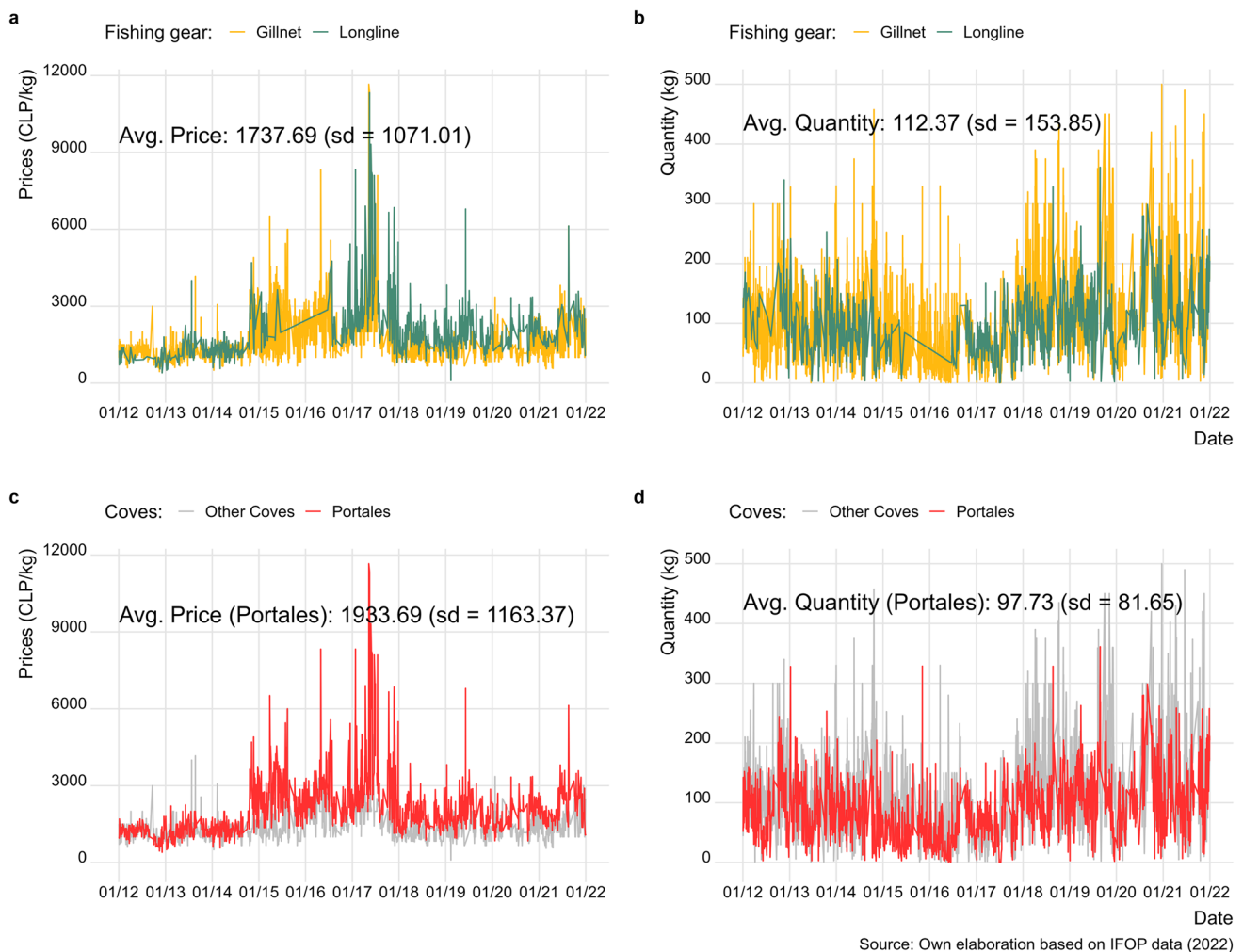


**Fig. 1** Location of the artisanal *Caleta* in the Valparaíso Region, commune of Valparaíso (red), Continental Central Chile

*encarnadoras*, and other workers. To protect people's identities, we use pseudonyms in this work. The conversations revolved around the formation of prices, relationships with other fishermen and assistants, information sharing, and the structure of hake sales. The participant observation time schedule varied largely. Sometimes, his observation began at approximately 3 am and ended at around 1 pm when the

last hake was sold. On most days, the observation lasted between 3–4 h, depending on the volume of hake and the flow of buyers. The first author embarked on fishing vessels several times and bought fish to get direct evidence.

Drawing on the concept of embeddedness (Jentoft 2020) (i.e., the interdependence between market and community), we identified different network structures in our



**Fig. 2** Average ex-vessel prices and catches in other Chilean *caletas* compared with Caleta Portales, 2012–2021

ethnographic exploration (see Table 1). We focus on three actors: fishers (fish and sell), assistants (sell), and buyers (who buy). The first type refers to the fishers' social ties when joining for fishing, with some of them taking the lead. The second type refers to the structure that appears when the boat returns to the cove with fresh catch and sets the initial price. The third type shows the process of market exchange. The fourth type identifies ties among buyers to strengthen their negotiation capacity. Finally, the table shows the aggregated network structure of the local market.

Based on this analytical framework, we analyze the market and price formation process. Yet, we conducted two further analyses. Firstly, we validated our conclusions with a cultural consensus analysis ( $N=15$ ; see Borgatti and Halgin 2011; Dressler 2020), a methodology that helps to identify the degree of shared beliefs and the existence of a single culture in a group. The purpose of this study was to reflect on whether there was a single culture about the functioning of the market, as shown by ethnography through fishermen's

responses to a questionnaire (see Appendix A). In our sample, 86.6% of the fishermen had family members involved in the fishery, and 73.3% had been in the activity for over 30 years. Table 2 provides more descriptive statistics.


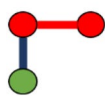


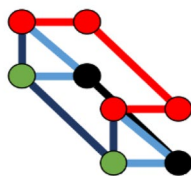
Secondly, we conducted a dynamic network analysis over nine days to identify interactions within the exchange units of the cove ( $N$  interactions = 95; Avg. daily interactions (per sale units) = 6.41 ( $SD=3.94$ ); Price variation over time = -0.33 (decrease) ( $SD=0.62$ )). This task validated and systematized the ethnographic observations regarding market relationships (see Appendix B).

## Results

Our findings unveil three elements that play a role in the local fish market: a) the types of social relationships (either community or market-oriented) that unite the actors in the market process; b) the network mechanisms (observation

**Table 1** Network market structure analytical framework. Red nodes = fishers; green = assistants (*oficiales*); black = buyers. The links are the same color for nodes of the same type (fisher-fisher, for

example). Otherwise, they are dark blue (fisher-assistant) or light blue (fisher-buyer; assistant-buyer)

Structure	Type	Analytical unit	References
	Fishers ties	The hake <i>extraction unit</i> in Caleta Portales. The fisher interacts to define who they fish with, where, and when they return to cove.	Gómez-Andújar et al., 2022; Maya-Jariego et al., 2016; Oyanedel et al., 2016; Wilson, 1980
	Fishers and assistants ties	The hake <i>sales unit</i> (supply) in Caleta Portales. Each extraction unit is associated with a sales assistant (called <i>oficial</i> ).	No references. Ethnographic exploration.
	Fishers, assistants, and buyers ties	The hake <i>exchange unit</i> in Caleta Portales. Buyers can be large or small and make monetary exchanges with the sales units.	Only fisher-buyer relation: Drury O'Neill et al., 2019; Elsler et al., 2023; Gallegati et al., 2011; González-Mon et al., 2019; Vignes & Etienne, 2011
	Buyers ties	The <i>purchasing unit</i> (demand) may have relationships in Caleta Portales to obtain information, better bargaining power, or other type of strategy.	Curchod, 2010; Dorantes-González et al., 2023; Gómez et al., 2023; González-Mon et al., 2019; Oyanedel et al., 2021; Wilson, 1980
	<p><i>Basic market structure from networks: each exchange unit has its own existence. However, between selling units and between buyers there can be a relationship during the time of sale.</i></p>		

**Table 2** Descriptive statistics of the sample in Cultural Consensus Analysis

N=15	Average	SD	Range
Age	60.08	16.51	20–74
Days in the cove (weekly)	3.82	2.27	1–6
Work hours (daily)	8.85	2.41	6–12

and negotiation), the key or relevant processes present in the market process; c) and the emerging network structures (cliques and chains), which are social forms that appear in the market process due to social relationships and mechanisms. Table 3 summarizes these findings in the local market of Caleta Portales, i.e., types of *Relationships* (Community and Commercial), *Mechanisms* (Observation and Negotiation), and resulting *Emerging Structures* (Cliques and Chain). According to the cultural consensus analysis, fishers achieve cultural consensus on the rules of the fishing market, with a Comrey Ratio of 3.45 and an average cultural competence of 0.82, indicating a high shared knowledge about the market's functioning rules (for a more detailed analysis, see Appendix A).

Let us describe the two types of social relationships related to price formation, introducing excerpts from the ethnographic fieldnotes.

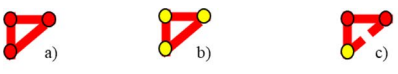

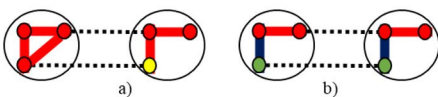
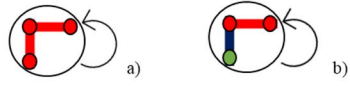

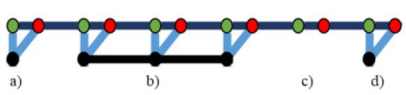
### Commercial and community ties in the local fishing market

*During a recent visit to Pepo's sales stall, I observed a distinct interaction pattern between him and his retail customers. Many attempted to bargain over prices, but Pepo and his assistant consistently refused to lower them. In some cases, they even raised the prices. For example, while some [recurrent] buyers were quoted CLP 5000 for three large hakes (maltonas), others were asked to pay CLP 7000. During the sales period, Pepo's assistant actively monitored the prices at other stalls and adjusted the hake's price accordingly. (Fieldnotes, February 19<sup>th</sup>, 2022)*

This passage reflects the dynamic combination of two types of relationships to set up prices: community-based and commercial. On the one hand, community relationships refer to the supportive ties that provide essential information for hake catching and trade. Fishers and their



**Table 3** Network structures in local market price formation. Red nodes/yellow/blue = fishers; green = assistants (*oficiales*); black = buyers

Market and price formation	
<i>Relationships</i>	
Community	 <p>Supporting ties that influence prices and quantity captured related to commercial and productive decisions. These ties can be either by closeness or affiliation with the fishing community. In close relationships, accurate information is often shared (cases a and b), while in other contexts, it is more likely to be false (case c).</p>
Commercial	 <p>Economic transaction ties. There are two subtypes: with large buyers (case a, structured and stable) and with small buyers (case b, unstructured and unstable). This impacts the level of bargaining. More bargaining typically occurs in relationships with large buyers (case a) and less with small buyers (case b)</p>
<i>Mechanisms</i>	
Observation	 <p>This process occurs between external units. Observation occurs among extraction units (case a) between close contacts or acquaintances, or between sales units (case b) involving fishers, assistants, or both.</p>
Negotiation	 <p>This process occurs within internal units. Negotiations develop within an extraction unit (case a) where fishing decisions are made (location, return, among others), or between sales units (case b) to decide on prices.</p>
<i>Emerging structures</i>	
Cliques	 <p>Extraction units (fishers) in the sea form cliques based on ecological information. Each clique has a specific location, potential quantity of hake, and trip cost. These cliques can be formed either by sharing information within the community (cases a, b, and c) or by following the actions of others (case d).</p>
Chain	 <p>A chain structure is formed among sales units based on price information. It is a temporary structure that starts with the first boat that sets the reference price (case a) and ends with the last buyer (case d). This structure directs the flow of prices among the actors and can disadvantage some (case c) or keep them informed against structured buyers (case b).</p>

assistants exchange information, including the location of hake schools (known as *dato*) and the current prices. During commercialization, *sales units* (boats' crews when landing) gather information from other units and analyze it carefully to make informed pricing decisions.

Information shared through community relationships is usually reserved for closer, trusted individuals, as the risk of receiving false or incorrect information increases otherwise. Regarding ecological information, fishers use the term *giving the mariana* to describe the fact of providing misleading information to other fishermen. This action has an economic rationale: to reduce competence and the chance of obtaining unfair prices.

*Q: I have seen how fishermen pass the dato [ecological information] around. [The fisherman looks on with a smile.]*

*A: Not all of them, not all of them. No, no... because how can I explain it to you? We are fishing alone, and we get better prices [when we get to the cove]. Obviously, the fisherman is sly: you can fool the fisherman [with false information], but you can't fool him for two or three days.*

*(Mark, fisherman, 67 years old, January 2022)*

On the other hand, commercial relationships relate to the typical buy-sell dynamics of the market, involving actors

outside the community, namely the buyers, either large or small ones. The latter refers to those who purchase in smaller quantities and visit the cove infrequently or irregularly. These buyers are not connected among themselves. Fishers and assistants consider these relationships unstable, which hinders the formation of close ties. Consequently, such buyers rarely obtain a reduced price, and the fisher or the assistant will likely reject any attempt at bargaining.

In contrast, commercial ties between sales units and big buyers involve more negotiation. These actors are institutionalized in fish markets. Fishers often recognize traders and vice versa, which provides a space for bargaining. They know how to deal with each other, and their interactions rely on an extensive record of past transactions. Although some fishers refer to traders as *bloodsuckers*, others acknowledge an affinity with them (“*they are friends... no, they are acquaintances... mm... no, they are work colleagues*”, Tico, assistant and ex-fisher, 70 years old, December 2021). This relationship allows bargaining between buyers and sellers, providing more profit for both sides.

Large buyers are often organized at various levels, ranging from regional to national, along with other commercial actors. Traders meet and exchange information, often knowing each other, and can use their position to pressure fishermen by following common strategies. It is important to note that the purchasing power of these buyers varies, with some buying only a few dozen while others purchase entire sales units catches. Large buyers are only sometimes successful at Caleta Portales due to the constant flow of small or retail buyers, which weakens their bargaining power. However, they still maintain a better buying position than small buyers.

However, when considering the buyers together, sales units tend to lower prices until the hake stock is depleted. The market operates in different periods. In the first period ( $t$ ), sales units set a price that buyers accept or decline. In the second period ( $t + 1$ ), sales units lower prices and select another group of buyers who want them at that price, and so on (in  $t + 2$ ), until all the hake is sold (in  $T_n$ ). The primary reason for this process is that fishers mean to sell all the catch on the same day.

*As the day progresses and the number of customers decreases, the remaining fish stalls begin to lower their prices on a dozen hake. The stall I am observing starts at CLP 7,000, but every 20 minutes, they reduce the price to CLP 6,000 and then to CLP 5,000. This reduction is not due to competition, as most other stalls have already sold out. Instead, it's a strategy to avoid being left with unsold fish, which is known locally as *estar chantado*. As the day wears on, the sellers become more willing to lower prices quickly, and they may even give away the remaining fish to ensure they do not have to take any home.*

(Fieldnotes, November 17<sup>th</sup>, 2020)

### Ecological information and maritimes cliques in the price formation process

*While speaking with a local fisherman, I inquired why they needed to travel so far for fishing and how they decided where to go. His response shed light on an interesting practice of sharing ecological information among themselves. He illustrated his point with his recent experiences: over the past three days, he had successful catches, except for yesterday, when he only caught four fish. The previous week was even tougher, as they failed to catch anything, facing an empty sea. The fisherman explained the community's collaborative process: at the cove, the first one to succeed in fishing, especially when catching hake, shares the exact location of the catch. The other fishermen then head to this spot in hope. He shared that, following this method, he and other fishermen recently moved towards Quintay, a known fishing spot, after learning that a colleague had found hakes there. When I curiously asked if this practice led to everyone heading in the same direction, he confirmed that, indeed, it does.* (Fieldnotes, July 3<sup>rd</sup>, 2021)

As we see in this excerpt, the information is shared through fishers' personal networks. These networks can either intentionally convey misleading information or accurate ecological information. The common hake is a mobile demersal resource that presents significant challenges for fishers in terms of locating and estimating its catch volume. The absence of location information prevents fishers from accurately predicting the market price of their catch, leading to uncertainty when bringing the hake ashore. This uncertainty hampers their ability to decide where to fish. Obtaining ecological information, known as *tener el dato*, as we mentioned before, is essential to their decision-making process, usually during the early mornings.

*Extraction units* (the boat or boats catching fish together) rely on various sources of information to address the challenge of fishing in an uncertain environment. These units employ two main network mechanisms: a) observation of other units and b) internal negotiation. Fishers constantly observe each other to acquire reliable information (“*You know who to ask because of the closeness and friendship we have; it's best to have a trusted group to consult*” – Chelo, fisherman, 69 years old, October 2021). Furthermore, extraction units constantly communicate with each other to define, triangulate information, and determine their fishing destinations.

They may adopt one of the following four strategies when deciding where to fish. First, they may replicate their success

by going to the same area and making some adjustments based on the observations of their peers and their negotiations. Second, they may rely on their close contacts who have caught a high volume of fish to guide their fishing location. Third, they may follow a boat that was successful the previous day, though this can be seen as free-riding behavior. Finally, they may venture into the sea without prior data, relying on their embedded knowledge and cultural background to find the resource.

When looking for ecological information, community ties led to emergent cohesive subgroups (cliques) at sea. Each group shares specific information in different cliques distributed throughout the ocean. Sometimes, two groups of nearby fishers share ecological data to determine where they will fish, while other fishers venture out alone to fish in a place without previous contact, which we may call *adventurers*. This process creates a relationship between actors and the *dato*, forming cohesive subgroups based on common membership (bi-cliques, a 2-mode network structure). The information shared among the fishers in cliques draws on the data previously shared in the cove. Each clique has a distance from the cove (cost) and a particular capture result (volume), which may vary. Depending on the number of boats and shoal size, some cliques may have a higher volume than others. Each clique has different accomplishments, and the success of an extraction unit (one boat) may lead to the formation of a clique on the next day of fishing.

The cliques' performance affects the hake price. The most significant factor is the suitability of the location chosen in terms of distance and relation to a hake bank. The second is the quantity or volume of hake the boat effectively carries from that location. The third is the quality of the hake caught by each clique, especially its size. In this context, when fishers obtain a high volume in cliques, prices tend to fall; when they obtain a low volume, prices tend to rise. Hake sizes are also priced differently (by informal sizes), with medium and smaller sizes regularly caught by fishers in cliques. To a lesser extent, the number of people in the cove and boats that go out can also impact the price, with a slight price increase when fewer people and boats exist.

When extraction units (boats) decide where to fish, they must also consider the price they will get for their catch. Different maritime cliques have varying distances from the cove, so the race is on to leave early and secure a good position for catching hake. Therefore, before setting out at dawn, each boat must have a good position when leaving the cove to quickly reach the coordinates of the hake banks and secure a favorable location for their fishing gear (gillnets or longlines).

Returning early is also crucial, allowing the first ones to set the reference price for the rest of the boats. In this way, the boats benefit from a price more in line with their catch (especially if a low volume of hake is obtained in one

clique and a high volume in others). The reference price is the starting point for all other boats to sell their hake. Boats employ the two relational strategies of observation and negotiation mentioned before: they observe other boats from their cliques and, if possible, those from nearby cliques to negotiate landings. Fishers have different thresholds for deciding when to return, which affects the negotiation within the boat.

### Reference price and the chain structure in price formation

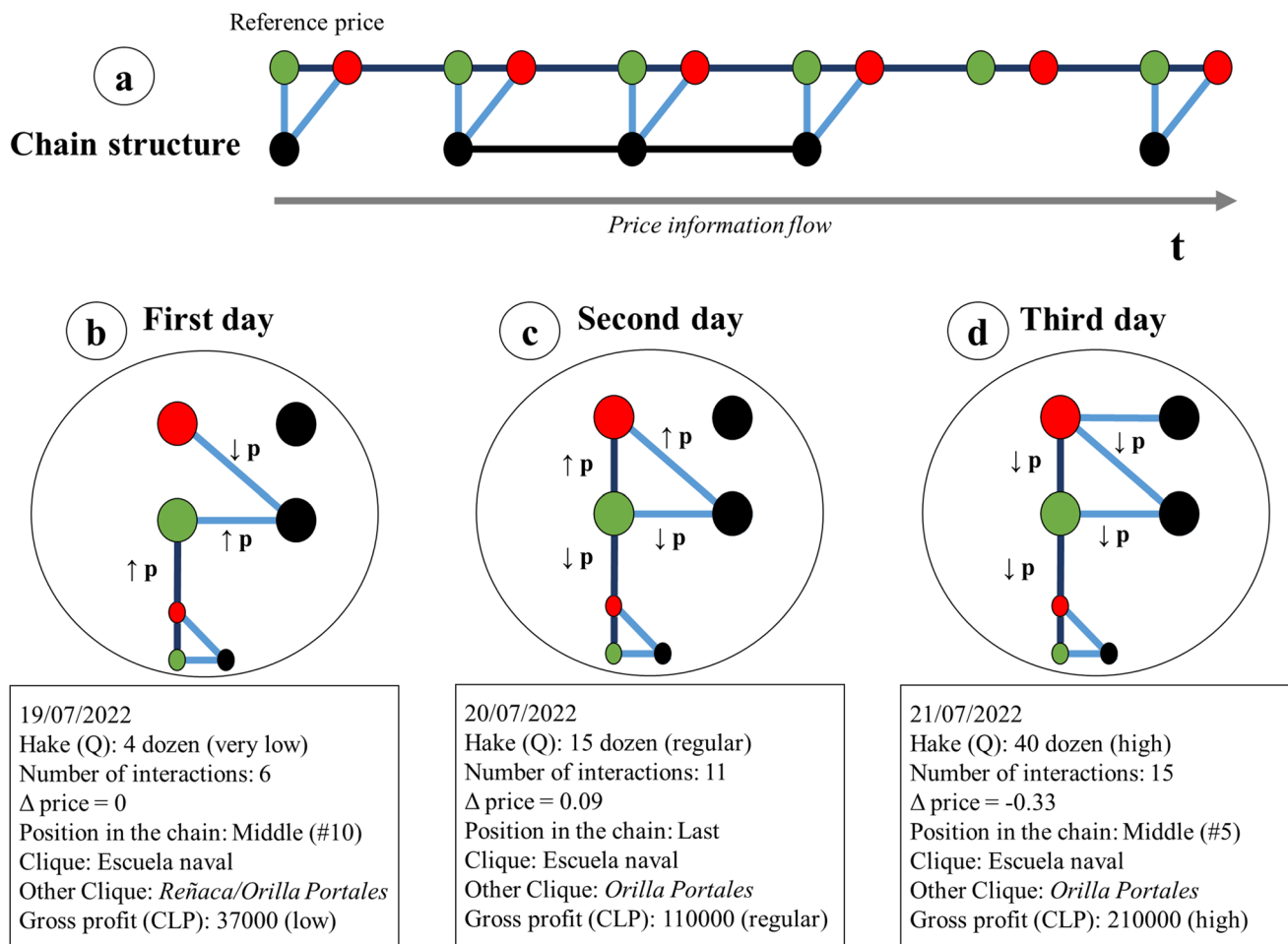
*[...] Initial stalls tend to sell more quickly, establishing a sort of monopoly. However, with the arrival of additional competitors, this dynamic transforms into an oligopoly and, finally, into a market characterized by numerous sellers. This has been mentioned by many fishermen: being the first to arrive means securing a better selling price and setting a reference price for the rest. Initially, the first stalls leverage their position to generate substantial income, but this situation fades as more competitors enter the market. Faced with a wider array of choices, buyers tend to visit different stalls to compare options. Despite this increased competition, a consistent practice remains: when a new seller (boat) arrives, buyers gather around to see what new products it offers, especially regarding their size. However, the interest in these new sellers is not as high as in the initial cases due to market saturation. Some traders stay alert, looking for opportunities to negotiate and lower prices.*

(Fieldnotes, May 20<sup>th</sup>, 2021)

The competition to get back to the cove early allows the first boat to sell its catch quickly and at a better price, as buyers are willing to pay a bonus price to get the hake as soon as possible. This creates a pseudo-monopoly for the first boat. Thus, as other boats return to the cove, they must adhere to the reference price set by the first boat, regardless of their clique affiliation. While boats from the same clique can benefit from the reference price, boats from other cliques with lower catch volumes may be in a worse position. Thus, the race to set the reference price and return to the cove early is essential for the fishers' economic success.

After the first boat arrives at the cove, the fishers have yet to determine the exact price to sell their hake (beyond considering the volume of the maritime clique), an informational issue. Despite the fact that they can set any prices they want upon arrival, they follow the institutionalized mechanism in the community and seek to know the prices of those who arrived earlier to adjust the value of the hake. At this point, the extraction unit transforms itself into a sales unit. Therefore, the main concern is to seek market information





**Fig. 3** Chain Structure (time,  $t$ , is equal to price information flow) and network dynamics in price formation (variation of the average price,  $P$ , at each relationship). Red nodes = fishers; green = assistants

(*oficiales*); black = buyers. The colors of the links: dark blue = fisher-assistant; light blue = fisher-buyer/assistant-buyer

to set a price, and once again, the sales units use observation and negotiation mechanisms to find a solution.

[...] I also asked the fisherman, Marty, about the assistants and their search for price information. He told me that they were the ones in charge of that; they had the role of looking for information because the fishermen would arrive very tired, and they had to put all the things in the boat in order. (Fieldnotes, July 7<sup>th</sup>, 2021)

At this point in the search process, one of the key participants already mentioned enters the scene: the assistant. This community member works inside the cove exclusively, supporting sales by seeking information on available hake prices, that is, by observing the sales units. These assistants' active role begins when the fishers arrive at the cove. They quickly go to other sales units to inquire about prices (surveying the nearest or closest sales units or stalls). The acquisition of information reduces the additional effort that fishers

must make. In a way, they solve the problem of asymmetric information and provide the information required to set the price of what the boat brought.

Once the boat sets a price—usually from one or two sales units they observe—the assistants return to the sales stall and discuss the prices with the fishers, and together, they define the value of the hake (a price equal to the rest, less, or a little more). In this sense, the negotiation mechanism appears to weigh on the pricing of each sales unit. In some cases, fishers trust their assistants and leave the task of setting the price to them; in others, fishers listen to the information gathered by the assistant to define prices. In a mixed case, fishers and assistants together define prices. The final word is always left to the boat's skipper.

In the daily hake market, the observation of other stalls by the assistants and the negotiation of each sales unit to set up prices create a *structural chain*. As shown in Fig. 3-a, the chain has a temporal dimension ( $t$ ): the first sale unit (the first boat) that arrives sets the reference price, and

subsequent units observe and negotiate with each other to determine the value of their catch. The observation of other sales units predominates in the cove price formation.

Figure 3 b-d show the pricing strategies of sales units that trigger exchange dynamics. The figure covers the transactions of a single unit that went to the same clique (*Escuela Naval*) for three days. On the first day, it had a wrong position in the clique, affecting its volume and sales; the situation improved on the third day. The cliques determine the starting point for the volume of catches, and the chain structure influences the value of that quantity. During hake sales, prices fluctuate due to community and commercial relations and tend to decrease over time, possibly due to fishermen's fatigue or indirect demand pressure. The dynamic networks analysis showed 21% of community relations in exchanges, a decrease of -0.35 in prices over time, 79% of commercial ties, and a decrease of -0.33. For further analysis, see Appendix B.

## Discussion

Ex-vessel prices have gained attention recently, especially for sustainable management of small-scale fisheries (Melnychuk et al. 2017; Peña-Torres et al. 2019). Currently, there are valuable attempts to monitor them (Osman and Samy-Kamal 2023; QProyect 2014; Young et al. 2020), but the social and cultural mechanisms in place have been ignored. By utilizing a network-informed ethnographic approach, we were able to comprehensively outline the relational mechanisms involved in establishing the local market for common hake. Our primary objective was to explore the factors contributing to price formation at the local level and the social and cultural dynamics that facilitate this process. As asserted by Beckert (2011), understanding the origins of pricing requires an analysis of the social and cultural context in which it occurs, a viewpoint echoed by Bourdieu (2005). An ethnographic and anthropological lens provides a detailed perspective of these intricate processes (Jerolmack and Khan 2018), which is crucial for understanding the social and cultural significance of pricing.

The quantity of fish in the market directly impacts its prices (Barten and Bettendorf 1989; Sjöberg 2015; Maynou 2022). However, understanding the social and cultural structures of the community can provide a better understanding of price-formation mechanisms and how they fluctuate daily. In this regard, the community social structures intermediate between ex-vessel prices and the quantity of fish caught. By studying commercial and community relationships, we can better understand market behavior and dynamics. Those relationships affect the ecological information shared, the emergence of cliques with different success rates, price information flow in chain structures, and price variation

among different stalls. While previous research has highlighted some of these aspects, the role of social relationships in price-formation processes has yet to be fully explored.

Communities possess a vast range of knowledge and skills that extend beyond the objects and categories they are familiar with, such as fish species (e.g., Medeiros et al. 2022). This knowledge includes practical or embodied knowledge they use daily (Bourdieu 2005). Our research has demonstrated that cultural patterns in networks shape prices and determine how the market functions. We can observe the same cultural rules among fishers (see Appendix A for further details). In addition, community knowledge has been recognized as a crucial factor in sustainable and effective resource management in other contexts (Berkes et al. 2000; Edelenbos et al. 2010; Gadgil et al. 1993; Norström et al. 2020; Olsson et al. 2004).

Fishing communities constantly adapt to market changes (e.g., Gómez and Maynou 2021; Nyiawung et al. 2022; Setälä et al. 2008; Siddiqua et al. 2022) due to their multiple networks (Jentoft 2020; Pauwelussen 2016; Symes 2020). However, research often assumes that small-scale fishing communities consist only of fishers; other actors are not mentioned or considered in fisheries market research, except for external actors (usually buyers). In our case, the selling unit is an essential piece of the market that is composed of not only fishers—who are the collectors and sellers—but also of their assistants, who are the ones who carry out most of the exchanges and collect price information. The assistants often set the flow of hake prices in the cove.

The local fish market operates within a local arena of interaction (Fine 2010, 2012), where economic relationships with buyers carry various connotations, such as commercial ties. In these local arenas, we find different meanings associated with relationships that create different expectations with buyers and, therefore, different modes of economic exchange (Fuhse 2009). In the case of small aggregate buyers, the dynamic resembles a repeated game: fishers propose a price, and buyers respond with their demand, leading to an encounter that ends with a total or partial coincidence between the two parties. This process repeats with each new supply specification and the appearance of new buyers until the available supply is exhausted, and the buyers agree to a price for the hake. According to Härdle and Kirman (1995), this process constitutes a strategic aggregate supply and demand. Relationships with small buyers are similar to the *market* or *arm-length tie* of Uzzi (1997), while large buyers are closer to the *embedded tie*. Big buyers operate differently, as they must decide whether to accept or decline the price offered by the fisher or set by the trader to finalize the exchange, akin to the ultimatum game.

However, in practice, the market needs extra-economic support relationships—such as those among other stalls, within the stall, or on the boat—to make more effective

decisions. The actors' expectations in the same local arena are supportive and often lead to cooperative exchanges (such as information or evaluation). This fact raises the question of whether local markets require a combination of cooperative and competitive behaviors to sustain themselves and be effective over time. For some authors (Fligstein 1996, 2001), it does not make sense to think of local markets as an arena where ruthless competition occurs; instead, it is an arena where competition occurs but avoiding extremes.

The mechanisms described in this paper contribute to classical maritime anthropology (Acheson 1981) and its new orientations (Aswani 2020). As we saw, local structures articulate the governance of resources (Bavinck et al. 2015) and their commercialization. In this light, the negotiation mechanism enables coordination and cooperation among team members on the boat or at the stalls through supportive and evaluative ties, as discussed with the *crew effect* versus the *skipper effect* (van Ginkel 2001). Also, the *observation mechanism* is critical to obtaining information among peers to decide where to go fishing, as shown in the classic literature (Acheson 1981), but also to decide the price of their products. In addition, sharing information, determining where to fish, and *forming cliques* are fundamental processes (Gatewood 1984), along with the *chain structure* described in this work. Moreover, *deception* is a fundamental issue (Andersen 1973). The two types of relationships, community and commercial, allow the coexistence of informational and support networks (Maya-Jariego et al. 2017) with competitive relationships.

As noted, the ethnographic approach had limitations when applied in our research. Notably, because it does not consider external processes that have affected the cove and price or its long-term economic dimension. Thus, we consider that further ethnographic research is necessary to acknowledge the mechanisms that communities construct to produce and sell their products. Our study aims to take a step in that direction. Contrary to the belief of some scholars, such as Agrawal (2001), case studies provide in-depth and high-quality data on governance system resources and their underlying mechanisms (Small 2013; Timmermans and Tavory 2018). We, then, need to apply new methods<sup>1</sup> in fish market analysis where decisions can be analyzed recursively at each market stage, affecting price formation.

Hence, additional research is necessary to explore more regional factors and to expand upon current ones, especially in a situation where overfishing of the common hake is prevalent, sea lions pose challenges to the coves, and illegal fishing is a considerable issue. Ultimately, as noted by Young et al. (2020), Caleta Portales has the advantage of direct

sales to consumers and is strategically located for liaising with various stakeholders, including government bodies.

## Conclusion

This research offers a network perspective of a local fish market using an ethnographic approach. We consider that the type of relationship –commercial or community-based– is fundamental to market exchange and price variation. Additionally, we described two critical network mechanisms: observation and negotiation. Both mechanisms are present during the extraction and marketing of hake, affecting ex-vessel prices. After that, relationships and mechanisms lead to the emergence of two network structures: cliques at sea (during extraction) and the chain structure in the cove (during marketing).

Despite its limits, the relational approach of this ethnography allows us to address other aspects not traditionally studied in the economic literature on ex-vessel prices which are, nevertheless, relevant for uncovering local structures in markets and natural resource management.

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## Declarations

**Competing interests** The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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<sup>1</sup> In anthropology, this was applied long ago with the ethnographic and tree-hierarchical decision models (Gladwin 1989).

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