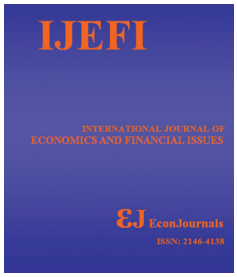

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Market Structure and Market Performance of Tuna Value Chain: A Case Study of Yellowfin Tuna and Bigeye Tuna Value Chain in Three South Central Provinces of Vietnam

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ABSTRACT

A value chain integrated Structure Conduct Performance (SCP) framework applied in agribusiness products in general and fishery products, in particular, is of great significance in conceptualizing the strategy design specifically to a value chain segment in a territory in terms of economic development. This study aims to analysed the market structure and financial performance of each actor in the tuna value chain in three South Central provinces of Vietnam to provide an overview of the economic efficiency of the value chain. Within the study, the interviews have been conducted with 315 respondents, including shipowners, middle-persons, and processors, directly related to the tuna value chain in 2018. The market concentration of each actor was quantitatively indicated in form of the Lorenz curve and Gini coefficient. In addition actor's financial performance was calculated by costs and earnings models. The results also showed that the market structure of middle-persons and processors tended to be monopolistic while shipowner's market structure tended to be in perfect competition. Besides, the processors received the highest return compared to other actors due to their highest value-added contribution and the most significant business scale. Finally, several policy interventions were suggested to improve the economic efficiency of the value chain.

Keywords: Market Structure, Market Concentration, Market Performance, Tuna Value Chain, Vietnam
JEL Classifications: M, Q, R

1. INTRODUCTION

Tuna is one of the most important seafood products in Vietnam. Specifically, the export value of tuna products in 2020 was estimated to obtain approximately 649 million USD, a decrease of nearly three percent year-over-year, which can be explained by the worldwide impact of the COVID-19 pandemic. Despite the decline in 2020, tuna products still contributed the largest turnover to Vietnam's total export value of fishery products (Custom, 2020). Like other small-scale fisheries globally, Vietnam's tuna fishery plays a significant part in food security, income, and employment through its fishing, trading, and processing activities. Furthermore, its tuna products mainly meet the export market's demands, generate foreign currency revenues and promote socio-economic growth in Vietnam's coastal areas.

On the other hand, Vietnam's tuna fishery remains several limitations, such as low product competition due to the small and fragmented production scale of fishers, poor production efficiency, and unsustainability (D-Fish, 2018b). In addition, the tuna fisher

remains is the most disadvantaged actor in the tuna value chain as he is a price taker, financially depends on the middle-persons or traders, and completely and openly lacks access to tuna market information. Meanwhile, the processor, who has decided the purchase price and the quantity of tuna raw materials, is the most powerful actor in the tuna value chain (Thu et al., 2020). Thus, it is admitted that some components of the economic inefficiency of Vietnam's tuna value chain seem to exist, which has not been clearly explained in previous studies. Therefore, our study aims to integrated the Structure Conduct Performance (SCP) model in the analysis of the tuna value chain in the three South Central provinces of Vietnam to examine its economic efficiency as a whole.

The value chain integrated SCP framework is a promising way of conceptualizing more specific strategic design idea for a value chain segment in a territory in terms of the economic development, in which the economic efficiency of the value chain in the local area is at the center of development discussions (Lazzarini et al., 2001; Figueirêdo Junior et al., 2014). According to (Bain, 1951; 1956), the SCP model consists of three main elements: Market structure, market conduct, and market performance. Specifically, market structure denotes market concentration, product differentiation, and barriers to market entry. Meanwhile, market conduct comprises behavioral patterns followed by firms in accepting or regulating the market (Bain, 1968), and market performance is the net result of market measured by net profit, return on equity, and efficiency in the use of plant, equipment, and other resources (Narver and Savitt, 1971).

An extended SCP framework for the fishery value chain in some countries has been mentioned in the literatures, such as (Kimani et al., 2020; Krishnan and Narayanakumar, 2011; Mebrate and Worku, 2019; Polymeros et al., 2010). First, (Polymeros et al., 2010) empirically examined the key factors affecting market performance in the Greek fishery industry by executing an SCP methodological framework. The results showed that market structure affects firm conduct, and also it is both market structure and firm conduct that directly or indirectly impact market performance. Furthermore, (Krishnan and Narayanakumar, 2011) investigated India's structure, conduct, and performance of the seaweed farming value chain to explore the production, institutional, marketing, social, and community relationships in small-scale seaweed farming. Their findings demonstrated that business leader's marketing, institutional arrangements, commitment, and synergistic production offers considerable savings in transaction costs. Moreover, (Mebrate and Worku, 2019) analyzed the structure, conduct, and performance of the fish market in Ethiopia and pointed that the fish market was oligopolistic, controlled by a few large wholesalers. Finally, (Kimani et al., 2020) empirically analyzed the influence of market structure, actor's conduct, and other factors on market performance in the Kenya fishery value chain. Their study results indicated that structure did not significantly affect actor's conduct, while both structure and conduct affect market performance within only on a few variables.

A value chain SCP framework applied in agribusiness products in general and fishery products, in particular, is a key element in the concept of value chain strategy since existing tools such as Strengths-Weaknesses-Opportunities-Threats (SWOT), Five-forces, and Competitiveness Diamond have not highlighted the connections between interventions and outcomes (Humphrey and Schmitz, 2010; Vellema, 2010). Using the SCP value chain framework allows development practitioners to make an integrated assessment on structure, conduct, and performance from a value chain perspective, facilitating further interventions as well as stimulating value chain theorists to continue further study on the domain of value chain strategy to generate better strategic alignment to desired outcomes (Figueirêdo Junior et al., 2014).

Referring to research on the Vietnamese tuna value chain, only (Nguyen and Jolly, 2018) investigated the structure, conduct, and performance of the tuna value chain in Khanh Hoa province within a value chain governance framework. This study interviewed 46 key actors operating on the tuna value chain in 2013, in which market structure and firm's conduct performed qualitatively, while market performance was described quantitatively. The results of this study qualitatively identified actor's operations in an imperfectly competitive market, and intermediaries received the most significant benefit compared to their investment costs. Basing on the results of (Thu et al., 2020), we identified that there seem inequalities in the market share and economic benefits distributed among actors, participating in the tuna value chain in the three South Central provinces. Therefore, this study focuses on analyzing the market structure and financial performance of key economic actors in the value chain to provide an overview of the economic efficiency of the whole tuna value chain, thereby proposing some policy interventions to improve the economic efficiency of the chain, promoting the sustainable development of Vietnam's tuna fishery. In particular, our study aims to:

- Quantitatively measure the market structure of key actors in the tuna value chain
- Analyze financial performance and financial positions of the actors in the chain
- Qualitatively assess whether the market structure and other actors affect actor's financial performance
- Propose recommendations for policy interventions to improve actor's financial performance and contribute to the sustainable development of the tuna fishery.

This paper is the second study, which is the follow-up of the (Thu et al., 2020) research on exhibit the outputs of a Ministry of Science and Technology-funded national research project on fishery value chain entitled "Developing Feasible and Comprehensive Policies for Sustainable Fisheries Development in Vietnam" from 2018 to 2020. The study consists of 5 sections: the introduction, a brief review of the literatures on the extended SCP value chain and the measurement of the market concentration, the method of this study, and the results of the surveys, discussions and conclusions.

2. LITERATURE REVIEW

2.1. Value Chain Analysis

A value chain is a concept of business management, which was first introduced and described by (Porter, 1985). This research suggested that each firm performed its activities throughout the entire process of product design, production, sales, delivery, and after-sales service. These interconnected activities can be defined in terms of a value

chain, also known as the narrow value chain approach. Subsequent studies have provided the definition of a value chain in a broad sense, which is defined as encompassing all activities involving a product, from the procurement of raw input materials to the after-sales services for the end customers (Gereffi, 2011; Kaplinsky, 2000; Morris, 2001). The functions of each stage relate to input resources, production, and then product distribution to the next stage in the value chain (Macfadyen, 2012). Furthermore, (M4P, 2008) stated that a value chain consists of strategies, organization and cooperation, and power relationships among economic actors. Last but not least, (Kula et al., 2006) indicated that a value chain encompasses firms and their end markets, supply and demand levels, business processes, horizontal and vertical links, supporting actors, and a set of global, national, and local government regulations and practices which provide the necessary support as well as further incentives for private sector development.

A fishery value chain includes all interconnected activities from receiving inputs, exploring fish, adding value to raw fishery materials through various marketing functions to the end customers (Adolf et al., 2015; Nguyen and Jolly, 2018). It consists of main processes such as input provision, exploitation, procurement, processing, and distribution of fishery products to final customers (Silva, 2020; Thu et al., 2020). Several value chains of important species, such as salmon, shrimp, tilapia, and tuna have been mentioned in the academic literature, such as (Mabe et al., 2016; Nguyen and Jolly, 2018; Tran et al., 2013; Thu et al., 2020; Ussif RashidSumaila, 2011).

The analysis of value chain analysis is a process of identifying all marketing support activities that add value to its final product and evaluating activities in terms of financial performance, including revenues, costs, and profit (Kaplinsky, 2000; Morris, 2001; Macfadyen, 2012; USAID, 2006). It is also a diagnostic tool to help actors eliminate unnecessary and wasteful activities to deliver products to customers at the lowest possible cost (Kaplinsky, 2000). Furthermore, (Bolwig et al., 2010; Macfadyen, 2012) pointed that the value chain analysis recognizes actions and supports improving financial performance throughout the value chain by reducing costs and increasing output. Moreover, (Nguyen and Jolly, 2018) stated that the value chain analysis is necessary to understand market structure, relationships between different actors, actor's conduct, and performance, while the underlying principle of the structure-conduct-performance model is the connection between firm's performance and their conducts, which depends on market structure (Figueirêdo Junior et al., 2014). Furthermore, (Thu et al., 2020) used value chain analysis framework to map the tuna value chain in the three South Central provinces, whereas this study integrated market structure and market performance on analyzing the tuna value chain in the same study area in order to provide the overview of the economic efficiency of the value chain.

2.2. Structure-Conduct-Performance Model

(Bain, 1951, 1956; Mason, 1939) formulated the Structure - Conduct- Performance (SCP) model, which is a framework for empirical analysis of the effect of market structure on industry performance. The SCP model has three main components, namely market structure, firm conduct, and market performance. It assumes that market structure would determine a firm's conduct to determine market performance (Bain, 1956; Roth, 2004). Furthermore, (Williams, 1994) stated that the market structure could be changed to improve a firm's conduct and market performance.

(Figueirêdo Junior et al., 2014) indicated that the SCP model is a promising way of conceptualizing strategy design, linking it to structural aspects and performance. This model was initially proposed to explain the firm's market power (Timothy, 1989). Subsequently, it was used to perceive corporate strategies for firms (McKinsey, 2010). Furthermore, (Barney, 2001) argued that the SCP model is compatible with the resource-based perspective that enables a company to discover valuable resources in terms of industry structure. In addition, (Figueirêdo Junior et al., 2014; Lazzarini et al., 2001) identified that extending the SCP framework to value chains provides economic development strategies for companies's networks as well as supports actors in a value chain segment in a territory. Moreover, the SCP model is proven to have impact on the efficiency of the value-adding process through assessing the levels of competitiveness, pricing behavior, and economic efficiency (Nguyen and Jolly, 2018).

2.2.1. Market structure

(Bain, 1956) defined that market structure includes firms's market shares, and every barriers against new entrants, while (Shepherd, 1972) identified that market structure refers to the concentration of sellers or buyers, barriers to entry, and levels of product differentiation in the private sector. Furthermore, (Tung et al., 2010) argued that market structure is a classification system for the main characteristics of a market, including the number of companies in the market, the similarity of products among firms, and the ease of entering and leaving the market. Moreover, (Lipczynski et al., 2013) suggested that market structure includes seller concentration or buyer concentration, degrees of product differentiation, entry/exit barriers market, and market demand growth rate.

Admittedly, there are indeed many different definitions of market structure, (Bain, 1968), argued that market structure includes three main aspects: Market concentration, product differentiation, and barriers to market entry. Market concentration is defined as the number of firms and the size distribution of sellers and buyers (Pomeroy and Trinidad, 1995). The degree of product differentiation, one of the entry barriers, is an essential element of market structure since it strengthens a firm's position and profitability (Pomeroy and Trinidad, 1995). Barriers to market entry are production costs that must be borne by potential entrants but not existing firms in the market, or any advantages that existing firms received in the market. Potential entry barriers are product differentiation and price elasticity, internal and legal factors, economies of scale, capital requirements, and technological factors (Pomeroy and Trinidad, 1995). Furthermore, (Bain, 1968) stated that the higher the market concentration is, the more barriers to entry are, and the higher the degree of product differentiation shows, the closer the market would be towards a monopoly structure.

When integrating the SCP model to the value chain, market structure represents the environment where sellers and buyers

interact at different stages of value chain (Nguyen and Jolly, 2018). It includes characteristics of a market organization that strategically influence the nature of competition and pricing behavior within the market (Harriss, 1993). Market structure affects the levels of profitability and pricing decisions. Some studies such as (Cotterill, 1986; Hall, 1979; Marion, 1979) established the relationship between market structure and profitability in the food industry, whereas others, such as, (Cotterill, 1987; Lamn, 1981) presented the relationship between market structure and price levels. Furthermore, (Molyneux and Forbes, 1995) argued that market structure depicts the levels of competition existing in different marketing stages and the profits that accumulate to more efficient competitive firms. Last but not least, (Ada-Okungbowa, 1998) stated that market structure could affect the nature of market competition and the process of price formation.

2.2.2. Market conduct

Market conduct includes behavioral patterns, created by companies, in accepting or adjusting to the markets where they sell or buy products (Bain, 1968). (Moore, 1973; Purcell, 1973) presented that market conduct refers to the actions and behaviors of firms within a given market structure, for example, pricing policies and non-price inducements practiced by businessmen to attract customers. Meanwhile, (Albert et al., 1999) stated that market conduct involves different decision-making techniques in determining price, output, sales promotion policies, and other tactics to achieve their economic goals. Additionally, (Nguyen and Jolly, 2018) pointed that market conduct implies the competitive nature of actors in the market and some significant aspects of corporate behavior, such as pricing behavior, advertising, research, innovation, development, etc., to maximize their business profits.

Regarding the relationship between market conduct and other factors of the SCP model, (Bain, 1956) argued that market structure and market conduct determine market performance. Additionally, (Bain, 1968) stated that by investigating the relationship between the market structural factors and some pricing practices (market conduct), it is possible to make some predictions on market performance.

2.2.3. Market performance

Market performance relates to the economic outcomes regarding pricing efficiency and flexibility to comply with changing real-world situations (Bain, 1968). Furthermore, (Narver and Savitt, 1971) stated that market performance is the net result of conduct and is measured in net profits, return on equity, efficiency generated by companies or individuals. Moreover, (Hay and Morris, 1991) argued that market performance is closely related to price levels, profit margins, levels of investments, and reinvestment of profits. Measures of market performance are mentioned in the academic literature such as price, quantity, product quality, resource allocation, production efficiency (Neuberger, 1997), or net returns and marketing margin (Pomeroy and Trinidad, 1995), or production efficiency, distribution and allocation efficiency, product quality, technical progress, and profitability (Pelton et al., 2014) or the rate of return concerning marketing costs and profit margins (Nguyen and Jolly, 2018).

Referring to the relationship between market performance and other factors in the SCP model, (Bain, 1956) argued that market performance is correlated with market structural conditions and firm's conduct in terms of pricing and product policies, and profitability. Meanwhile, (Neuberger, 1997) suggested that this relationship is demonstrated through price, productivity, allocative efficiency, and growth. Additionally, (Kimani et al., 2020) empirically examined the influence of market structure in terms of the value of equipment, actor's conduct in price collusion, product selection, access to market information, power to determine prices, and how these and other factors affect market performance in terms of profitability. The study found that marker structure did not significantly affect actor's conduct, whereas it is market structure and actor's conduct which influenced market performance in some variables.

2.3. Market Concentration

As discussed in Section 2.1, market concentration is one of the three main market structure characteristics (Bain, 1968) and is considered a significant factor in the traditional SCP model (Meschi, 1997). Also, it is the function of the number of firms and their respective shares of total output in a market (Times). Furthermore, (Mohamed et al., 2013) defined a market as a concentration when there are few companies operating in the industry, or an uneven distribution of market shares existing in the private sector.

Concerning the relationship between market concentration and market competition, (Ginevicius and Cirbas, 2007) argued that market concentration is often associated with market competition. The higher the concentration of the market, the higher the degree of monopoly, and the lower the level of competition. On the other hand, low market concentration implies low market power held by leading companies, resulting in a competitive market (Weiss, 1971). Besides, (Pomeroy and Trinidad, 1995) stated that the more concentrated the market, the higher probability of non-competitive behavior, such as collusion in the market. Similarly, (Edwards et al., 2006) argued that market concentration is inversely proportional to competition, as market concentration encourages collusion between actors in the industry.

In terms of the relationship between the degree of market concentration and the factors in the SCP model, firstly, (Pomeroy and Trinidad, 1995) argued that the degree of market concentration plays a significant part in determining a firm's conduct in the industry, as it affects the interdependence of actor's actions. Additionally, (Hass et al., 2016; Nguyen and Jolly, 2018) identified that market concentration is crucial in determining a company's market power in setting prices and quantity of products. Besides, (Allen, 2005) indicated that firms operating in highly concentrated industries are significantly more profitable than firms operating in less concentrated industries, regardless of efficiency. Thus, it can be said that market concentration is positively related to market performance. Conversely, market concentration will be negatively correlated with customer welfare and the number of firms in the market (Brock, 2009; Shepherd, 1972).

Measuring or quantifying market concentration is one of the main issues related to market concentration. There are two groups

of measures, namely discrete and cumulative ones, to quantify market concentration. The discrete concentration measurement explains only for a limited number of attribute carriers and does not consider market changes and other factors. In contrast, the cumulative concentration measurement account for all values of attribute carriers and cannot adequately describe the situation in the market (Ginevicius and Cirbas, 2007). The best known and most used discrete concentration measurement is the concentration index, the total percentage of the market shares of the largest companies in an industry (Rao, 1969). This index is an easy-to-use and a popular measurement, despite some drawbacks. Firstly, it shows only one point of the concentration curve, and thus does not explain the size distribution of firms in the market. Secondly, its accuracy largely depends on how the most significant number of firms in the market is chosen, which is difficult to be defined precisely for each type of market in the actual situation (Ginevicius and Cirbas, 2007). For measuring cumulative market concentration, six popular measures are presented in the (Ukav, 2017) literature, including the Herfindahl index, Lorenz curve, Gini index, Horwath index, Entropy index, and Rosenbluth index. Lorenz curve and Gini index were commonly used in analyzing fisheries market concentration in many studies such as (Drury O'Neill et al., 2018; Hass et al., 2016; Oparinde and Oluwadare Ojo, 2014; Wamukota et al., 2014). In our study, the Lorenz curve and the Gini index were used to measure the market concentration of the yellowfin and bigeye tuna value chain in the three South Central provinces of Vietnam.

3. METHODOLOGY

3.1. Study Sites

This study was conducted in three South Central provinces of Binh Dinh, Phu Yen, and Khanh Hoa in Vietnam (Figure 1), which yielded the highest oceanic tuna catches and had the largest tuna fishing vessels compared to other provinces. In 2018, Binh Dinh had the largest tuna catches in Vietnam with 52,823 tons, of which 10,050 tons of yellowfin tuna and bigeye tuna and 42,773 tons of skipjack tuna. Khanh Hoa occupied the second position with 19,103 tons, of which 3,203 tons of yellowfin tuna and bigeye tuna and 15,900 tons of skipjack tuna, followed by Phu Yen with 8,616 tons, of which 3,829 tons of yellowfin tuna and bigeye tuna and 4,787 tons of skipjack tuna.

Skipjack tuna is caught by purse seine and gillnet fisheries, taking place all year-round, while yellowfin and bigeye tunas are caught by longline/handline fisheries, mainly operating during the primary-fishing season from November to May. During this time, the tuna usually has the best quality, and the volume of tuna catches is also the largest of the year. Meanwhile, from June to October, the rest of the year is the secondary fishing season with low productivity.

Regarding the number of tuna fishing vessels, Binh Dinh had the highest number with 2,010 ships, in which 1,425 ships for longline/handline fishery, while Phu Yen came behind the second position with 657 ships, in which 502 ships were contributed to longline/handline fishery. Khanh Hoa kept the third position with 539 ships, in which 348 ships were allocated for longline/handline fishery (D-Fish, 2018).

For tuna purchase and tuna process and export in the three South Central provinces, most of the tuna output is sold through purchasing actors (middle-persons and traders), then sold to processing companies. This is shown in the detailed tuna value chain description in the three South Central provinces of Vietnam in the (Thu et al., 2020) literature. In 2018, there were thirty-six tuna purchasing establishments and fifteen tuna processing companies in the study area. Table 1 shows the number of tuna fishing vessels, tuna purchasing establishments, and tuna processing enterprises in Vietnam's three South Central provinces in 2018.

In terms of infrastructure and logistics services serving tuna fisheries in the research area, Binh Dinh has three fishing ports: Quy Nhon, De Gi, and Tam Quan ports. Phu Yen has three fishing ports: Tien Chau, Phu Lac, and Dong Tac ports, while Khanh Hoa has two main fishing ports: Hon Ro and Da Bac ports. In 2018, infrastructure at the fishing ports has been specifically invested, with the rennovated fishing ports (roof system, wastewater treatment system). However, this investment has not met the requirements for the sustainable development of tuna fisheries.

Figure 1: A map of three provinces of Binh Dinh, Phu Yen, Khanh Hoa showing study sites (Property, 2017)

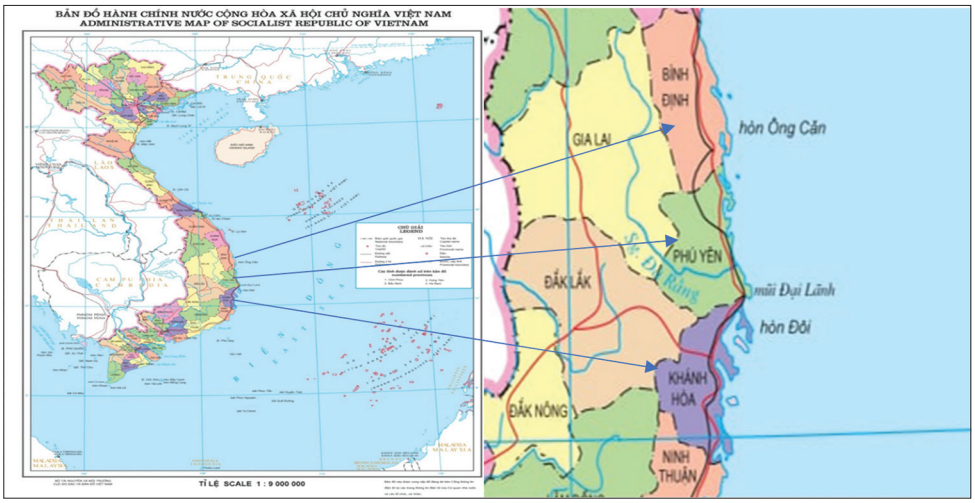


Table 1: The number of tuna fishing vessels, tuna purchasing establishments, and tuna processing enterprises in three South Central provinces of Vietnam in 2018

Province	Number of vessels			Purchasing agent			Processing company		
	Yellowfin tuna, bigeye tuna	Skipjack tuna	Total	Yellowfin tuna, bigeye tuna	Skipjack tuna	Total	Yellowfin tuna, bigeye tuna	Skipjack tuna	Total
Binh Dinh	1425	585	2010	8	9	17	1	0	1
Phu Yen	502	155	657	6	3	9	5	1	6
Khanh Hoa	348	191	539	5	5	10	8	0	8
Total	2275	931	3206	19	17	36	14	1	15

Source: D-Fish, 2018

For example, there remain no logistics services and specialized fishing berths for the tuna industry, and there are no freezers at the fishing ports are available for preserving tuna products. In addition, some fishing ports had purchasing activities that fail to meet hygiene conditions. Furthermore, shipbuilding and repairing services were fragmented and small-scale and there was a shortage of technological and material facilities. Moreover, ice plants had low capacity and poor ice quality due to outdated ice production machinery technology (D-Fish, 2018).

3.2. Study Phases and Study Scope

3.2.1. Study phase

This study was conducted in four phases: Interview surveys, focus group discussion, key informant interviews, and validation workshop presented in detail of the (Thu et al., 2020) study. Quantitative data in this study was mainly obtained from the interview surveys from March to June 2018. The contents of the semi-structured questionnaires on the economics of the tuna fishing, purchasing, and processing activities of actors along the tuna value chain in an average month in the last year (2017) were required. Data on volume, revenues, price, variable costs, fixed costs of every actor in an average month allowed us to construct Lorenz curves, Gini coefficients, and costs and margins models for each actor along the chain. The open-ended questions in the interview surveys, focus group discussion, key informant interviews, and validation workshop helped to collect qualitative information, especially the main factors affecting the financial performance of actors as well as some possible solutions to improve the performance of actors along the chain.

3.2.2. Study scope

Out of 435 respondents presented in the interview surveys of the (Thu et al., 2020) research, 315 persons were directly related to the yellowfin tuna and bigeye tuna value chain, the remaining respondents were associated with the skipjack tuna value chain. To ensure higher reliability for the analysis of the market structure and market performance of actors along the chain, we selected the yellowfin tuna and bigeye tuna value chain was chosen as a case study. Therefore, the scope of the study presented in this paper was limited in studying the market structure and financial performance of actors in the yellowfin tuna and bigeye tuna value chain in three South Central provinces of Binh Dinh, Phu Yen, and Khanh Hoa at the survey time in 2018. Four different distribution channels of the yellowfin and bigeye tuna value chain which have existed in these provinces, were mentioned in the (Thu et al., 2020) literature. In this study, we mainly focused on the second distribution channel, which includes fishers, middle-persons, processors, and export markets because sixty-six percent total volume of yellowfin tuna and bigeye tuna was traded on this channel in 2018 (Thu et al., 2020).

The market structure and financial performance of actors were analyzed in this study, focusing on analyzing the market concentration of each actor by determining its Lorenz curve and Gini coefficient, and evaluating the market performance of each actor in the chain. Through the value chain analysis process, we qualitatively assessed whether the market structure and other factors can affect the financial performance of each actor in the chain.

All data on the market structure and financial performance collected and presented in this paper are monthly averages and pertain to the survey time in 2018. These data are recall data, presenting economic transactions of actors in the tuna value chain last year (2017). Also, the data for each link in the chain for three provinces covered by the study are averages and hide the individual characteristics. Table 2 summarizes the number of individual questionnaires and focus group discussions completed in each of the three provinces, and the number of participants involved in the key informant interviews and validation workshop.

3.3. Data Collection

The data collected during the study, allowed us to estimate the number of critical indicators for each actor in the tuna value chain. For shipowners, the indicators were calculated both separately for each province by taking averages of respondent's values in each province and on the entire sample frame. For middle-persons and processors, the indicators were only calculated on the total sample in the three provinces since the number of respondents in each province was tiny. An interesting point in this study, we assumed that revenues and costs made by the shipowners during a sea trip were monthly revenues and monthly costs. Meanwhile, monthly revenues and monthly costs made by the middle-persons and processors were in an average month.

We used the average monthly revenue made by each actor to demonstrate the Lorenz curve and calculate the Gini coefficient for each actor in the chain in order to measure market concentration. The sale volume and the selling price for one kilogram of yellowfin tuna and bigeye tuna during peak and off seasons are significantly different. As a result, the average monthly revenue of each actor was calculated by averaging the average monthly revenues during the primary and secondary harvesting seasons.

Table 2: Sample frame used during the study

Province	Shipowners	Middlemen	Processors	Representatives related to the tuna value chain
Binh Dinh	121 questionnaires 1 FGD with 12	Eight questionnaires	One questionnaire	• 1 D-Fish's member, 3 DoFIs's members, 1 VINATUNA's member, 1 VASEP's member, 1 VIFEP's member for the KIIs; • 20 tuna value chain players (shipowners, middle-persons, processors), 5 D-Fish's members, 5 DoFIs's members for a validation workshop
Phu Yen	77 questionnaires	Four questionnaires 1 FGD with 5	One questionnaire	
Khanh Hoa	98 questionnaires	Three questionnaires	Two questionnaires 1 FGD with 3	
Total	296 questionnaires	15 questionnaires	Four questionnaires	

The financial indicators which were calculated for each actor, based on the (M4P, 2008) literature, including gross margin, gross margin per kilogram of yellowfin and bigeye tunas, net income, net income per kilogram of yellowfin and bigeye tunas, marketing margin, and marketing margin per kilogram of yellowfin and bigeye tunas. The calculation on these indicators was made possible with the detailed questions in the semi-structured questionnaires, which provided the data on sales volumes, price, variable and fixed costs and allowed to construct costs and earnings models for each actor.

Variable costs change according to the amount of tuna caught/traded/produced (M4P, 2008). These costs are expenses incurred during a sea voyage for tuna fishers, including fuel, ice, bait, food, necessary necessities, and wages paid for labor. For tuna purchasing businesses, variable costs are typically related to the costs of purchasing raw tuna, loading and unloading, fish hygiene, and ice costs. Meanwhile, variable costs typically include the costs of purchasing raw tuna and wages paid for tuna processing workers for tuna processing enterprises.

Fixed costs do not vary according to the amount of tuna caught/traded/produced (M4P, 2008). These costs typically include monthly taxes/fees, financial expenses (monthly principal and interest), repair and maintenance costs, depreciation expenses, and other expenses for tuna fishers. Meanwhile, fixed costs are typically associated to salaries paid to tuna purchasing staff, financial costs, monthly taxes, depreciation expenses, and other expenses for tuna purchasing businesses. For tuna processing enterprises, the fixed costs include packaging costs, repair and maintenance costs, financial costs, chemical costs, microbiological costs, electricity costs, water costs, environmental costs, selling expenses, taxes, depreciation expenses, and other expenses.

For shipowners, average operational costs incurred during a average sea trip in 2017 were assumed as average monthly operational costs. These costs were entirely recall data without any records. By contrast, monthly operational costs incurred in tuna purchasing and processing enterprises were based on accounting records.

3.4. Data Analysis

Descriptive statistics such as frequency and percentage were used to analyze the socio-economic characteristics of key actors, including shipowners, middle-persons, and processors. Lorenz curves and Gini coefficients were applied to measure the market concentration for each actor in the chain. Financial performance indicators based on the (M4P, 2008) literature were calculated to analyze the economic efficiency of each actor in the chain.

3.4.1. Market structure

In this study, market concentration is measured to get a thorough look at the market structure of each actor in the chain. An understanding of the market structure can provide an aid in formulating appropriate development strategies based on a deep grap of the actual market. Based on previous studies such as (Bila and Bulama, 2005; Mkunda et al., 2019, Ndaghu et al., 2011; Oparinde and Oluwadare Ojo, 2014; Taru and Lawal, 2011), the Lorenz curve and Gini coefficient were used to measure the market concentration of each actor in the chain.

3.4.1.1. Lorenz curve

Lorenz Curve, which was developed by Lorenz in 1905, is used to give an intuitive nature of the market concentration of each actor through a graphical representation. It represents the cumulative percentage of monthly revenues in relation to the cumulative percentage of the whole population. If all individuals have the same monthly revenues, the Lorenz Curve lies in the 45-degree line, the perfect equality line, or the egalitarian line. If there is an inequality in monthly revenues, the Lorenz Curve is below the 45-degree line.

Lorenz Curve for each actor in the tuna value chain was constructed on the basis of guidelines of (FAO, 2005). Firstly, monthly revenue distribution in each actor was sorted from the smallest value to the largest value. Next, the proportion of monthly revenue owned by each individual and the ratio of each individual to the total population were defined. In the third step, the cumulative proportion of revenue and the cumulative proportion of the population were calculated. Then, the equidistributed line, representing the cumulative proportion of revenue equal to the cumulative proportion of the population, was plotted. Finally, the Lorenz Curve, which is always below the equidistribution line, was plotted to represent the cumulative proportion of revenue against the cumulative proportion of the population.

3.4.1.2. Gini index

The Gini coefficient, developed by Gini in 1912, and it was used to determine market concentration through the Lorenz curve. It measures the ratio of the area between the Lorenz curve and the

equidistribution line (which is called the concentration area) to the maximum concentration area (FAO, 2006). It is expressed by the following formula:

$$G = \frac{A}{(A+B)} \quad (1)$$

Where: G = Gini coefficient; A = Area that lies between the line of equality and the Lorenz curve; $A+B$ = Total area under the line of equality.

Based on the (Bila and Bulama, 2005; FAO, 2006; Ndaghu et al., 2011) literatures, the Gini coefficient was determined according to the following formula:

$$G=1-\sum X^{*}Y \quad (2)$$

Where G = Gini coefficient; X = proportion of population; Y = cumulative proportion of monthly revenue.

The Gini coefficient for each actor in the chain was also determined on the basis of guidelines of (FAO, 2006). The Gini coefficient ranges from zero to one. A perfect equality in concentration (low) of actors is expected if G tends towards zero, while perfect inequality in concentration (high) of actors is expected if G tends toward one. If G =1, the market is imperfect, and G = 0, the market is perfect and competitive.

3.4.2. Market performance

3.4.2.1. Actor's operational and financial performance

Based on the (M4P, 2008) literature, financial performance indicators of each actor in the chain was calculated. These indicators were defined as follows:

- $Gross\ margin = Revenues - Variable\ Costs$ (3)
- $$Gross\ margin\ per\ kilogram = \frac{Gross\ margin}{Volume\ of\ tuna}$$ (4)
- $Net\ income = Revenues - Variable\ Costs - fixed\ costs$ (5)
- $$Net\ income\ per\ kilogram = \frac{Net\ income}{volume\ of\ tuna}$$ (6)
- $Marketing\ margin = Revenues - Purchase\ cost$ (7)
- $$Marketing\ margin\ per\ kilogram = \frac{Marketing\ margin}{Volume\ of\ tuna}$$ (8)

3.4.2.2. Relative financial position of actors in the value chain

In this step, the breakdown of costs, revenues, gross margins, net incomes, and marketing margins among the actors in the chain were taken into consideration. The comparison method, proposed in Tool 6 of the (M4P, 2008) was used to compare the financial performance indicators of actors both at per unit and at total monthly sale volumes. With these results, the conclusions about the financial position of each actor in the chain was withdrawn.

4. RESULTS

4.1. The Yellowfin Tuna and Bigeye Tuna Value Chain

As detailed in Figure 8 of the (Thu et al., 2020) research, yellowfin and bigeye tunas were caught by longline/handline fisheries in the South Central Coast of Vietnam. After catching the tunas, fishers stored them in cold basements in their tuna ships. After the duration of the sea trip, averaging from 20 to 25 days, tuna ships landed at the fishing port; tunas were sold to middle-persons and then sold and transported to processors by cold trucks. At processing plants, raw yellowfin tuna and bigeye tuna were stored and processed into finished tuna products such as tuna loin/CO, tuna Cube/CO, tuna Saku/CO, tuna Steak/CO. These tuna products were mainly exported to foreign markets such as the US, EU, Japan, China, and other countries, while by-products of the tuna processing process were sold to the domestic market. Although there were many different actors in the chain, due to time and money limitations, only three main actors including shipowners, middle-persons, and processors were interviewed and analyzed in the study.

4.1.1. Shipowners

296 shipowners catching yellowfin tuna and bigeye tuna in three South Central provinces in 2018 were randomly chosen for the interview. The survey results showed that all shipowners were men, who were in middle-age with an average of 46 ± 11 years old, which have accumulated enough experience and capital to manage tuna fishing operations. Most of them were married, accounting for ninety-two percent of total respondents. They were also the head of the family and were primarily responsible for the family budget. In addition, each shipowner's household was an extended family from six to seven persons. They usually lived with their parents and had an average of three to four children. The majority of the shipowners had a low educational level, with ninety-three percent of total respondents completing primary and secondary education. Therefore, it is difficult for them to quickly access science and new technology in catching and preserving tuna raw materials. Eighty-nine percent of total respondents have eleven years to over thirty years experience of fishing, which allowed them to actively participate in tuna fishing, promptly deal with extreme weather on offshore, and transfer their experience to other fishers. Table 3 summarizes the socio-economic characteristics of 296 shipowners exploiting yellowfin and bigeye tuna in the three South Central provinces in 2018.

The survey results in 2018 showed that most oceanic tuna ships were made of wood, from 15 to 24 m in length, and four fishing rods. Each tuna ship had an average of six to seven persons, including the shipowners and crew members. Most fishers used traditional methods to catch yellowfin tuna and bigeye tuna, and then preserved tuna raw materials in the cold basements made of styrofoam which were not guaranteed for keeping cold. After docking, tunas were sold to middle-persons at the fishing ports, where fresh tunas were classified into three grades, namely first-grade tuna (average weight of 30 kg or more), second-grade tuna (average weight of 20-30 kg), and third-grade tuna (average weight lower than 20 kg). Based on this classification, the quality control staff of the processing plant will evaluate the tuna meat quality accordingly. If tunas met the weight and meat quality required

Table 3: Socio-economic characteristics of shipowners in sampled three South Central Provinces of Vietnam

Variables	Categories	Binh Dinh		Phu Yen		Khanh Hoa		Average Three South Central Provinces	
		Frequency	(%)	Frequency	(%)	Frequency	(%)	Frequency	(%)
Sex	Male	121	100	77	100	98	100	296	100
	Female	0	0	0	0	0	0	0	0
Age	≤30	17	14	11	14	0	0	28	9
	31-40	31	26	23	30	24	24	78	26
	41-50	28	23	16	21	29	30	73	25
	51-60	40	33	22	29	28	29	90	31
	>60	5	4	7	9	17	17	29	9
Mean±SD		44±9.63		45±11.18		49±10.77		46.03±10.62	
Marital status	Single	4	3	3	4	3	3	10	3
	Married	112	93	69	90	90	92	271	92
	Divorced	0	0	0	0	0	0	0	0
	Widowed	5	4	5	6	5	5	15	5
Household size	≤5	50	41	30	39	40	41	120	41
	6-10	71	59	47	61	58	59	176	59
	>10	0	0	0	0	0	0	0	0
Mean±SD		6±2		7±3		6±2		6.5±2	
Position									
	Shipowner	121	100	77	100	98	100	296	100
	Captain	0	0	0	0	0	0	0	0
	Other	0	0	0	0	0	0	0	0
Educational level									
	Illiteracy	0	0	0	0	0	0	0	0
	Primary	59	49	37	48	49	50	145	49
	Secondary	49	40	36	47	44	45	129	44
	High school	13	11	4	5	5	5	22	7
	College/University	0	0	0	0	0	0	0	0
Tuna fishing experience									
	≤10	16	13	8	10	11	11	35	11
	11-20	93	77	53	69	61	62	207	70
	21-30	12	10	15	20	26	27	53	18
	>30	0	0	1	1	0	0	1	1
Mean±SD		15.8±5.6		17.22±5.93		18.58±5.92		17.07±5.91	

Source: Primary Processed Data, 2018

by the plant, they would be purchased at the set price; otherwise they will get a lower price. The assessment of tuna quality, which was utterly dependent on the judgment of the processors, often were often disappointing to fishers. In addition, the tuna trading business between shipowners and middle-persons is based on the credit relationship in which shipowners get loans from middle-persons before a sea voyage and sell the caught tunas to these lenders afterward, which is one of the main reasons for the weak negotiating power of shipowners in tuna transactions (Thu et al., 2020).

In general, the number of shipowners fishing for yellowfin and bigeye tunas was relatively large. The majority of shipowners owned one tuna ship, while only few shipowners owned two. Shipowners encountered numerous disadvantages, namely: (i) They had a weak price negotiation and were always price takers; (ii) They lacked information on the tuna market; (iii) They were completely dependent on the judgment of the processors on their tuna products; (iv) They were at high risk because there was no sale contract between the shipowners and middle-persons; (v) They did not have substantial financial resources and thus depended on middle-person financing, making it a challenge to change the better tuna buyers.

4.1.2. Middle-persons

15 middle-persons, including directors of yellowfin and bigeye tuna purchasing establishments in the three South Central provinces in 2018 were interviewed. Among the respondents, eighty percent were men, and twenty percent were women. The average age of middle-persons was 49 years old, and they all had sufficient experience, capital, and relationships to manage their tuna purchasing companies. All interviewed middle-persons were married and both husbands and wives were all involved in the management of tuna purchasing companies. Most of the husbands were the managers in charge of dealing with processors and banks, whereas their wives were responsible for managing tuna purchasing at fishing ports and working with shipowners. Most middle-persons had a medium family with six to seven persons. They had a better education level than shipowners (seventy-three percent of middle-persons had education levels from secondary school or higher). Most middle-persons had eleven years or more experience of purchasing tuna. In addition, they lived in the tuna fishing communities and understood fishers; thus, they could purchase a large amount of raw tuna at reasonable prices. According to respondents, there were three business scale types: small, medium, and big companies. A large tuna purchasing company was a large-capital enterprise that financed from one-hundred-fifty to three hundred ships. A medium tuna purchasing

company was an enterprise that financed between fifty and seventy ships, while a small tuna purchasing company financed from twenty to thirty ships. Among fifteen middle-persons interviewed, five were directors of large tuna purchasing companies and ten were directors of medium-sized enterprises. Table 4 presented the socio-economic characteristics of middle-persons in the study in 2018.

The survey results showed that most middle-persons had two prominent roles: Providing loans, oil, and ice for tuna ships before a sea trip and buying tunas from shipowners to sell to processors. Most tuna purchasing companies acted as purchasing agents of the processors through contracts. They undertook tuna procurement from shipowners according to the tuna volume and price requirements of processors, and received commission from the processors. These middle-persons accessed tuna market information regularly and had good long-term relationships with the processor (Thu et al., 2020).

Table 4: Socio-economic characteristics of middlemen in sampled three South Central Provinces of Vietnam

Categories	Three South Central provinces in Vietnam	
	Frequency	(%)
Sex		
Male	12	80
Female	3	20
Age		
30-40	1	7
40-50	9	60
50-60	5	20
Mean±SD	48.9±5.84	
Marital status		
Single	0	0
Married	15	100
Divorced	0	0
Widowed	0	0
Household size		
≤5	3	20
6-10	12	80
>10	0	0
Mean±SD	6±2	
Position		
Director	15	100
Manager	0	0
Other	0	0
Educational level		
Illiteracy	0	0
Primary	3	20
Secondary	6	40
High school	4	27
College/University	2	13
Tuna purchasing experience		
≤ 10	0	0
11-20	9	60
21-30	5	33
>30	1	7
Mean±SD	20±6.22	
The operational scale of tuna purchasing companies		
Large (finance for 150-300 tuna vessels)	5	33
Medium (finance for 50-70 tuna vessels)	10	67
Small (finance for 15-30 tuna vessels)	0	0

Source: Primary Processed Data, 2018

4.1.3. Processors

Directors of four tuna processing and exporting companies in three South Central provinces of Vietnam in 2018, including one company in Binh Dinh, one company in Phu Yen, and two companies in Khanh Hoa, were interviewed individually. These companies are the leading tuna processing and exporting enterprises in Vietnam, with the number of employees from 300 to 600 people, production capacity from 5000 tons to 15000 tons per year. The survey results showed that there was an equal percentage of processors as men and women. Meanwhile, according to secondary data from the three surveyed provinces, there were eight male owners of tuna processing companies (sixty percent processors) and six female owners (forty percent) in the study area in 2018. The respondents were forty-nine years old on average, and they have gained sufficient education, experience, capital, and relationships to manage tuna processing and exporting activities in their companies. All respondents were married and had a medium family with five to six persons per household. They also graduated from universities, enabling them to quickly acquire advanced tuna processing knowledge. Most respondents had experience in processing and exporting tuna from 11 years to 30 years. In general, processors were the main actors creating much-added value in the tuna value chain. Due to high negotiating power, they determined the purchase price and volume, and were the most influential actors (Thu et al., 2020). Table 5 summarizes

Table 5: Socio-economic characteristics of processors in sampled three South Central Provinces of Vietnam

Variables	Categories	Three South Central provinces in Vietnam	
		Frequency	(%)
Sex	Male	2	50
	Female	2	50
Age	40-50	2	50
	50-60	2	50
Mean±SD		48.8±4.79	
Marital status	Single	0	0
	Married	4	100
	Divorced	0	0
	Widowed	0	0
Household size	≤ 5	2	50
	6-10	2	50
	> 10	0	0
Mean±SD		5±2	
Position			
	Director	4	100
	Manager	0	0
	Other		
Educational level			
	Illiteracy	0	0
	Primary	0	0
	Secondary	0	0
	High school	0	0
	College/University	4	100
Tuna processing experience			
	≤ 10	0	0
	11-20	3	75
	21-30	1	25
	>30	0	0
Mean±SD		17.75±3.4	

Source: Primary Processed Data, 2018

Table 6: Estimate of Gini coefficients for shipowners in sampled three South Central Provinces of Vietnam. Unit: VND 1,000

Class of shipowners according to monthly revenue	Number of shipowners	Proportion of shipowners (X) (%)	Cumulative proportion of shipowners (%)	Total value of monthly revenues	Proportion of total revenues (%)	Cumulative proportion of total revenue (Y) (%)	X*Y
0	0	0	0	0	0	0	0
0-100,000	1	0.34	0.34	95,444	0.18	0.18	0.00001
100,001-150,000	74	25.00	25.34	9,863,553	19.06	19.24	0.04811
150,001-200,000	143	48.31	73.65	24,634,724	47.61	66.86	0.32300
200,001-250,000	74	25.00	98.65	16,085,579	31.09	97.95	0.24488
250,001-300,000	4	1.35	100.00	1,058,090	2.05	100.00	0.01351
Total	296	100		51,737,389	100.00		0.62951
Gini index				0.37049			
Mean value of revenue				174,788			

Source: Computed from the field survey data, 2018

the socio-economic characteristics of processors interviewed in the three South Central provinces.

4.2. Market Structure through the Tuna Value Chain

4.2.1. Shipowners

Table 6 shows how to calculate the Gini coefficient was calculated in 296 shipowners in three South Central provinces in 2018. The majority of shipowners (48.31%) had total monthly revenues range from VND 150,001,000 to VND 200,000,000. The value of the Gini coefficient computed was 0.37, which tends to approach zero. It implies that there was an equality in the market share of shipowners in the study area. It also means that most shipowners had average monthly revenue in the same range, and their market shares are relatively equal. This result was further reinforced by the Lorenz curve, which showed relatively equality in market shares among shipowners (Figure 2), with 67% of the shipowners accounting for about 74% of monthly revenues. This Lorenz curve is close to the 45^0 line, implying an equilibrium in shipowner's market shares.

4.2.2. Middle-persons

Table 7 describes calculating the Gini coefficient for 15 middle-persons in the study area in 2018. Most middle-persons (66.67%) had total monthly revenues between VND 9,500,000 and VND 19,500,000,000. The value of the Gini coefficient calculated was 0.51, indicating an inequality in the market share of middle-persons in the study area. It means that the tuna market for middle-persons is concentrated, but only few control the majority of the market share. The Lorenz curve (Figure 3) indicated a high inequality in market shares with 69% of the middle-persons accounting for about 87% of monthly revenues. This curve is far from the 45^0 line, implying a high inequality in the middle person's market shares.

4.2.3. Processors

Table 8 shows computing the Gini coefficient computed data on four processors in the study area in 2018. The Gini coefficient value was 0.44, indicating that there is partial inequality in the tuna market for the processors. The Lorenz curve (Figure 4) indicates that 75% of the monthly revenues were accounted by 65% of the processors. It means that there is an inequality in the processor's market shares.

Figure 2: Lorenz curve of shipowners

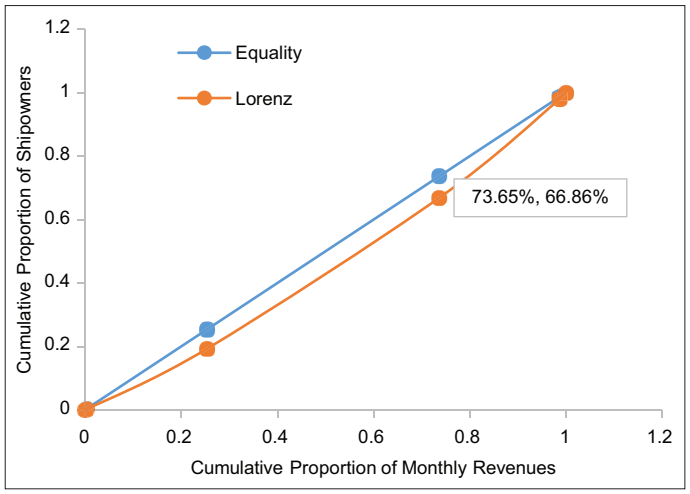
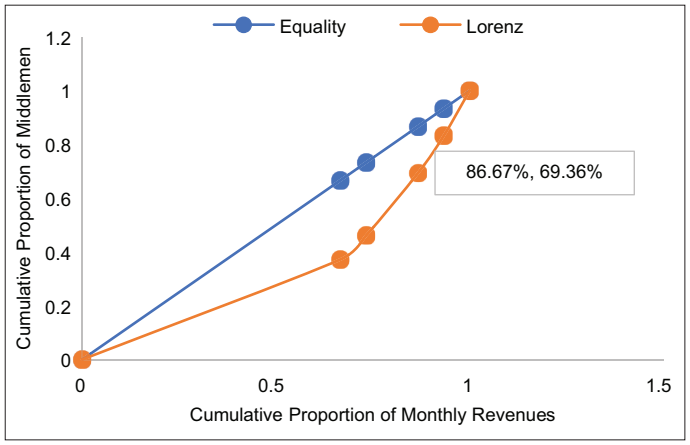


Figure 3: Lorenz curve of middlemen



4.2.4. Comparisons of market structure through the tuna value chain

The values of the Gini coefficients and the Lorenz curves for shipowners, middle-persons, and processors were calculated and described in Tables 6-8 and Figures 2-4 to assess the income equality and the market share's distribution of each actor in the tuna value chain. The comparison of the Gini coefficients of three main actors in the chain indicated that middle-persons had the highest value (0.51),

Table 7: Estimate of Gini coefficients for middlemen in sampled three South Central Provinces of Vietnam

Class of middlemen according to monthly revenue	Number of middlemen	Proportion of middlemen (X) (%)	Cumulative proportion of middlemen (%)	Total value of monthly revenues	Proportion of total revenues (%)	Cumulative proportion of total revenue (Y) (%)	X*Y
0	0	0	0	0	0	0	0
9,500,000-19,500,000	10	66.67	66.67	121,874,250	37.23	37.23	0.24820
19,500,001-29,500,000	1	6.67	73.34	29,452,500	9.00	46.23	0.03082
29,500,001-39,500,000	2	13.33	86.67	75,740,000	23.13	69.36	0.09248
39,500,001-49,500,000	1	6.67	93.34	45,600,000	13.93	83.29	0.05553
49,500,001-59,500,000	1	6.67	100.00	54,720,000	16.71	100.00	0.06667
Total	15	100.00		327,386,750	100.00		0.49369
Gini index				0.50631			
Mean value of revenue				21,825,783			

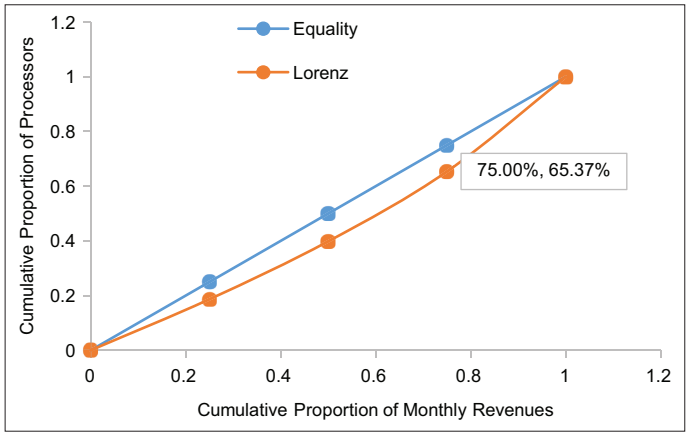
Source: Computed from the field survey data, 2018. Unit: VND 1000

Table 8: Estimate of Gini coefficients for processors in sampled three South Central Provinces of Vietnam

Monthly revenue	Number of processors	Proportion of processors (X) (%)	Cumulative proportion of processors (%)	Total value of monthly revenues	Proportion of total revenues (%)	Cumulative proportion of total revenues (Y) (%)	X*Y
0	0	0	0	0	0	0	0
25,220,650	1	25.00	25.00	25,220,650	18.67	18.67	0.04668
28,588,320	1	25.00	50.00	28,588,320	21.16	39.83	0.09958
34,500,000	1	25.00	75.00	34,500,000	25.54	65.37	0.16342
46,793,900	1	25.00	100.00	46,793,900	34.64	100.00	0.25001
Total	4	100.00		135,102,870	100.00		0.55967
Gini index				0.44033			
Mean value of revenue				33,775,717			

Source: Computed from the field survey data, 2018. Unit: VND 1000

Figure 4: Lorenz curve of processors



followed by processors (0.44), and then shipowners (0.37). Thus, the Lorenz curve of middle-persons lays furthest from the 45^0 line, followed by the Lorenz curve of processors, and finally, the Lorenz curve of shipowners lying close to 45^0 line. This result showed that the higher the Gini index is, the greater the Lorenz curve area gets, the higher the inequalities in monthly revenue, the higher the concentration level, and the more imperfect the markets are. Therefore, the market structure of middle-persons and processors tends to be monopolistic while shipowners's market structure tend to be in perfect competition.

4.3. Market Performance through the Value Chain

4.3.1. Shipowners

Table 9 provides the economic characteristics of yellowfin and bigeye tuna fishing vessels and the financial performance of each shipowner in the tuna value chain.

Some interesting points drawn from this table were as follows:

- Yellowfin and bigeye tuna fishers made, on average, nine sea trips per year, with the average of twenty-five days per trip and six people per fishing vessel.
- There were significant differences in revenues, volumes, and selling price per kilogram of yellowfin and bigeye tuna made by each shipowner in an average sea trip during the peak and low-fishing seasons. The average revenue per sea trip during the main season was 1.7 times higher than that during the secondary season. Similarly, the average volume of tuna caught in a sea trip during the peak fishing season was 2,300 kg, while that in the low fishing season was 1,100 kg. Furthermore, the average selling price of 1-kilogram tuna caught in the peak season was 98,000 VND/1 kg, while that in the low season was 121,000 VND/1 kg. The reason for such differences was that the average volume of tuna caught in a sea trip in the main season was very high, many vessels would like fish for tuna, and thus a significant volume of raw tuna was landed at the fishing port at the same time. Also, most shipowners did not have cold storage to preserve fish, and they would like to sell tuna caught promptly to return their home; thus, they were willing to accept the lower prices. Meanwhile, the volume of yellowfin tuna and bigeye tuna was scarcer in the low season, and few tuna shipowners would like to go fishing during this period; therefore, processors and middle-persons set higher prices to encourage more fishers to go offshore to catch tuna
- The average revenue of each tuna fishing vessel per sea trip was VND 174,788,000, and there was an insignificant difference in the shipowner's average revenues in each province in the study area. The average production cost of each vessel per sea trip was VND 128,763,000, including

Table 9: The economic characteristics of a yellowfin and bigeye tuna fishing vessel and financial performance of per shipowner in the tuna value chain

Variables	Binh Dinh		Phu Yen		Khanh Hoa		Average	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Number of days in a sea trip	24	3	24	4	26	4	25	4
Number of sea trips in a year	9	2	9	2	8	2	9	2
Number of employees on the board	6	1	6	1	6	1	6	1
The volume of tuna caught in a sea trip in main-harvest season (kg)	2,200	400	2,300	400	2,300	400	2,300	400
The volume of tuna caught in a sea trip in sub-harvest season (kg)	1,000	400	1,100	400	1,100	400	1,100	400
The volume of tuna caught in a sea trip (kg)	1,600	300	1,800	300	1,700	300	1,700	300
The selling price of 1-kilogram tuna caught in main-harvest season (1000VND/kg)	98	3	98	3	98	3	98	3
The selling price of 1-kilogram tuna caught in sub-harvest season (1000 VND/kg)	121	4	121	4	121	4	121	4
The average selling price of 1-kilogram tuna caught in a sea trip (1000 VND/kg)	110	3	110	3	110	3	110	3
Revenue in a sea trip in the main-harvest season (VND 1000)	219,017	37,048	221,226	37,467	221,274	37,489	221,226	37,467
Revenue in a sea trip in the sub-harvesting season (VND 1000)	125,732	45,928	128,351	45,119	128,320	45,437	128,351	45,119
Revenue in a sea trip (VND 1000)	172,375	34,141	174,606	34,452	174,797	34,512	174,788	34,442
Unit price(VND 1000)	105	3	106	6	105	3	106	6
Total variable costs in a sea trip (VND 1000)	101,275	4,702	102,090	4,793	102,036	4,837	102,090	4,793
Total fixed costs in a sea trip (VND 1000)	26,522	2,679	26,673	2,784	26,679	2,781	26,673	2,784
Total operational cost (VND 1000)	128,777	9,219	128,763	5,377	128,715	5,393	128,763	5,377
Unit total cost (VND 1000)	81	16	81	17	81	16	81	17
Gross margin in a sea trip (VND 1000)	71,100	33,981	72,699	34,615	72,631	34,634	72,699	34,615
Gross margin per kilogram (VND 1000)	41	13	42	14	41	14	42	14
Net income in a sea trip (VND1000)	44,578	34,007	46,025	34,657	45,952	34,684	46,025	34,657
Net income per kilogram (VND 1000)	24	16	25	17	25	17	25	17
Marketing margin (VND 1000)	172,375	34,141	174,606	34,452	174,797	34,512	174,788	34,442
Marketing margin per kilogram (VND 1000)	105	3	106	6	105	3	106	6

Source: Computed from the field survey data, 2018

total variable costs of VND 102,090,000 and total fixed costs of VND 6,673,000. Total variable costs accounted for 80% of total production costs, in which fuels accounted for the highest percentage with 45%, followed by labor (24%), ice (15%), food, and bait (16%). Meanwhile, total fixed costs only accounted for 20% of total production costs, in which interest and bank charges contributed to the most significant proportion of the total fixed costs

- The financial performance of each shipowner in the three South Central provinces of Vietnam was positive in terms of gross margin, net income, and marketing margin, both in total value and value per kilogram. Each shipowner earned a gross margin in a sea trip of VND 72,699,000 and a gross margin per kilogram of VND 42,000. Furthermore, they achieved net income in a sea trip and net income per kilogram with VND 46,025,000 and VND 25,000, respectively. Moreover, each shipowner's marketing margins for the total volume and per kilogram counted for VND 174,788,000 and VND 106,000, respectively. Each shipowner attained the marketing margin in a sea trip equals total monthly revenues due to tuna purchase price of zero. The financial performance indicators of each shipowner in each province were insignificantly different. It was explained that fishers in the three South Central provinces live in close geographical areas and catch yellowfin and bigeye tunas together in the East Sea. Therefore, each tuna ship's economic characteristics, revenues, and total production costs in a sea trip were almost similar.

The results also showed that most shipowners achieved a positive profit in a sea trip, especially during the peak fishing season. However, most shipowners operated individually, and there were no horizontal and vertical linkages in the chain. Thus, each tuna ship's production costs were very high, so each shipowner's economic efficiency was not truly expected.

4.3.2. Middle-person

Table 10 provides the data results collected and analyzed for middle-persons in the tuna value chain. Middle-persons are significant economic actors in the chain since they support finance for shipowners, set purchasing prices, and grade raw tuna at the fishing ports (Thu et al., 2020).

The results showed that the average monthly volume of tuna traded per middle person was 190,267 kg, with 260,067 kg in the peak fishing season and 120,467 kg in the low fishing season. It is also noted that the raw tuna price paid to shipowners was equal mong both middle-persons and processors, and the middle-persons only received a sales commission from the processors. The results presented that the average selling price of 1 kilogram of yellowfin and bigeye tunas was VND 115,000, with the figure in the peak season being slightly lower than that of low seasons,

at VND 106,500 and VND 123,500, respectively. Meanwhile, as regards the selling price of 1 kilogram of the tuna was presented on the purchasing contract agreement between the processor and the middle person. There was a difference between the purchase price of the raw tuna from shipowners and the one agreed by the middle person with the processor. The average difference of 5000 VND/a kilogram of the tuna was the amount of money paid by the processor to the middle person, including 3000 VND/a kilogram for ice, labor, and other costs, and 2000 VND/a kilogram for the commission for the middle-person. Therefore, the larger amount of the tuna is traded, the higher the sale commission the middle-persons receive.

Other interesting observations which can be drawn from the data in the table were as following:

- The average monthly revenue of each tuna purchasing enterprise was substantial with VND 21,825,783,000, which was 125 times higher than that of each shipowner. which was middle-persons interviewed have great economic potential and close relationships with shipowners and processors
- The average monthly total production cost of each tuna purchasing enterprise was VND 21,478,867,000 in which 98% (VND 21,110,600,000) was a monthly total variable cost and 2% (VND 368,267,000) was allocated to monthly total fixed cost. The structure of total variable cost included the tuna purchasing cost explaining 99% of total cost and the remaining proportion (1% of total cost) for the loading and unloading cost and ice cost. Meanwhile, the total fixed costs were generally meager, in which the financial cost accounted for 50%, and the remaining was allocated relatively evenly, to others such as depreciation, taxes/fees, and other expenses. Most respondents said that they had to borrow money from banks to have financial capital for the tuna business. They had strong economic potential, so their bank loan procedure was more straightforward than that of shipowners
- The profitability indicators per kilogram of yellowfin and bigeye tuna achieved by each middle person were very low. For instance, monthly gross margin and monthly net income per kilogram of yellowfin and bigeye tuna attained by each middle person were 4000 VND/a kilogram and 2000 VND/a kilogram, respectively. Similarly, each middle person achieved a marketing margin per kilogram (or added unit costs of tuna sold) of 5000 VND/a kilogram. However, the profitability indicators for the total monthly traded tuna volume attained by each middle person were significant due to the large monthly volume of tuna traded. For example, each middle person gained a monthly gross margin of VND 715,183,000, a monthly net income of VND 346,917,000, and a monthly marketing margin of VND 896,450,000. The larger the volume of tuna was traded, the greater the returns each middle person could earn. The absolute financial performance indicators implied the financial position or wealth of each middle-person in the chain. To sum up, purchasing actors added a little value to tuna products; however, they played significant roles in supporting finances for shipowners and buying raw tuna for processors.

Table 10: Financial performance of per middle-person in the tuna value chain

Variables	Three South Central provinces of Vietnam	
	Mean	SD
The monthly volume of tuna traded in main-harvest season (kg)	260,067	181,642
The monthly volume of tuna traded in sub-harvest season (kg)	120,467	82,977
The monthly volume of tuna traded (kg)	190,267	132,287
The selling price of 1-kilogram tuna in main-harvest season (1000VND/1 kg)	106.5	0.5
The selling price of 1-kilogram tuna in sub-harvest season (1000 VND/1 kg)	123.4	1
The selling price of 1-kilogram tuna (1000 VND/1kg)	115	0.6
Monthly revenue in main-harvest season (VND1000)	27,666,700	19,265,108
Monthly revenue in sub-harvest season (VND1000)	14,823,467	10,123,101
Monthly revenue (VND1000)	21,825,783	15,081,506
Unit price (VND1000)	115	1
Total variable cost in an average month (VND 1000)	21,110,600	14,658,683
Total fixed cost in an average month (VND 1000)	368,267	237,279
Total operational cost in an average month (VND1000)	21,478,867	14,890,836
Unit cost (VND1000)	113	0
Monthly gross margin (VND 1000)	715,183	430,708
Monthly gross margin per kilogram (VND 1000)	4	0
Monthly net income (VND 1000)	346,917	197,676
Monthly net income per kilogram (VND 1000)	2	0
Marketing margin (VND 1000)	896,450	541,081
Marketing margin per kilogram (VND 1000)	5	1

Source: Computed from the field survey data, 2018

4.3.3. Processors

Table 11 provides the outputs of the data collected and analyzed for processors in the tuna value chain. Processors are the most critical influencers in the tuna value chain since they have the highest negotiating power and thus can determine raw tuna's volume and purchase price (Thu et al., 2020). The results showed that the average monthly volume of processed tuna products traded was 94,485 kg. Some kinds of processed yellowfin and bigeye tuna products were fillet tuna meat, whole, and frozen tuna, frozen tuna loin with and without CO, slice (steak) with and without CO, frozen cut pieces (saku, cube) with and without CO. According to interviewees in 2018, the selling price of processed tuna products ranged from USD 15 to USD 20 (about VND 345,000 - VND 460,000). The average price of 1 kilogram of processed tuna products of all kinds was 356,000 VND/a kilogram. Therefore, the average monthly revenue of each processor was VND 33,775,718,000.

Other interesting observations which can be drawn from the data in the table were:

- The average monthly volume of tuna materials of each processor was 160,625 kg, , of which the amount in the main fishing season was 187,500 kilograms and that of the secondary fishing season was 133,750 kg. The average buying

Table 11: Financial performance of per processor in the tuna value chain

Variables	Three South Central provinces of Vietnam	
	Mean	SD
The monthly volume of processed tuna traded (kg)	94,485	24,383
The selling price of 1 kg of processed tuna traded (VND 1000)	356	11
Monthly revenue of processed tuna traded (VND 1000)	33,775,718	9,488,518
Unit price (VND 1000)	356	11
The monthly volume of tuna materials in main-harvest season (kg)	187,500	55,000
The monthly volume of tuna materials in sub-harvest season (kg)	133,750	28,100
The monthly volume of tuna materials (kg)	160,625	41,452
The buying price of 1 kg of tuna materials in main-harvest season (VND 1000)	106.5	0.58
The buying price of 1 kg of tuna materials in sub-harvest season (VND 1000)	123.5	1.29
The buying price of 1 kg of tuna materials (VND 1000)	115	0.58
Total variable cost in an average month (VND 1000)	19,460,288	5,128,118
Total fixed cost in an average month (VND 1000)	4,831,188	1,293,497
Total operational cost (VND 1000)	24,291,475	6,420,343
Unit total cost (VND 1000)	257	3
Monthly gross margin (VND 1000)	14,315,315	4,399,906
Monthly gross margin per kilogram (VND 1000)	150	10
Net income (VND 1000)	9,484,128	3,148,106
Net income per kilogram (VND 1000)	99	9
Marketing margin (VND 1000)	15,296,655	4,712,028
Marketing margin per kilogram (VND 1000)	161	10

Source: Computed from the field survey data, 2018

price of 1 kilogram of raw tuna was VND 115,000, of which the main and secondary seasons were VND 106,500 and VND 123,500, respectively. Therefore, the monthly purchase cost of each processor was VND 18,471,875,000. According to the respondents, the volume of tuna raw materials caught by fishers in the three South Central provinces did not meet the tuna processing and the export demand during the low fishing season. Thus, to encourage fishers to catch the tuna offshore, processors regularly increased the purchasing price to VND 15,000 - VND 20,000 for 1-kilogram yellowfin and bigeye tuna. At the same time, they also imported tuna materials from other countries such as Indonesia, or the Philippines

- The average monthly production cost of each processor was VND 24,291,475,000 in which the total variable cost was VND 19,460,288,000 (80%) and the total fixed cost was VND 4,831,188,000 (20%). The total variable cost structure consisted of the tuna purchasing cost (95%) and the direct labor cost (5%). Actual fixed cost items incurred by each processor including packaging costs, maintenance, and repair costs, financial expenses (interest and bank charges), chemicals/microorganisms, electricity costs, water costs, management costs, shipping cost, telephone/transaction cost, environmental charges, depreciation, marketing expenses, tax, and other costs
- The financial performance indicators of each processor were high in terms of a kilogram of processed yellowfin and bigeye tuna product and for the total volume of tuna product traded. Regarding the profit index per kilogram of the tuna product traded, each processor gained a monthly gross margin, net income, and marketing margin of VND 150,000, VND 99,000, and VND 161,000, respectively. Considering the performance indicators of the total volume of tuna product traded, each processor achieved VND 14,315,430,000, VND 9,484,243,000, and VND 15,296,655,000, for gross margin, net income, and marketing margin, respectively.. To sum up, the processors created the most value and also received the most profit in the tuna value chain.

4.3.4. Comparison of market performance across the tuna value chain

Mapping the yellowfin and bigeye tuna value chain and constructing costs and earnings models for each stage in the value chain, as shown above, allows a comparison among different actors in the chain. Table 12 presents a comparison of revenues, costs, gross margin, net income, and marketing margin per kilogram of yellowfin and bigeye tuna. This table also shows the percentage of each actor's cost and earnings contribution compared with the entire value chain.

These are some exciting observations in the table as follows:

- The processors were the most significant contributor in added costs and the price of a kilogram of yellowfin and bigeye tunas in the chain. Concerning the total added cost of a kilogram of the tuna in the entire chain (approximately VND 230,000/kg), the processors contributed the most considerable cost with VND 142,000 (62%), followed by the shipowners of VND 81,000 (35%), and then the middle-persons of VND 7,000 (4%). Regarding the price of the tuna per kilogram sold by the processor (VND 356,000), the shipowners and the middle-persons attained the low percentages of 30% and 32% of the total unit price, respectively with a difference of only 2%. Meantime, the proportion difference between the unit price of the processors and that of the middle-persons was 68%. Due to their modern processing technology and export value chain, the processors created the most value for the tuna value chain (68% of the total unit price). Fishers occupied the second position (30%) thanks to their raw tuna exploitation, whereas middle-persons only added 2% of the total unit price due to their middle role in the tuna value chain.
- The processors achieved the highest gross margin, net incomes, and marketing margin per kilogram of yellowfin and bigeye tuna compared to other actors in the chain. Regarding the total gross margins for a kilogram of the tuna in the entire chain (approximately VND 196,000/a kilogram), the processors attained the highest gross margins with VND 150,000/a kilogram (77%). The shipowners achieved tthe second-highest amount with VND 42,000/a kilogram (21%), followed by the middle-persons with the lowest figure of VND 4,000/a kilogram (2%). Similarly, the total net incomes per kilogram of the tuna in the entire chain were VND 126,000/a kilogram, in which the processors achieved the highest value with VND

99,000/a kilogram (79%), followed by the shipowners and the middle-persons with 25% and 2%, respectively. Referring total marketing margin for a kilogram of the tuna in the entire chain (VND 272,000/a kilogram), the processors still achieved the highest value with VND 161,000/a kilogram (59%), while the shipowners and the middle-persons occupied the second and the third positions with 39% and 2%, respectively.

In summary, for each kilogram of yellowfin and bigeye tunas, the processors created the biggest value and received the highest profits due to advanced processing technology and tuna export. The shipowners ranked second position because of their tuna exploitation capability. Meantime, the middle-persons ranked the lowest position based on their roles on purchasing and distributing tuna materials.

However, for the total volume of raw tuna materials traded, total costs, total revenues, total net incomes per actor in an average month, there were different scales of actor's tuna exploiting, purchasing, and processing activities. Table 13 presents the average monthly material volume, costs, revenues, net income, and margins per actor in the yellowfin tuna and bigeye tuna value chain in the three South Central Provinces of Vietnam.

The results shown in Table 13 are interpreted as follows:

- Compared with the shipowners, the processors and the middle-persons had overwhelming advantages in the total tuna volume traded, total costs, and total revenues. Concerning the total tuna volume in the entire chain (352,592 kg), the middle-persons and the processors ranked the first and second positions with 54% and 45.5%, respectively. In contrast, the shipowners only accounted for a tiny percentage with 0.5%. Regarding the total monthly costs in the entire chain (VND 45,899,119,000), the processors and the middle-persons accounted for 52.9% and 46.8%, respectively, while the shipowners only occupied 0.3%. With reference to the total revenues in the entire chain (VND 55,773,876,000), the processors constituted the most significant proportion with 60.6%, followed by the middle-persons with 39.1%, and then the shipowners with only 0.3%. These results showed that tuna processing and purchasing enterprises had large-scale capital and business operation, whereas the shipowners had low-scale capital and scattered production operations
- Like the financial indicators presented above, the processors attained the highest percentage in total gross margin, net incomes, and marketing margins. Table 13 only showed the total net income and marketing margins of the actors in the chain. Specifically, the processors achieved the highest net incomes and marketing margins with 96.04% and 93.47%, respectively, while the middle-persons attained 3.51% and 5.48% in turns. Finally, the shipowners gained the lowest percentages with 0.45% and 1.05%, respectively
- These results also showed that the processors gained the highest financial performance indicators in total value and a kilogram of tuna compared with other actors based on adding the most value to the tuna products and being the most significant scale finance and production in the chain. The middle persons obtained the modest financial performance indicators in a kilogram of tuna traded due to adding the least value to the tuna products. In addition, they attained the second position on performance indicators in the total volume, based on their large-scale finance and business. Although the shipowners contributed the relative value for 1 kilogram of

Table 12: Relative financial position of actors in the yellowfin tuna and bigeye tuna value chain in three South Central Provinces of Vietnam

Value chain actor	Costs (VND 1000)			Revenues (VND 1000)		Gross margins (VND 1000)		Net Incomes (1000 VND)		Marketing Margins (1000 VND)	
	Unit total cost	Added unit cost	% VC added cost	Unit price	Unit price as % export price	Unit gross margin	% VC gross margin	Unit net income	% VC net income	Unit margin	%VC margin
Shipowner	81	81	35	106	30	42	21	25	20	106	39
Middle-person	113	7	4	115	32	4	2	2	2	5	2
Processor	257	142	61	356	100	150	77	99	79	161	59
Total		230	100			196	100	126	100	272	100

Source: Computed from the field survey data, 2018

Table 13: Relative financial position of actors in the yellowfin tuna and bigeye tuna value chain in three South Central Provinces of Vietnam

Value Chain Actor	Total tuna material's volume (kg)		Total costs (VND 1000)		Total revenues (VND 1000)		Total net incomes (VND 1000)		Marketing margins (VND 1000)	
	Volume (kg)	% VC volume	Costs (VND 1000)	% VC Cost	Revenue	% Total VC revenue	Net incomes (VND 1000)	% VC net income	Marketing Margins	% VC Marketing Margin
Shipowner	1,700	0.5	128,777	0.3	172,375	0.3	44,578	0.45	172,375	1.05
Middle-person	190,267	54.0	21,478,867	46.8	21,825,783	39.1	346,917	3.51	896,450	5.48
Processor	160,625	45.5	24,291,475	52.9	33,775,718	60.6	9,484,128	96.04	15,296,655	93.47
Total VC	352,592	100	45,899,119	100	55,773,876	100	9,875,623	100	16,365,480	100

Source: Computed from the field survey data, 2018

tuna products, they achieved the lowest financial performance indicators in the total volume because of their small and scattered tuna fishing operations.

4.4. Critical Factors Impacting on Value Chain Performance

Through questionnaire respondents and focus group discussions, our study qualitatively explored whether the market structure and other factors can affect the financial performance of the actors along the tuna value chain. We have chosen in this paper to focus primarily on presenting the market structure and financial performance of key actors in the chain. However, through the value chain analysis process, we summarized several significant factors determining the value chain performance as follows:

- The market structure can affect the value chain performance. The processors and middle-persons tended to be monopolistic, and their financial performances were well-performed, but the incomes were accrued to a small group of market participants. This finding denoted an inefficient and imperfectly competitive market with a monopolistic nature, which was suggested by economic and game theory
- Economies of scale and collective marketing can improve the financial performance of the chain's actors. The processors and middle-persons, who have a large scale of finance and production, had a significant volume of traded tuna products, thus reducing the cost of doing business and increasing their returns. Meanwhile, the shipowners, who have a small scale of finance and scattered operations, failed to take advantage of the benefits of collective marketing when they purchased material inputs and sold raw tuna individually; thereby, their financial performance indicators were not good as they had expected
- Access to market information and business loans can influence an actor's market performance. The processors and the middle-persons, who have more comprehensive access tuna market information and business loan than the shipowners, had much better financial performance indicators than the shipowners.

5. DISCUSSION AND CONCLUSION

5.1. Discussion

The tuna value chain mainly served the export market and included three main actors: fishers, tuna purchasing enterprises, and tuna processing companies. Representatives of these actors investigated during the field survey were shipowners, middle-persons, and processors. Most shipowners, who were middle-aged, owned a tuna fishing ship. They held a low level of education but a lot of experience in the tuna fishing. Meanwhile, most middle-persons, middle-aged, owned large or medium tuna purchasing businesses and financed many tuna fishing vessels. They had an average level of education and lots of experience in tuna procurement. More prominently, most processors, who were middle-aged, were directors of large tuna processing companies, and had a university education and many experiences in processing and exporting tuna.

In this study, we examined the market structure and the market performance of actors in the yellowfin and bigeye tuna value chain in the three South Central provinces of Vietnam. Using the Lorenz curve and Gini coefficient to measure the market structure of actors in the tuna value chain, the research findings showed that the market concentration indexes of these actors were different. Most shipowners had average monthly revenues at similar levels, and their market structure tended to be perfectly competitive. Meanwhile, the market structure of middle persons was concentrated, and it tended to be in monopolistic competition. Similarly, the market structure of processors was also concentrated, with a few processors largely controlling their market shares. Concerning the market performance of actors in the tuna value chain, the processors attained the most returns in the total tuna volume traded and per kilogram of tuna traded, followed by the middle persons and then the shipowners. The processors and the middle-persons reaped significant benefits due to the largest and the second-largest financial scale and business operation size, respectively, while the shipowners received the least benefits because of their small financial scale and scattered production.

Our research results have some similarities with those of previous studies in Vietnam's tuna value chain, such as (Thu et al, 2020; Nguyen and Jolly, 2018; USAID, 2020) in two aspects of mapping the tuna value chain and identifying the roles of actors in the chain. All studies have determined that most yellowfin tuna and bigeye tuna went through the distribution channel of fishers - tuna purchasing enterprises -processing companies. Shipowners have little power to negotiate prices and products, whereas middle-persons have a strong financial potential, act as tuna purchasing agencies, and provide loans/credits, oil, and ice. Finally, processors have the most powerful actor since they create the most added value, have high negotiating power, and set the tuna purchase price and volume.

However, our study has revealed significant and new contributions compared with previous studies, presented as follows:

Firstly, this study has conducted on large, complete, and new sample data. We interviewed 315 key actors, were interviewed, including shipowners, middle-persons, and processors in the three provinces of Binh Dinh, Phu Yen, and Khanh Hoa in 2018. Meanwhile, (Nguyen and Jolly, 2018) only examined 46 key actors in Khanh Hoa province in 2013, (Thu et al., 2020) interviewed 163 key actors in three provinces of Binh Dinh, Phu Yen, and Khanh Hoa in 2014 and 2015, and finally (USAID, 2020) studied only 23 key actors in Binh Dinh province in 2019.

Secondly, our results have some differences, compared with other studies. Although (Nguyen and Jolly, 2018) qualitatively described the structure-conduct-performance components of each key actor in the tuna value chain, our study focused on analyzing the market structure through quantitatively determining market concentration by plotting Lorenz curve and calculating Gini coefficient for each actor in the chain. In addition, the financial performance indicators of actors, were quantitatively examined, and qualitative evaluation was done on whether the market structure and other factors influence the performance of actors. Furthermore, monthly averages were calculated by taking average values in the peak and the low fishing seasonsto measure the financial performance indicators of actors in the chain, whereas (Thu et al., 2020) and

(Nguyen and Jolly, 2018) used yearly averages to analyze the actor's financial performance. In our study, the use of monthly averages took into account the seasonality of the yellowfin and bigeye tunas, which reflects more precisely on the nature of the tuna fishery than previous studies.

Moreover, our research results showed the difference between the selling price of a kilogram of yellowfin tuna and bigeye tuna during the peak and the low seasons, which was not discovered by any previous studies. From this finding, we recognized the weakness in the tuna trade management at the fishing port during the peak season was identified. During this period, a large amount of tuna was imported at the same time, and because there was no cold storage system to preserve fish, and shipowners had to sell the tuna quickly to avoid post-harvest losses; thus, the price of a kilogram of the tuna sold in the peak season was lower than in low season. Therefore, the Directorate of Fisheries and the local fisheries departments need to have investment policies so that the fishing port has a cold storage system to help fishers eliminate the concern of "good season, devaluation." Finally, our study identified the financial positions of actors in the value chain were identified by comparing each actor's financial performance indicators on both per kilogram of tuna and total volume of tuna, which has not been explicitly mentioned in the previous studies.

Findings from our study have some similar results compared with the previous studies on the fisheries value chain in the World. Firstly, this study discovered the capital asymmetry, with most low-capitalized fishers at the bottom and a few middle-persons and processors with high capital at the apex. Furthermore, the results showed that the processors and middle-persons have a large financial and production scale, significantly higher than the shipowners. Thus, their volume and revenue of traded tuna were more remarkable than those of the shipowners. These results are consistent with those of the previous studies on the fisheries value chains such as (Adeogun, 2009; Daw, 2014; Kulindwa and Lokina, 2013; Wamukota et al., 2014). Furthermore, our study identified that the processors with a large scale of capital determined the purchasing price and the total volume of tuna traded, while the shipowners with much lower capital always received the price, which has also been mentioned in the previous studies such as (Grydehoj and Nurdin, 2015; Sebastian et al., 2014). Finally, the variable costs incurred by actors in the chain accounted for a more significant proportion than the fixed costs, one of characteristics of identifying the producer-driven value chains (Jimenez et al., 2020; Kulindwa and Lokina, 2013; Kimani et al., 2020).

Several challenges and weaknesses are drawn from the yellowfin and bigeye tuna value chain in three South Central provinces of Vietnam. Firstly, shipowners still have not cooperated and linked together to buy input materials such as gasoline, oil, ice, food at reduced price, based on the volume purchased in large quantities. Each shipowner buys input materials individually at retail prices, so production costs are often very high, reducing their profit in a sea trip. Furthermore, the tuna fishing activities of the shipowners are small and scattered which makes them unable to generate large volumes in order to sign direct contracts to processors. Moreover, shipowners have meager financial resources and depend on middle-persons, so they are forced to sell tuna caught to these middle-persons. In addition, the tuna classification and quality assessment at the fishing port depend entirely on the assessment of middle-persons and processors, which is often detrimental to the fishers. Secondly, shipowners do not have complete access to information about the tuna market and are only price recipients in tuna transactions; thus, they do not have much incentive to improve tuna fishing and preserving techniques, bringing higher economic efficiency in a sea trip. Furthermore, shipowners are usually meet the situation of "good season, devaluation" during the peak fishing seasons. Finally, the processors have not shown their leadership roles in the chain. They still depend on the middle-persons to collect tuna materials, without having any specific solutions, to increase the sustainable development of the tuna value chain in the study areas.

Due to the remaining challenges and weaknesses in the chain presented above, we propose some solutions are proposed to improve the economic efficiency of the tuna value chain. Firstly, it is essential to build a tuna auction center under the strict management of the Fisheries Departments in the investigated provinces to determine the standards of tuna materials, tuna grades, and tuna purchase price. Secondly, the Vietnamese government needs to support building cold storage systems at the fishing port, helping fishers eliminate the "good season, devaluation" situation during the peak fishing season. Finally, the Directorate of Fisheries and Fisheries department in the local area should open short-term training programs to help fishers approach scientific methods in fishing and preserving raw materials to add value to the tuna, increasing their economic efficiency in a sea trip.

5.2. Conclusion

This paper analyzes key actor's market structure and performance in the yellowfin and bigeye tuna value chain in the three South Central provinces of Vietnam in 2018. We use the Lorenz curve and Gini coefficient were used to quantitatively determine the market concentration of each actor in the tuna value chain. Furthermore, we calculate financial performance indicators were calculated to determine the financial position of each actor in the value chain. Through the analysis of the tuna value chain, qualitative assessment was done on whether the market structure and other factors can affect the financial performance of each actor. Finally, we proposed some possible solutions were recommended to improve the economic efficiency of the tuna value chain, promoting the sustainable development of Vietnam's tuna fishery.

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