A STUDY ON THE ECONOMIC EFFICIENCY OF THE OFFSHORE LONG LINE FISHERY IN KHANH HOA PROVINCE, VIETNAM

BY

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Master Thesis in Fisheries and Aquaculture

Management and Economics

(30 ECTS)

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May, 2009

ACKNOWLEDGMENTS

I would like to express my great gratitude to the NOMA Program in Fishery and Aquaculture Management and Economics (NOMA-FAME) for giving me the opportunity to study and conduct this master thesis on Fishery and Aquaculture Management and Economics. Also, I would like to extend my specific thanks to the NORAD project for all the financial support.

I would like to express my great appreciation to my supervisor, Prof. Ola Flaaten, Tromso University, who has made a great effort to support me in my thesis. His profound comments have been really helpful, not only in completing this study but also in improving my methodology for fisheries economic study. I am very much indebted to him for his unreserved devotion to my study.

I wish to present my sincere appreciation to Assoc. Prof. Dr. Kim Anh Thi Nguyen, my national supervisor, Nha Trang University, who has encouraged, supported and gave me a lot of guidance from the start to my finishing the study.

I would like to thank my national co-supervisor, Thanh Thuy Thi Pham, Nha Trang University, for her great assistance during the last study period of time.

I want to thank Dr. Kim Long Le, Nha Trang University, and Khanh Tran for their generous assistance with the data collection.

I would like to express my great gratitude to all Lecturers of NOMA Program from Tromso University and Nha Trang University for their knowledge sharing and supports.

I wish to express my sincere appreciation to locals and authorities in Khanh Hoa for their helps on collecting primary and secondary data.

Finally, I would like to express my great gratitude to my family, friends, and colleges for their love, encouragement, and help.

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ABSTRACT

Since the 1990s, Vietnam's government has made great efforts to develop the offshore fisheries development program. Study on the economic efficiency of the offshore long-line fishery is needed to evaluate and improve the program's effectiveness. This thesis presents findings based on survey data collected through a representative sample of 37 registered offshore vessels operating in the Vietnam's Exclusive Economic Zone and in the international waters. The empirical results show that excluding the government fuel subsidy, the owner of an average long-liner earns a profit of 63.363 million VND - equivalent to profit margin of 7.5% and return on investment of 16.0%. With subsidies, profits increased to 93.111 million VND and the two corresponding economic ratios also went up to 10.6% and 23.5%, respectively. This paper also discovered that the fishery in 2008 was less economically efficient than in 2004. However, the average monthly crew share is 1.8 million VND, higher than the average income per labor working in the gill net fishery in Khanh Hoa Province. A closer inspection of the economic data reveals that direct subsidy to compensate partly for fuel costs increase affected the overall fishery. Furthermore, this study provides evidence to support why an average longliner is still able to generate profits in the open access regime if vessels can capture more cost efficiency while the average revenue of relative standardised effort for all vessels is the same. Finally, this study also demonstrates, the surprising result, that the vessel group with the biggest engines, larger than 150 hp, are least cost efficient, whereas the vessels with the smallest engines, less than 90 HP, are most cost efficient and have the highest return on investment.

Key words: Economic efficiency, fuel subsidy, relative standardised effort, longline, Vietnam's fisheries policy.

Chapter 1 INTRODUCTION

In Vietnam, fishing provides employment for millions of fishers and for workers in associated industries such as boat building and net making. Fishers purchase boats and fishing gear, sell catches, spend income, invest profit and receive subsidy. One might expect fishing to be a profitable business. Apart from the costs of boats and gear, fishers have open and free access and they reap harvests that grow without being sown. However, in global terms, the fishing industry is highly inefficient. Economic analyses help policy-makers to know the economic realities of fishery and then have solutions to better manage the fishery (Jennings at al., 2003). Hence, a study on the economic efficiency of the fishery is an important requirement for fisheries management.

Vietnam has a 3,200 km long coast with stretching beaches, several big rivers and lakes and more than 1 million km^2 of EEZ (Exclusive Economic Zone). Besides, Vietnam has a huge abundance of natural resources with species having more economic value. In addition, a huge number of labor force with more than 3 million people working in fisheries sector (Thao, 2002) plays a vital role to the development of the fisheries sector in Vietnam. Since the mid-1990s, Vietnamese government has made the policy to develop the offshore fishery to reduce the pressure on exploitation in coastal water as well as increase marine fish production for domestic consumption and for export (FAO, 2005).

Seeking information that may be used to improve Vietnam's fisheries policy, some studies analyze the economic performance of offshore fishing fleets (see e.g. Kim Anh et al., 2006). Long et al., 2008 uses performance indicators and finds some factors that affect the gross revenue and income. These authors also demonstrate, based on costs and earnings data in 2004, that over-investment may lead to inefficiency of the Khanh Hoa offshore long line fishery. In the period from 2004 to 2008 some key economic events happened in the Vietnamese economy, such as a strong increase in the price of fuel and food (GSO, 2008), and this may have affected the fishery. From the government point of view, a common socioeconomic and political aim has often been to improve the income and profitability of the fishing industry in Vietnam. In 2008 this resulted in a program of a quasi lump sum fuel subsidy for fishermen, introduced to compensate partly for the fuel price increase (Ministry of Finance, 2008). Assessment of the economic effects, short run and long run, of such government interventions is of interest to policy makers and researchers as well. The offshore long line fishery often catches tuna resources in the main season. Tuna is a strong and heavy fish caught in offshore grounds far away from the coast. During the last few years there has been a technological improvement and economic development of the vessels, implying an increase in the total fishing effort (FAO, 2005). However, whether these fishing vessels have achieved improved economic results or not is hardly known. Thus, a study on the cost efficient vessel is also needed for the vessel owners, policy-makers, and other industry representatives to know the economic realities of the fishing fleet, which often fish in the EZZ of Vietnam and the international sea waters where the fishery is still open access. This not only painted an up-to-date picture of the current economic performance of fisheries but also provides evidence to support why an average longliner is still able to generate profits in the open access characteristics of this fishery based on the costs and earnings data in 2008. Hence, this paper focuses on a study on the economic efficiency of the offshore longline fishery in Khanh Hoa Province, Vietnam.

This paper will address two main objectives. The first is to present the cost and earnings findings in 2008 based on data collected through a representative survey of 37 vessels, accounting for 34.58% of Khanh Hoa offshore long-line fleet. The following indicators and ratios are presented: Gross revenue, gross value added, gross cash flow, a profit margin and return on investment, and consider how subsidies affect this fishery through comparison of these economic indicators and the ratios between cases of subsidy and subsidy absence. The second is to explain why profit still is generated given the open access regime as well as what vessel group has the most cost efficiency. This is done by calculating average cost per relative standardised effort for each vessel. Relative standardised effort is the ratio of the expected fishing effort indicator to the average of the expected fishing effort indicator for a longliner. Hull length, engine power and fishing days are integrated into developing the expected fishing effort indicators. Variance in vessels' relative standardised effort may explain vessels' cost efficiency is heterogeneous. Hence, positive profit is produced if vessels can capture more cost efficiency while the average revenue of relative standardised effort for all vessels is identical. In addition to the main objectives we also demonstrate that a survey may provide statistically reliable information. This is of particular importance in a developing country where fishing industry data sources are costly and scare to collect (Raakjaer at al., 2007).

Some hypotheses are posed in this paper, namely:

Hypothesis 1: Is the offshore longline fleet profitable?

Hypothesis 2: Is this fishery in 2008 more economically efficient compared to 2004?

Hypothesis 3: Vietnam government program of fuel subsidy in 2008 good or bad for this fishery?

Hypothesis 4: What is the income of crew member, and how is this compared to other people in the province?

Hypothesis 5: Do larger vessels perform more efficient smaller vessels?

Hypothesis 6: How to define the relative standardised effort?

Hypothesis 7: What are the results when there are technically and economically heterogeneous vessels?

Hypothesis 8: Is the average per relative standardised effort for all vessels the same? Does it have the horizontal shape?

To address these problems, the author will apply the fisheries theory (Flaaten, 2010) and accounting framework getting from the research papers (Flaaten at al., 1995). The data sources from the author, the newspapers, magazines and the web addresses of the fisheries related organizations.

Chapter 2 BACKGROUND OF VIETNAM'S FISHERIES INDUSTRY, KHANH HOA'S FISHERIES INDUSTRY AND LONG-LINE FISHERY.

2.1. Vietnam's Fisheries Industry

Vietnam has 3,200 square kilometers with long beaches, several big rivers and lakes and more than 1 million km^2 of EEZ (Exclusive Economic Zone). These natural favorable conditions present many opportunities for Vietnam to develop the marine capture and aquatic farming activities. Besides, Vietnam has an abundance of natural resources with more than 2,100 species of fish; over 75 species of shrimp; about 653 species of marine alga and other species of high economic value. In addition, the combination of the high concentration of natural resources and favorable regional factors provide the necessary conditions to raise aquatic products, especially shrimps and catfish (Basa and Tra fish). Furthermore, a high number of labor force with more than 3 million people working in fisheries sector plays a vital role to developing the fisheries sector in Vietnam (Thao, 2002). Overall, the fisheries sector is considered a key economic sector with an annual contribution of 4-5% to the national GDP, 9-10% to the national export turnover, and creating millions of employment for the labor force in Vietnam (Ministry of Fishery, 2001) (Lewis, 2005). In 2008, a total of 4.58 millions metric tonnes in fishery production was reported by General Statistics Office (GSO), a 9.2% increase over 2007. Of which, farming production stood at 2,448.9 thousand tons and rose by 15.3%; capture at 2,134 thousand tons, with an increase by 2.9% (marine capture of 1,938 thousand tons, increasing by 3.3%). The total corresponding export turnover was 4.27 billions USD (increasing by about 13.86% as compared with 2007). These figures combined help Vietnam achieve the leading position, joining the group of one of the ten largest exporters in the world (Hai, 2008).

Vietnam's marine fish production originated from inshore and offshore catches. The total level of marine capture was about 1.6 million metric tonnes (FAO, 2005). In 1985, the national fishing fleet had 29,000 motorized vessels with a total of 456,796 horsepower (hp). The total number of inhabitants living in the coastal regions was 1.47 million people. Among them, about 644,233 labors employed in marine fishing activities - accounting for 43.83% (Thao, 2002). Most fishermen in Vietnam are poor and their capital investment is limited. Few fishers have been able to afford investments in offshore vessels. Thus, they have little choice but focusing on fishing in coastal waters. The majority of fish production comes from inshore fishing. This has resulted in heavy pressures on inshore resources (FAO, 2005). Long (2003) investigated the trend in fishing capacity and fishery outputs during the last two decades. This trend shows that the aggregate horsepower of the fishing fleet enjoyed a five-fold increase but the total production amount only increased by half of this level. He also noted catch per unit of fishing effort (CPUE) go down recently. This has caused a lot of resource pressures on coastal communities whose livelihoods depend much on fishing activities (Long at al., 2008).

Since the mid-1990s, the Vietnamese government has adopted the offshore fishery development policies by providing incentives such as preferential loans and tax exemption. The objectives of Fisheries Master Plan to the year 2010 is to place strong emphasis on the development of offshore fisheries, both to generate export income and relieve pressures on the already over-exploited inshore resources. In addition, the major development goals for Vietnam's offshore marine fisheries up to the year 2015 are to ensure sustainable and efficient offshore fisheries and to enhance income, create new jobs and improve the living standards of fishing communities. By the end of 2001, the number of powered vessels was approximately 79,000 with a total capacity of 3,722,557 hp, increasing by 172.41% and 714.92% in terms of vessels number and horse power respectively when compared to 1985 (FAO, 2005). This figure continued to increase to 85,914 vessels with a total capacity of more than 4,721,701 hp in 2005 (Ministry of Fishery, 2005) (Luong at al., 2009).

As suggested by FAO (2005), the offshore fish stock is 1.93 millions in which 770,000 tons can be exploited. It indicates that the development of offshore fishing is highly potential. According to 2002 statistics, there were 6,675 offshore fishing vessels with an aggregate engine power of about one million horse powers. The effectiveness of this program was constrained by several factors such as the lack of suitable fishing technologies and high input costs, insufficient information on offshore resources. Therefore, a large number of offshore vessels have performed poorly in economic terms and repayment rates on loans have been very low.

Furthermore, during the last period of time when the fuel prices increased sharply, the operating results of the fishery have been negatively affected, leading to huge business misfortunes. Many fishermen took the hit and got out of the sector (VietNamNet, 2008). To maintain employment in the fisheries sector and keep the stability within fishing communities, the government has provided some fundamental subsidies for the sector, especially fuel subsidy (VnEconomy, 2009). Hence, a study on the economic efficiency of the fishery is an important requirement for fisheries management.

2.2. Khanh Hoa Fisheries Industry

Khanh Hoa is a coastal province of the Southern Central of Vietnam. It covers nearly 5,200 km^2 area with a coastline of 520 km and more than 200 islands (Long at al., 2008). Khanh Hoa fishery assumes an important position in the local economy, achieving a high growth rate during the 2000-2005 periods. This growth has contributed to the overall development of Khanh Hoa's economy and affected positively to the socioeconomic conditions of fishers and farmers. An example of this achievement in Khanh Hoa is the increase in the export value from 120 millions USD to 265 million USD. Aquaculture alone increased by 16% per year during 2001-2007 periods, contributing substantially to local GDP and creating about 48,000 jobs (Vietsea, 2009).

The fisheries in Khanh Hoa have existed for a long time. The existing number of fishing fleets is about 12,802 vessels (Khanh Hoa Fishery Ministry, 2009). The fishery is still open access and multi–species fisheries in nature. Fishermen often use a variety of fishing gears, including gill-net, long line, trawl, seine net, set-net and hook. Thus, measuring the economic efficiency of open access fisheries is important for fisheries policy makers in Khanh Hoa province.

In the past, fishing took place around the inshore waters, using simple gears such as nets, hand longline, lift net, basket, along with boats, artisan vessels or low capacity motorized vessels. There is a high concentration of fishing activities in the coastal waters. Light equipments, are commonly employed, namely torch, incandescent gas – lamp. The number of fishing days is limited, the fishing technique used is very simple, and the fishing type is outdated. For that reason, the quantity of fish was very low and highly fluctuated. Following the Vietnamese war until 1980, the Khanh Hoa' fishery has witnessed the expansion with respect to both fishing gears and number of labors. As a result, the total amount of catches increased, leading to the gradual shift from onshore to offshore grounds (Vietsea, 2009).

In 2007, the number of labors employed in the fisheries sector is 31,500. The average number of labors in the vessel was 6-8 people per vessel. Fishers' education level is generally low. About 90% of the fishing population does not complete the primary education. Fishing experiences are passed down from generation to generation. The skippers may have taken part in some short training. However, due to the limited training time, their fishing skills are primarily acquired from experiences. Their ability to acquire and operate modern equipment and machines is very limited. Therefore, it is hard for them to seek new fishing grounds. In recent years, a reasonable amount of fishing activities has taken place in offshore grounds.

Having that exposure, a group of fishermen have developed the awareness of improving fishing productivity by using the modern machines and equipment (Vietsea, 2009).

According to the statistical number of Khanh Hoa's Fishery Department, from 2006 to 2008, the total catch fluctuated from 65,000 through 68,000 metric tonnes. Although Khanh Hoa government invested in building more new vessels, the index of the horse power per vessels (hp/vessel) increased from 30 hp/vessel in 2001 to 35 hp/vessel in 2008. However, the average yield declined from 0.6 metric tonnes/hp to 0.44 metric tonnes/hp. This is because fisheries resources have been over-exploited, exceeding the threshold of the total allowable catch (Vietsea, 2009). Around 80% of the fishing vessels operating in the coastal areas makes up only 11% of the those operating in the Exclusive Economic Zone (Fishery of Ministry, 2005) (Thuy at al., 2006). According to the statistical number of FAO (2005), the total catch of the national fishing fleet within its EEZ is 0.6 million metric tonnes occupying only 54.5 % of the maximum sustainable yield. These figures speak to some advancement in the offshore fishery in Vietnam in generally and in Khanh Hoa in particular. Khanh Hoa fishery has received some benefits from the Offshore Fisheries Development Plan for the 2010-2015 periods. Vietnamese government had the preferential loan policy for fishermen to upgrade their vessels over 90 hp and to purchase modern equipment and fishing gears (Vietsea, 2009). In 2008, Khanh Hoa had 10,188 fishing vessels with a total capacity of 354,121 horse powers, equivalent to 35hp/vessel, increasing by about 16.7% compared with 2000. Vessels are classified according to the type of fishing vessels and the structure of fishing gears. In terms of fishing vessels, they are categorized into artisanal vessels and motorized vessels. There are 87 artisanal vessels in total while the number of motorized vessels is 10,101, accounting for 99.15%. Among motorized vessels, vessels with the engine capacity of less than 20 hp is the most popular, with 6,445 vessels (63.8%), followed by vessels with the an engine power ranging from 20 to 50 hp, totaling 2,163 vessels (21.4%). Next, those with the engine capacity of 50 to 90 hp is 738 (7.3%) and with engine capacity ranging from 90 to 150 hp is 479 (4.7%). The two final groups are vessels with engine capacity ranging from 150 to 400 hp and larger than 400 hp, around 266 vessels (2.6%) and 10 vessels (0.2%) respectively. In general, more than 85% vessels have the engine capacity of less than 45 hp. By 2009, Khanh Hoa has the total of 12,802 fishing vessels and the Khanh Hoa fishing fleets includes gillnet, longline, trawl, purse seine, purse seine using light, lift net, and others (shown in Table 1). Among them, the purse seine using light gets the highest proportion (25.9%) while lift net (3.2%) is at the end of the list (Khanh Hoa Fishery Ministry, 2009). Most of them are multi-purpose vessels. The design comes as a response to fluctuating seasonal changes. For example, a vessel may be designed to fish tuna in the main season and catch squid in the sub season (Vietsea, 2009).

Table 1: Number of fishing vessels categorized by fishing gears in 2009.

Types of fishing gear	Unit of measurement: vessels	Percentage (%)
Gill net	828	6.5
Longline	1,299	10.1
Trawl	1,688	13.2
Purse seine	995	7.8
Purse seine using light	3,322	25.9
Lift net	415	3.2
Others	4,255	33.2
Total	12,802	100

Source: Khanh Hoa fishery Ministry, (2009).

Among 10,188 fishing vessels in 2008, Khanh Hoa has 955 offshore fishing vessels with a total capacity of 127,980 horse power (Khanh Hoa Fishery Ministry, 2009). The offshore fishing fleet is equipped with modern telecommunications equipment, including global positioning system and fish-finding machine. The capital investment required for the offshore fleet is large while most fishers in Khanh Hoa Province are poor. Few fishermen can afford investments in offshore vessels. Furthermore, offshore fishing activities are often more dangerous because of the varied weather pattern and the unpredictable levels of marine resources (Vietsea, 2009). Therefore, all offshore fishing vessels occupied only 9.5% of the total fishing fleet in 2008 (Khanh Hoa Fishery Ministry, 2009). During the last period, some offshore vessels performed poorly because variable costs per trip soared unexpectedly, mainly driven by the increase in fuel prices during 2006-2009. Thus, many of them exited the sector or shifted to other fishing gears (http://www.khuyennongvn.gov.vn/c-hdknkn/b-tthuanluyen/khanh-hoa-thanh-lap-hiep-hoi-ca-ngu-111ai-duong). In response to the dire situation in the fishing sector, Vietnam's government implemented the fuel subsidy program for fishing vessel owners. The main objectives are to maintain employment and to ensure that fishers receive a reasonable income from their businesses (VnEconomy, 2009). Therefore, assessing the economic efficiency of offshore fishery in Khanh Hoa Province is needed to provide information and insights for the policy making process in fisheries development.

2.3. Khanh Hoa Longline Fisheries Industry

Longline fleet plays an important role in the fisheries in Khanh Hoa Province. The local offshore longline fishery has been developed since the mid-1990s. Long line is considered passive type of fishing gear[1]. They are deployed to catch either demersal or pelagic species. The gear consists of a long fishing line and a wire or rope to which baited hooks are attached via shorter lengths of line. Long-lines are often set in fleets that may be thousands of metres long with hooks spaced ten metres apart. Each vessel may fish with several thousand hooks, each of which needs to be baited (Jennings at al., 2001)). In 2009, the total number of longline vessels was 1,299. Among them, the offshore longliners was 107, occupying for 8.2%. The remaining proportion for longliners operating along inshore grounds is 91.7% (Khanh Hoa Fishery Ministry, 2009). In 2001, Khanh Hoa had about 563 longliners. Among them, 64 longliners operated offshore and this number increased to 200 in 2004 (Long at al., 2008). However, the total number of offshore longliners was only 107 vessels in 2009 (Khanh Hoa Fishery Ministry, 2009). This may indicate a downward trend in offshore fishing vessels. The main reason for this decline is that variable costs per trip were very high, driven by the combination of high fuel costs and low market price for fish. As a consequence, many longliners recorded poor economic performance during the last periods of time, ultimately pushing some vessel' owners out of the industry (http://www.khuyennongvn.gov.vn/c-hdknkn/b-tthuanluyen/khanh-hoa-thanh-lap-hiep-hoi-ca-ngu-111ai-duong).

About 97.2% of the offshore longline fleet (107 vessels) concentrate in Nha Trang City and 2.8 % comes from other regions (Cam Ranh, Ninh Hoa) (Khanh Hoa Fishery Ministry, 2009). The offshore longliners target key species such as Tuna, Squid, Shark, Flying fish. However, Tuna remains the most important target. These include Yellowfin Tuna (Thunnus albacares) and Bigeye Tuna (Thunnus obesus). The main export markets for these two species are United States and Japan. The National Fishery Report contains the following information presented by Mr. Duong Long Tri, Vice-Director, Fisheries Information Centre, Ministry of Fisheries, Hanoi (Lewis, 2005):

"Vietnam's sea area is situated in the region where tuna resources are abundant. Therefore, in recent years, tuna fisheries in Vietnam have developed rapidly. Because of insufficient

[1] Passive gears entangle or trap target species that come to them. Examples are traps, longline and pots (Jennings at al., 2001).

statistical system, data on the catch of tuna is not available. However, it was estimated for the year 2001 the catch was around 20,000 ton".

"Target species were mainly bigeye tuna and yellowfin tuna. Resources of bigeye tuna and yellowfin tuna are mainly distributed in the central region. Unfortunately, up to now, researches into these resources have not been paid much attention to, those do not meet demands in information on tuna for fishermen"

"Tuna longlines have been main fishing method used in tuna fisheries. It develops strongly in the central provinces, e.g. Da Nang, Phu Yen, Khanh Hoa and Binh Dinh. The fishing season is from November to March; 70% of tuna catch was bigeye tuna"

Fishermen often fish Tuna in the EEZ of Vietnam and also in the international waters (Figure 1).

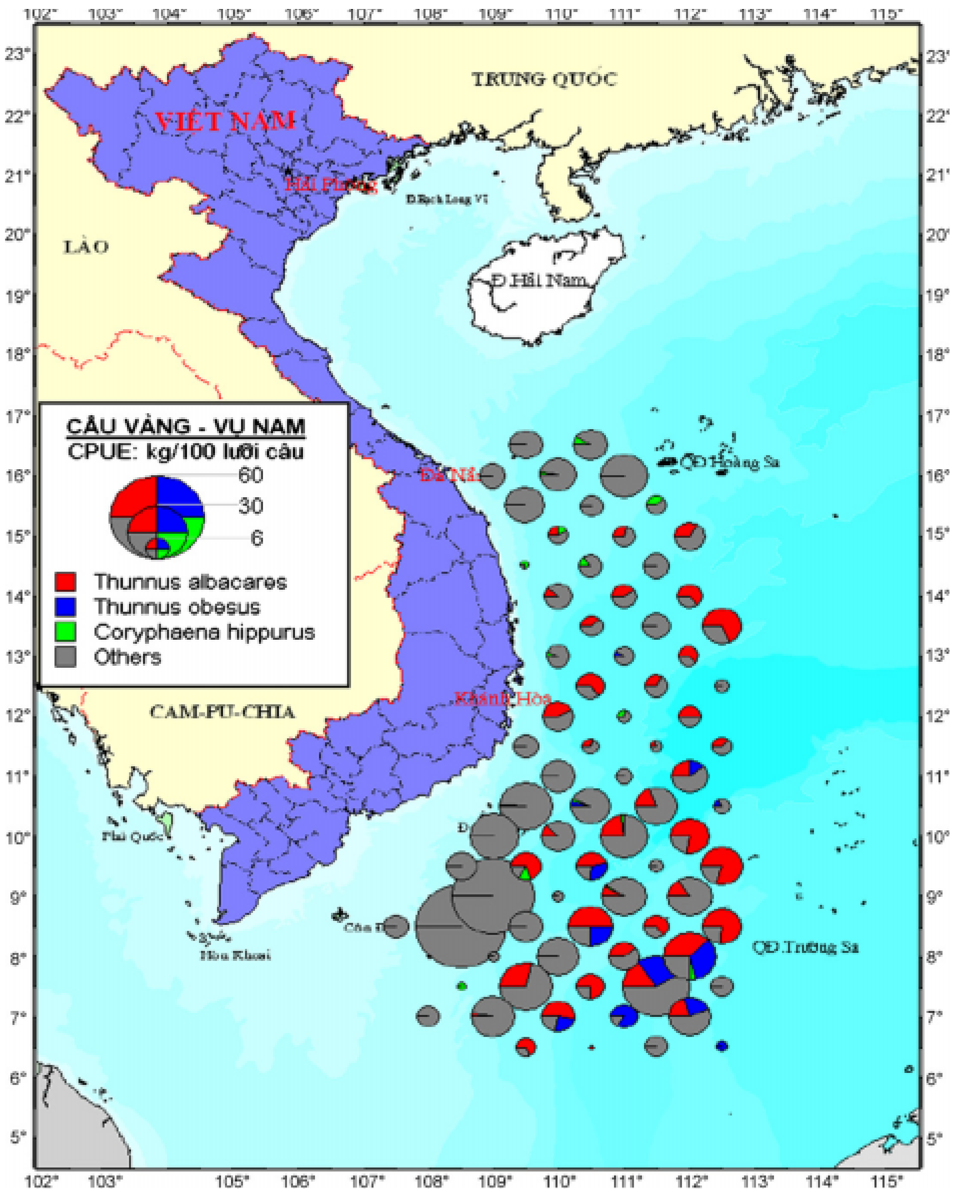

Figure 1: The distribution of fishing productivity of some pelagic species from researching results of some longliners . Notes: TRUNG QUỐC (in Vietnamese) = CHINA (in English); CÂU VÀNG-VỤ NAM = LONGLINE-SOUTH-WEST MOONSOON; KG/100 LƯỠI CÂU = KG/ 100 HOOKS (Long at al., 2008).

The offshore fishing grounds are far away from the coastal areas and it takes about 50-70 hours for each vessel to get to these grounds. These offshore longliners normally operate from December to August (September). From December to March (April), it is called the North East fish crop. In this fishing season, fishers catch from the Northeast of Paracel (Hoang Sa) Islands and all the way to Philippine sea waters. The second crop is the South West fish season. It lasts from April (May) to August (September). Fishing activities spread from the vicinity of the Spartly (Truong Sa) Islands to the Malaysian waters. After each fishing trip, fishermen often take 5-7 days off to prepare for the next fishing trip. During the rest of the year (September to November), fishermen will maintain and repair their vessels (Long at al., 2008).

The offshore fishing fleet has large expenses. These vessels are often well equipped with compass, global positioning system and communication system. Long line is set in each vessel. The length of longline is about 35-60 km with 900-1,400 hooks per longline. The total amount of catch per trip is about 1,000-2,500 kg. Among them, tuna (Yellowfin tuna, Bigeye tuna) accounted for 80-90%. Other fish include sail fish, scads, and so on. Each vessel owner normally owns one vessel. Skippers may be boat owners or the sons of the boat owners. Skippers are usually from 30 to 45 years old and have more than 20 years of fishing experiences (5-14 years operating longline gear). Each longliner has about 8-10 crew members. The majority of longline fishermen has good fishing experiences and come from the families with long fishing traditions. Income in this fishery is often higher than in other fishing gears. Although tuna gets high economic value, fishers may change targets seasonally. For example, some longliners can consistently catch tuna for the whole year while others can fish squids or flying fish in sub seasons.

According to the statistical number of Khanh Hoa Fishery Department, the total catch of Khanh Hoa in 2008 was 68,800 metric tonnes, increasing by 3.3% and 5.9% as compared to 2007 and 2006 respectively. The total catch of longliners was 2,260 metric tonnes in 2008, occupying for 3.3% of the total of catch. Offshore longlineers landed 1,950 metric tonnes, representing 3.3 %.

The offshore longline fishery in Khanh Hoa still remains open access. In recent years, Vietnam's government has adopted the national offshore fisheries development. One of the main objectives of this program is to reduce fishing efforts on coastal waters by shifting to offshore fishing activities. This program provides incentives such as loans with easy credit terms and tax exemption. In addition, tuna is the main offshore marine resource with high economic value. Thus in the recent months, vessel owners received fuel subsidy due to an increase in the fuel prices (VnEconomy, 2009). Subsidies may increase the probability that fish stock will be exploited beyond their biological limits. However, driven by social priorities, the government offered this direct support to maintain employment in the fisheries sector and to prevent the collapse of fishing communities. By providing the economically efficient analysis, this study may contribute to future improvements in longline fishing strategies and management.

Chapter 3 REVIEW LITERATURES

There are many definitions of economic efficiency. They are originated from different sources on Internet. The first definition of economic efficiency refers to using of resources in such a way that: "*Maximize the production of goods and services. In relative terms, one economic system is more efficient than another if it can provide more goods and services for society without using more resources. In absolute terms, a system can be called economically efficient if:*

- *No one can be made better off without making someone else worse off.*
- *More output cannot be obtained without increasing the amount of inputs.*
- *Production proceeds at the lowest possible per-unit cost*".

(Wikipedia, 2010)

We have the another definition of economic efficiency in Finance and Business Dictionary as follows: *"Economic efficiency means the production and distribution of goods at the lowest possible cost"* (Qfinance, 2010)

Farrell (1957) suggested that the efficiency of a firm consists of two components: technical efficiency and allocative efficiency. Technical efficiency reflects the firm's ability to obtain maximum output from a given set of inputs. Meanwhile, allocative efficiency reflects the firm's ability to use the inputs in optimal proportions, given their respective prices and the production technology. These two measures are then combined to provide a measure for the total economic efficiency (Coelli at al., 2005)

Efficiency is measured using either DEA (Data Envelopment Analysis) or Stochastic Frontier Methods. Some advantages of Stochastic Frontiers over DEA are: 1) it accounts for noise; 2) it can be used to conduct conventional tests of hypotheses. However, some disadvantages are: 1) the need to specify a distribution form for the inefficiency term, 2) and the production function (or cost function) (Coelli at al., 2005). Another method to measure economic efficiency is to build the economic performance indicators based on the accounting ratios such as profitability, the ratio of net profit to gross revenue, the ratio of net profit to the capital value (Flaaten at al., 1995 and Kim Anh at al., 2006)

Economic efficiency is one way to measure the economic performance. Economic performance, however, is assessed by relating the value of output to the real cost of inputs needed. In practice, assessment of the economic performance of fisheries is derived from economic surveys of the individual fishers participating in the fishery. Regular surveys of economic performance are undertaken in order to meet the monitoring requirements of their respective fisheries policy.

Flaaten at al., 1995 studied the economic efficiency of Norwegian Purse Seine Fleets. This is processed by comparing the profitability of purse seine vessels with no license fee with the profitability of vessels with license fees. The results show that vessels that purchased licenses have a significantly lower profitability than the other vessel group. This is due to the owners who bought licenses along with vessels have higher capital costs.

Floc'h at al., 2008 assessed the capital value and the economic performance of the commercial fishing fleet of the French region of Brittany. Based on these two sources (technical and financial information of fishing fleet and bookkeeping databases), measurement of economic performance can be produced for the short term using gross surplus; and for the long term including the cost of capital and the differences between them are then discussed.

Whitmarsh at al., 2000 studied on the assessment of both the actual profitability of UK marine fisheries and also their potential profitability under alternative fisheries management regimes. These not only provided the current economic performance of fisheries but also altered or improved under different policy scenarios for fisheries in UK.

Beside that, many authors presented the economic performance through the measurement of technical efficiency and economic efficiency of fishing fleets. This is done by using Stochastic Frontier Production Function (SFPF) and Data Envelopment Analysis (DEA) methods. For SFPF, most studies aimed to examining the underlying factors (Kirley at al., 1998) and only one input is singled out. This is contrast with the DEA method. It means that when using DEA, we do not consider the variables. However, both methods evaluate the effect of management measures on technical efficiency as well as economic efficiency. The fishery decision makers could therefore adjust technical efficiency by constraining the use of inputs (Pascoe at al., 2001).

Tingley at al., 2005 studied the factors affecting technical efficiency in fisheries. In this study, they calculated Technical Efficiency (TE) scores by using the econometric Stochastic Production Frontier (SPF) or the non-stochastic, linear-programming Data Envelopment Analysis (DEA) methodologies. The results of both techniques for segments of the English Channel fisheries then will be compared. They found that such factors include vessel and skipper characteristics influencing the technical efficiency.

Christos at al., 2008 pioneered in estimating and assessing capacity utilization in the Eastern Mediterranean through Data Envelopment Analysis. The results showed that the purse-seine fleet segments operated below their capacity output level, indicating the existence of overcapacity. The fleets with 24–40m were more efficient than the 12–24m fleet segment. The quantitative measures of excess and overcapacity were obtained, contributing valuable information in balancing the productive capacity of the stock with the harvesting capacity of the fleet.

Fousekis at al., 2003 assessed the Technical Efficiency (TE) and estimated the interaction between with vessel- and skipper characteristics for the fleet of trammel netters in Greece. This is done by including the simultaneous estimation of the stochastic frontier model and the inefficiency model by Maximum Likelihood methods based on trip data from a sample of vessels. The empirical results suggest that there is potential for short-run output increases without additional fishing effort. These authors also suggest that vessel- and (to a lesser extent) skipper-specific characteristics do influence TE levels.

In Vietnam, most studies focus on developing economic indicators for the fishery in Khanh Hoa Province as well as finding key factors influencing the vessel performance, represented by gross revenue and (or) income (Tuan at al., 2007, Kim Anh at al., 2006, and Long at al., 2008). These authors contributed more information for making decisions to improve and manage fisheries strategies in Vietnam. For example, we can see Tuan at al., 2007 specified some factors affecting gillnet vessels operating in inshore grounds by using regression analysis for 60 sample vessels which have been surveyed in Vinh Phuoc and Xuong Huan wards in 2005. The results show that hull length and the age of vessel have the most considerable effects on revenues variations. In addition, Luong at al., 2009 conducted the research project "Economic performance indicators for coastal fisheries - the case of pure-seining in Khanh Hoa". This paper presents preliminary findings for 100 purse seiners in Nha Trang and Cam Ranh in the group of vessels with engine power of less than 90 hp. The results show that the coastal purse seine fishery in Cam Ranh is more profitable than other vessel groups. In addition, he also found some significant technical factors affecting revenues are the length of net, fishing experience of skipper and location. Beside these studies on the economic performance of inshore fisheries, we also find some more studies on the economic performance of offshore fishing fleets in Vietnam. Kim Anh at al., 2006 studied on the cost and earnings of purse seines in Nha Trang, Vietnam. The empirical results suggest that the offshore gill net fishery with tuna and mackerel is one of the offshore fisheries with relatively high economic efficiency. The ratio of profit to the capital owner in 2004 and 2005 were 10.9 % and 17.9% respectively. These ratios were relatively higher than bank interest rate benchmark (7-9%). The main reasons for this are that offshore resources are abundant and market demands for Tuna and Mackerel is increasing. Long et al., 2008 studied on the economic performance of offshore longliners in Khanh Hoa, Vietnam. The study suggested that the average annual crew remuneration was 93% of labour earnings in the most productive sectors in Khanh Hoa and the owner of an average longline performer has a profit margin of 12.1%. Furthermore, the regression analysis of gross revenue and income showed that if other factors were constant, a vessel of hull length 15.9 and 15.1m would maximize gross revenue and income respectively. This implies that over-investment in vessels may lead to inefficiency. Offshore vessels financed partly with low borrowing costs have hull length longer than the level that allows maximizing annual gross revenue and income of the vessel.

Chapter 4 THEORETICAL FRAMEWORK

4.1. Fisheries theory

4.1.1. Bioeconomic model

Gordon (1954) has provided the traditional economic model. This model was built based on the assumption that each competitive homogeneous fleet has a common cost structure (i.e. the average cost per unit of effort is the same for all boats). The long-run relationship between total revenue and fishing efforts will be presented by the hump shape of the sustainable yield function, which may be expected to have a unique maximum point, called MSY - Maximum Sustainable Yield. Market prices are assumed not to be affected by the quantity of fish landed from this one fishery. For simplicity, total costs may be supposed to increase linearly with efforts, and the vertical distance between total revenue and total cost will define the economic profit from the fishery. Under open access regime, vessels will enter the fishery if revenue per unit of effort is greater than cost per unit, and will exit the sector if the cost per unit is higher than revenue. When average revenue of effort equals marginal cost of effort, there will be an economic equilibrium with neither an incentive to leave nor an incentive to enter the fishery. In Figure 1, the level of effort under open access equilibrium is where TR(E) equals TC (E) and is denoted as E_{OAE}. In other words, profit at this effort level under the open access fishery is zero. In addition, the level of effort at which economic profit from the fishery is maximized is called the Maximum Economic Yield, shown in the diagram as E_{MEY}. The economic profit generated at this effort level will be TR_{MEY} -TC_{MEy} (Flaaten, 2010). Under conditions of optimal effort regulation, to obtain an empirical estimate of potential profits, we clearly need a bioeconomic model, which requires an explicit understanding of the interaction between the fish stock and the efforts needed to harvest it (Whitmarsh at al., 2000). Therefore, it is very difficult to measure the potential profit in the conditions of poor data (lack of stock data). In this paper, the author only measures the actual operating profit of long line fishery under open access regime by using data obtained from costs and earnings surveys in 2008.

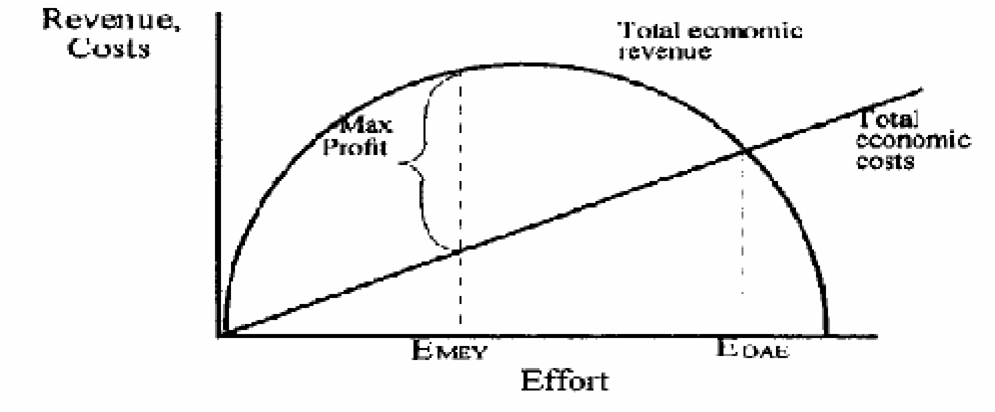

Figure 2: The Traditional Bioeconomic.

Source: Ola Flaaten, (2010)

4.1.2 Fishing vessel economics

In this section, the author will dissect and adapt the general fisheries theories to this specific study (Flaaten, 2010). In reality, the fishing fleets are often different in costs structure. This stemmed from the difference in engine power, hull length, skills of the skipper and crew. Therefore, they usually vary with respect to efficiency and cost perspectives. For example, the fuel prices are often lower in large cities than they are in small, remote fishing villages. This is because of transportation costs. Thus, variations in the efficiency of efforts and market prices of inputs may all contribute to the existence of heterogeneous efforts in the fish harvesting industry.

We will study on the economic adaptation of fishing vessels. This includes the economic objectives of fishing activities, the costs structure, the size and the availability of natural resources, and the fish stock. A fishing effort measures the activity level of a vessel. Vessels can be different in effort levels, determined by differences in the total number of inputs needed to generate fishing efforts (Flaaten, 2010).

Suppose that e is the amount of effort of one fishing vessel. The total cost of effort is therefore $tc(e) = c(e) + f$, *where* $c(e)$ is variable cost and f *is* fixed cost. Similarly, $ac(e) = tc(e)/e$ is average cost of an effort calculated from total costs divided by effort and $mc = mc(e) = dtc(e)/d\ e$ is marginal cost of vessel effort. Analyzing for a single vessel'adaptation, we also assume that a vessel has no significant effects on the stock level and market price (Flaaten, 2010).

According to the theory of the firm, marginal cost may decline when outputs go down, hitting the bottom (minimum), and then going up, which is consistent with the form of the production function. In the case of fisheries, effort is considered as the (intermediate) product of the production process and this (intermediate) product is produced by regular inputs according to a regular production function. In a given period of time the vessel's catch is a function of its effort and the stock level. Assume that the vessel harvest function is the Schaefer linear harvest function: $h(e;X) = qeX$, where q is the catchability coefficient (Flaaten, 2010).

The operating profit of the vessel is $\pi(e,X) = ph(e;X) - c(e)$ or $\pi(e;X) = pqeX - c(e)$

Assuming that the vessel operator targets maximising operating profit. This can be translated into the formula $\pi^{'}(e;X) = pqX - mc(e) = 0$. This formula implies the following criterion for the vessel's adaptation of its effort is that $mc(e) = pqX$ (*)

The formula (*) tells that the marginal cost of vessel effort is equal to the marginal revenue of effort. The latter equals the product of fish price, catchability coefficient and stock level. The result represents the revenue earned by the adding one unit of effort. In the traditional theory of production or theory of the firm, the right hand side of the equation corresponding to (*) would include only *p*, whereas in this case both *q* and *X* are included in addition to the price. For a given set of *p*, *q* and *X* the vessel's optimal effort is implicitly given by equation (*) (Flaaten, 2010).

In the production theory, we can measure product along the horizontal axis but in this case we can use fishing effort as the fisher's decision variable. An ordinary firm can control its total production process, including all inputs needed and the costs incurred. A fish-harvesting firm, however, does not control it's the most important input, especially the fish stock. Fish stock is not the same as fuel and bait that can be purchased in the input market. Thus cost per unit of harvest will depend on both input costs and on the stock level and its catchability (Flaaten, 2010).

We will compare the adaptation of optimal effort for two profit maximising vessels, vessel *i* and vessel *j (shown in* figure 3*)*

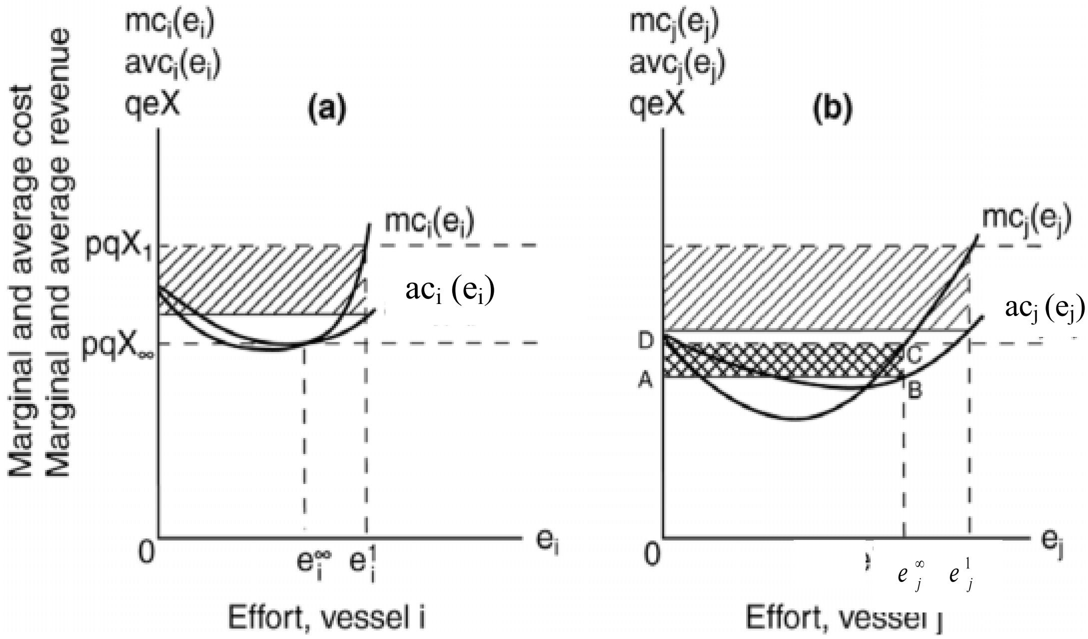

Figure 3. Two fishing vessel's short-run adaptation of effort for a given cost structure, price of fish, catchability and stock level.

Source: Ola Flaaten, (2010)

Panel (a) of this figure shows the marginal revenue of effort, *pqX*, for two levels of the fish stock, namely X_∞ and X_1. The optimal effort of vessel *i* is e_i^∞ for stock level X_∞. This effort is according to the optimality criterion in equation (*), that is, marginal cost of effort equals marginal revenue of effort. In this case, vessel *i* does not make any profit, just remain break-even, since the marginal revenue of effort, $pq\,X_\infty$ equals the average cost. It is contrary to panel (b) of this figure. In this case, vessel *j* achieves its maximal profit for effort e_i^∞ at stock level X_∞, and that profit is represented by the area ABCD. This profit is called producer's surplus or quasi rent in the theory of the firm and intra-marginal rent in fisheries economic theory[2]. Thus vessel *i* is a marginal vessel at stock level X_∞ since just a small reduction in the stock level will force the vessel out of operation whereas vessel *j* is intra-marginal at this level. Note that vessel *j* would be able to operate with a positive profit even at a stock level somewhat lower than X_∞. However, it will be optimal for vessel i to stop fishing since marginal revenue will be below the minimum average cost at stock level smaller than X_∞ . In

[2] Sometimes intra-marginal rent refers to rent related to the average total cost curve. However, the main point is that intra-marginal rent is a surplus that accrues to those vessels that are more cost efficient than the marginal one.

other words, it is better for the vessel i to be idle with zero profit than to operate with negative results. If replaced X_∞ by X_1 thanks to active management of the fishery, figure 3 shows that the profit maximising effort for these two vessels will be e_i^1 and e_j^1 respectively. In this case the profit for each of these two vessels will be the single-shaded areas of panel (a) and panel (b) (Flaaten, 2010).

In empirical results, the author assumes that the vessel operation considers stock as constant. This also applies to the market price of fish- seen from a vessel operator's point of view the market price is considered unaffected by the landings of each vessel. Thus, the vessel operator acts as if his fishing has no effect on the stock level or on the market price. In addition, we need to estimate the fishing effort function and then get the expected fishing effort for each vessel. However, interpreting the actual value of the expected fishing effort is difficult because horse power, length of vessel, and fishing days may have different units of measurement. Scaling the expected fishing effort by the average of the expected fishing effort for a longline eliminates the units of measurement and defines a relative standardised effort (this content will be represented in section 4.3.1). Hence, average revenue per unit relative standardised effort for all vessels is the same and it has the horizontal shape (presented in section 4.3.2). We will also study on Salter graph showing the different cost structure of each vessel in heterogeneous vessel group (shown in figure 4).

In figure 4, we suppose that this vessel group includes 12 vessels so that figure 4 will show each of twelve vessels the relative standardised effort along the horizontal axis and the average cost per unit relative standardised effort along the vertical axis. The vessels are arranged from the left to the right according to their cost efficiency, with vessel no. 1 as the most cost efficient one and vessel no. 12 as the least cost efficient. We may choose one vessel as the standard vessel against which the effort of the others is measured. Since the width of each vessel bar illustrates the relative standardised effort of each vessel, we will consider fishing efficiency as well as the cost efficient vessels through comparison of relative standardised effort and cost per relative standardised effort between standard vessel and others in the group of heterogeneous vessels. For example, as vessel no 9 was selected as the standard vessel, we can see that vessel no. 3 produces about double effort as compared to the standard vessel no. 9. This implies that vessel no. 3 would fish twice as much as vessel no. 9. Further, we notice that the average cost per unit of relative standardised effort is lowest for vessel no. 1 even though this vessel no. 1 produces the same relative standardised effort as the standard vessel no. 9 (Flaaten, 2010). Furthermore, from figure 4, we can imply that what vessel group has the most cost efficiency among three vessel groups which is categorized according to an engine size.

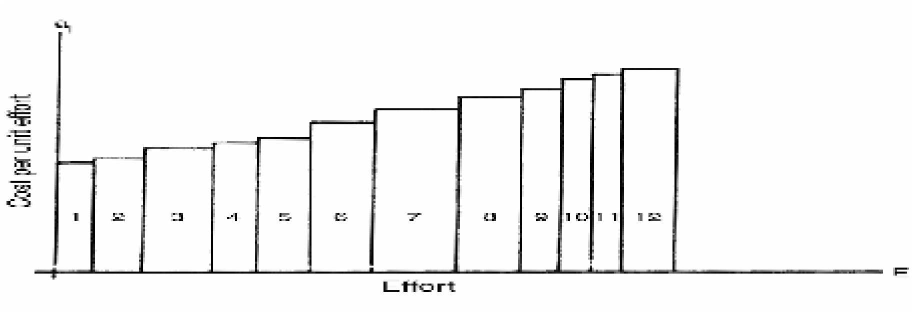

Figure 4: Salter Diagram.

Source: Ola Flaaten, (2010)

Overall, the average revenue per relative standardised effort for all vessels is the same. Vessels that have more efficient cost structures will achieve more economic efficiency in open access fishery. Thus this can indicate that the open access fishery still allows generating profits. The key issue is how to define relative standardised effort in this case. It is presented in the section 4.3.

4.2. The concepts of costs and earnings

The concepts of costs and earnings are based on those of profitability analyses of fishing vessels in industrialized countries (Flaaten at al., 1995)

Table 2: The concepts of Economic performance Indicators

Gross revenue Fuel subsidy - Operating cost (Variable cost and fixed cost)
= Gross value added - Labor cost
= Gross Cash Flow - Depreciation - Interest loan payment - Calculated interest on owner’s capital
= Profit

Gross revenue is calculated as the average revenue of each trip multiplied by the number of fishing trips in both the main and other seasons in the year 2008.

Fuel subsidies are an example of fisheries subsidies, generally defined as direct or indirect financial transfers by the government of a country to its fishing sector. However, fisheries subsidies depend directly or indirectly on harvest rates and/or fishing effort (Munro at al., 2002). The program of Vietnam government fuel subsidy is classified according to the horse power (hp) of vessel: 30 million VND for vessel with an engine size of more than 90 hp; 26 million VND for vessel with an engine size ranged from 40-90Hp and 24 million VND for vessel with an engine size of less than 40 hp (Ministry of Finance, 2008*).* In this case, fuel subsidies may appear as fuel quasi-lump sum subsidies payable (fixed monetary amount) to the vessel owners. We can see subsidy accrued to vessel owners as the income and it added into gross revenue if counting profit with subsidy.

Operating Costs include variable costs, repair and maintenance, and insurance. Variable costs consist of fuel, lubricant, ice, provisions and bait.

Gross Value Added (GVA) is gross revenue minus operating costs. Gross Cash Flow equals gross value added less labor cost or it refers to gross revenue after deducting all of expenses (excluding depreciation and loan interests, calculated interest on owner's capital). In other words, GVA is the total of labor cost, depreciation, interest payments, calculated interest on owner's capital and net profit.

Profit is simply calculated as the gross revenue minus all expenses. It equals gross cash flow minus depreciation, loan interest and calculated interest on owner's capital[3]. It is very easy to aggregate depreciation, loan interest and calculated interest on owner's capital to get the capital cost.

Depreciation is the loss in the value of vessel, including equipment. In this study, the author employs a linear depreciation plan because of limited information in the data set. One method is to depreciate the vessel on the basis of acquisition value and apply inflation rates due to changing price levels. Using this method, the owner receives compensation for increasing price levels through inflation rates extracted from *http://www.indexmundi.com/vietnam/inflation rate_%28consumer_prices%29.html;*

[3] Calculated interest on owner capital is based on what the own capital invested in the vessel could have earned in the next best alternative investment (e.g invest money into a bank)

Life span of items for depreciation is based on the owner's estimated lifespan of the fixed capital items. Annual vessel depreciation includes hull, engine, equipment and gear.

The calculated interest on owner's capital is counted as the calculated own capital of vessel' owner multiplied by the average bank' interest rate in 2008. The information about the bank' interest rate is extracted from *http://www.sbv.gov.vn/vn/CdeCSTT-TD/tracuu.jsp*. The calculated own capital of vessel'owner is counted as the asset value at the time of the calculation minus the loans in which the calculated asset value equals the acquisition cost minus the accumulated depreciation.

Loan interest is the annual payment of the vessel-owner.

The comparison of profit between fuel subsidy and fuel subsidy absence is performed to view the economic differences. Profit with subsidy is counted as gross revenue adding more fuel subsidy minus total costs.

Some ratios were also taken into account for the economic differences such as profit margin and return on investment. The profit margin is defined as

$$Profit\ margin = \frac{profit * 100}{gross\ revenue}$$

where the profit is the gross revenue minus all of expenses. The profit margin represents what is left to vessel owner as compensation to the capital as a percentage of sales, *i.e.*, the gross revenue.

The return on investment (ROI) is defined as:

$$\mathrm{Re}turn\ on\ investment = \frac{profit * 100}{the\ value\ of\ the\ total\ assets}$$

This ratio shows what is left to vessel owner in relation to the value of the total assets including the value of the vessel and equipments, have received their compensation.

4.3. Econometrical model

4.3.1. Model of fishing effort

In the fisheries, effort is an abstract concept that includes many factors such as length of vessel, horse power, fishing time, a number of gears or a number of boats, the skill of skippers and crew, etc (FAO, 2003b). Alternatively, It is well known that fishing effort is measured as the natural characteristics of fishing vessel (such as gross tonnage and engineer power) or fishing operation (for example, fishing days and number of hauls) (FAO, 2003a). Holland and Sutinen (1998) considered that fishing capacity is usually thought of in terms of the ability to produce fishing effort per period (FAO, 2003a). In FAO (2000), fishing capacity was subsequently defined as follows: *the amount of fish (or fishing effort) that can be produced over a period of time (e.g. a year or a fishing season) by a vessel or a fleet if fully utilized and for a given resource condition* (FAO, 2003b). To a certain degree, fishing capacity is positively correlated with catch so fishing capacity may be estimated by the adoption of either catch (or effort). Obviously thus it is very difficult to present the exact formulation to measure a fishing effort because of basing on biological and economic characteristics of the fishery (Padilla at al., 1995). In this case, a fishing effort measures the activity level of a vessel (Flaaten, 2010). Building a function of fishing effort will base on the technical and operational characteristics data of vessel in this study. The estimated purpose of this fishing effort function is to consider increase in fleet size, and fishing activity that total yield rose, whether vessel fishing was the cost efficiency, specially the cost per relative standardised effort. The fishing effort function is defined follows:

First, design a fishing capacity measure from horsepower (hp) and length of vessel (L) (FAO, 2003b) using a Cobb-Douglas function: $k = AHp^{\alpha} L^{\beta}$

Assume effort (e) is a product of days of fishing and capacity, ie, e=dk. Then expected catch $h = qeX$ is with X as the (unknown) fish stock.

In this Schaefer harvest function, we assume a bi-linear relationship between the two inputs, *fishing effort* (*e*) and *fish stock* (*X*), and the produced *catch* (*h*). The coefficient *q* is a gear and stock specific constant, referred to as the catchability coefficient (Eide at al., 2003). The Schaefer harvest function implies that an increase in fishing effort leads to an increase in the catch at the same rate, for a constant stock.

Now we have $h = qXdHp^{\alpha} L^{\beta}$ .We may estimate this function using log linear form, treating qX as a constant. The estimated fishing effort function follows

$\ln h = \alpha_0 + \alpha LnHp + \beta \ln L + \gamma \ln d$ (setting $\alpha_0 = \ln qX$) where h is the catch volume, Hp is horse power of vessel, L is the length of vessel and d is fishing days of vessel. However, due to lack of catch volume data for each vessel, regression analysis of fishing effort based on revenue data as a proxy.

The returns to the variable inputs also can be measured by output elasticities (FAO, 2003b). In this case, the parameters are the horse power-output elasticity (α), the length of vessel -

output elasticity (β), and the fishing days-output (γ). It is expected that the signs of all estimated parameters are positive. They are explained by some reasons below.

Engine power is correlated to efficiency of fishing operations. This is because the higher the engine capacity, the more quickly vessels can travel between the fishing ports and fishing grounds. High speed vessels are also in increased demand, driven by both and market and safety reasons (Parente, 2004). Also, the increase in engine power of fishing vessel is relevant to the expansion of the average size of vessel length. In fact, vessels with higher length may carry larger volume, increasing the corresponding values of the fishing effort and enhancing the probability of catching more fish (Parente, 2004). Fishing days is calculated as actual fishing time of each vessel. This would involve the time spent on searching for fish, looking for fishing grounds, preparing or maintaining the fishing gear, and harvesting. When the fishing time increases, fishing effort also increases accordingly. The total amount of catch is highly correlated to the actual fishing time (FAO, 2003a). In this study, fishing time is calculated as the average number of days per trip less the average number of days that vessel travel to fishing grounds and come back home port, and then multiplied by a number of trips in year.

In fact, the returns to the variable inputs are likely to be diminishing. For example, doubling boat size, engine power, and variable input usage in many fisheries would likely result in catch increasing by less than the rate of increase in all factors of production. In other fisheries, however, it is possible that a doubling of effort might more than double catch (FAO, 2003b). Therefore, parameters α, β and γ give the percentage increase of *catch* (*h*) (or fishing effort) with an increase of 1% of *horse power (hp*), *length of vessel (L*)*, and fishing days (d),* respectively. Hopefully, all these input factors increase by the same proportion, we would expect that an increasing in fishing effort will be less than this proportion or $\alpha + \beta + \gamma < 1$, at least $\alpha + \beta < 1$. With a log linear function estimated, the elasticities can be obtained by using an Ordinary Least Squares (OLS) regression. The econometric package EVIEWS version 4.0 is used (Hoai, 2006)

The more general Cobb-Douglas production function has been used in some empirical works on Northeast Arctic cod harvest (Edie at al., 2003) and application of production function to estimate fishing effort (Padila at al., 1995).

This fishing effort measure is, however, often standardised to account for differences in relative fishing power, because fleet often varies according to size of length, horse power, and, fishing days. Such standardized measures of the relative performance of different boats compensate for heterogeneity in the fleet (FAO, 2003b). Hence, in this study, we will use the relative standardised effort instead of the fishing effort for all vessels. After discussion between Prof. Ola Flaaten, Assoc. Prof. Dr. Kim Anh, Mr. Duy and me. We defined the relative standardised effort as follows:

First, after estimating of fishing effort function, we can derive the expected fishing effort indicator for each vessel. Second, based on a range of the expected fishing effort indicator for each vessel from the largest to smallest expected fishing effort, we will define the average of the expected fishing effort indicator of a vessel in the sample. Finally, relative standardised effort indicator for each vessel equals the expected fishing effort indicator for each vessel divided into the average of the expected fishing effort indicator for a vessel. In other worlds, relative fishing effort is the ratio of the expected fishing effort indicator to the average of the expected fishing effort indicator for a longline.

If vessels have low fishing effort, its relative fishing efficiency will be low and vice versa. The difference in relative standardised effort for all vessels may indicate that vessels are heterogeneous, which is determined by cost and efficiency perspective. In this case, we represent vessels along relative standardised effort axis, from the most cost efficient one to the left and the least cost effective ones to the right (shown in figure 6). Relative standardised effort of an average vessel was chosen from a range of relative standardised efforts for all vessels to compare with that of the remaining vessels and then we may imply that what vessels and what vessel group have the most cost efficiency. In addition, vessels vary with engine capacity, hull length and number of fishing days so that defining relative standardised efforts for each vessel will define the average revenue of relative standardised effort for all vessels is the same.

4.3.2. Model of the average revenue per relative standardised effort

In this study we expect that the average revenue per relative standardised effort for each vessel in this study is homogenous. The result is developed from conducting regression analysis of the average revenue per relative standardised effort with respect to relative standardised effort and performed T test for its horizontal shape. The estimated model of the average revenue per relative standardised effort is $\ln y = \beta_1 + \beta_2 \ln E$, in which y represents average revenue per relative standardised effort and E is relative standardised effort.

Chapter 5 DATA

5.1. The method of collecting data

Based on a survey of cost and earnings as well as the technical and operating characteristics of Khanh Hoa's fishing fleets, the author collected data for this study. The questionnaire is designed by Prof. Ola Flaaten, Assoc. Prof. Dr. Kim Anh Thi Nguyen, and other enumerators. This questionnaire was applied for some studies on the cost and earning of the fishery in Vietnam during the last period (see for example, Kim Anh at al., 2006). Before undertaking the survey, the author was also trained to ensure the quality of the data set collected. All data was collected during mid -August through October in 2009 in Nha Trang City (97.17% of 107 offshore longline concentrate on this city (Khanh Hoa Fishery Ministry, 2009). This period is seen as the transition between the 2008 fish harvest crop and the new crop in 2009. The author conducted face to face interviews with fishing households to collect data about the cost and earnings in 2008 as well as technical and operational characteristics of offshore longliners through using the standardised questionnaire form (Appendix A). Respondents are often vessel owner and/or his wife.

Data collected include technical characteristics of offshore longliners, the number of trips in the main season and sub-season, the number of fishing days per trip, fixed costs and variable costs. According to the statistics of Khanh Hoa Fishery Department, there were 107 tuna long liners registered for offshore fishing activities. 42 samples were selected randomly. However, 5 samples were removed from this data set because of the lack of information. Hull length was selected as the key criteria to determine the sample representativeness (see Appendix B, table 11). In Table 11, application of T-Test statistics for sample representativeness tests is performed and the results show that the sample size of 37 offshore longline vessels as in this case is considered representative for Khanh Hoa's offshore longline population because T-test=1.0269< $t_{(0.025,36)} = 2.0281$. Hence, 37 observations in this study can be used as the reliable proxy for the whole population.

5.2. Descriptive statistics of variables

Table 3: Descriptive statistics of 37 longliners in 2008.

Criteria	Mean	S.D	Min	Max
Engine (hp)	126.081	45.478	60.000	320.000
Length(m)	15.324	0.770	14.000	17.500
Number of fishing days (days)	99.568	31.567	52.000	178.000
Gross revenue	845.123	152.277	500.000	1,200.000
Subsidy	29.784	0.917	26.000	30.000
Variable costs	460.714	166.614	219.000	993.012
Maintance and repair costs	29.268	13.488	0.000	55.000
Insurance cost	2.517	1.610	0.336	5.000
Labor cost	192.205	54.779	103.494	377.975
Drepreciation	51.039	19.050	14.343	95.121
Loan interest payment	13.849	11.876	1.050	43.200
Calculated interest on owner's capital	32.168	19.191	3.849	81.705
The calculated value of total assets	396.920	230.606	42.765	910.462

Unit of measurement: million VND

Source: Own data and calculation

In 2008, there were about 107 offshore longliners in Khanh Hoa Province. Table 3 presents a summary of economic and technical data for 37 surveyed longliners. We can see that hull length for the sample longline fleet ranged from 14m to 17.5m, with an average length of about 15.324m. Engine capacity varied from 60 to 320 hp, with the mean of 126.081 hp. The number of fishing days also ranged from 52 days to 178 days, with an average number of 99.568 days. Furthermore, table 3 shows the economic performance of an average longliner through some key indicators including gross revenue, subsidies, operation costs (variable costs, maintain, repair and insurance costs), labor cost, and capital cost (depreciation, loan interest payment and calculated interest on owner's capital) in 2008. Annual gross revenue of the vessel varied from 500 million to 1,200 million VND, with an average of 845.123 million VND. The average subsidy per each longliner was 29.784 million VND with a range from 26 million to 30 million VND. Variable costs also varied greatly from 219.000 to 993.012 million VND, with an average of 460.714 million VND. The average repair and maintainance costs was 29.268 million VND, with a range from 0 million to 55 million VND. The average depreciation of vessels under survey also varied from 13.617 million to 85.121 million VND, with an average amount of about 46.246 million VND. Furthermore, average loan interest was 13.849 million, with a range from 1.050 million to 43.200 million VND. Finally, calculated interest on owner's capital and the calculated value of total assets for an average sample vessel were 32.168 million VND (with a range from 3.849 million to 81.705 million VND) and 396.920 million VND (from 42.765 million to 910.462 million VND) respectively.

In addition, table 4 shows the sample vessel groups categorized based on engine capacity (hp). These three vessel groups are quite heterogeneous in terms of technical and operational characteristics such as hull length, horse power and number of fishing days. With the engine capacity of less than 90 hp, the average length of this vessel group was 14.52 m; and the average fishing days of 104.6 days per year. Except the number of fishing days, in average, the other performance indicators for the vessel group with the engine capacity from 90 to 150 hp were higher than those of the vessel group with the engine capacity of less than 90 hp. The last group had a mean vessel length of 15.733 m and the number of fishing days of this group is higher than that of fishing fleet with the engine capacity ranging from 90 to 150 hp but smaller than that of vessel with group with less than 90 hp.

Table 4 also describes the average economic variables for each of the three vessel groups. Gross revenues of these three vessel groups, ranging from the smallest to the largest engine capacity, were 702.140 million, 835.522 million and 981.543 million VND respectively. In 2008, the Vietnamese government decided to subsidize a fuel (quasi-lump sum subsidy) for vessel owners due to an increase in the fuel prices. The levels of subsidies depend on the engine capacity. For the costs, except the maintenance and repair costs, vessels with the engine capacity of larger than 150 hp had the largest costs. Some significant breakdowns are variable cost of 516.209 million VND, labor cost of 232.667 million VND, and depreciation cost of 62.457 million VND. Finally, the calculated value of total assets (including the vessel and equipment) were 170.630 million VND for vessel group with the engine capacity of less than 90 hp, 370.790 million VND for intermediate group with the engine capacity ranging from 90 hp to 150 hp, and 651.870 million VND for the last group.

Table 4: Descriptive statistics of three vessel groups in 2008

Offshore longliners (engine power (hp))						
	$hp < 90$		$90 \leq hp \leq 150$		$hp > 150$	
	(n = 5)		(n = 25)		(n = 7)	
Criteria	Mean	S.D	Mean	S.D	Mean	S.D
Engine (hp)	68	8.367	120	17.26	189.29	59.542
Length(m)	14.52	0.356	15.208	0.545	16.314	0.736
Number of fishing days (days)	104.6	34.825	98.72	30.804	99	36.747
Gross revenue	702.140	134.54	835.522	134.7	981.543	123.91
Subsidy	26.000	0.000	30.000	0.000	30.000	0.000
Variable costs	379.830	103.47	461.352	160.88	516.209	216.45
Maintenance and repair	31.500	10.755	30.882	12.324	24.072	17.707
Insurance	1.489	1.482	2.713	1.472	2.554	2.092
Labor cost	161.155	40.527	187.085	43.043	232.667	81.707
Drepreciation	40.677	7.195	49.915	19.978	62.457	17.307
Loan interest payment	20.000	0.000	5.885	4.553	22.176	13.064
Calculated interest on owner's capital	11.756	3.914	32.179	19.357	44.525	13.189
Calculated value of total assets	170.630	67.498	370.790	270.020	651.870	152.520

Unit of measurement: million VND

Source: Own data and calculation

Chapter 6 EMPIRICAL RESULTS

6.1. Economic performance indicators

Table 5 shows that some key important economic indicators in 2008 for an average longliner, including gross value added, gross cash flow and profit, are positive. In addition, all of these economic performance indicators are compared between two scenarios: without and with government subsidies. This difference between these two scenarios is determined by the amount of money that each vessel owner received from the Vietnamese government in 2008, with a mean subsidy of 29.748 million VND. We can see that the average gross value added for a vessel remained at an average of 352.624 million VND while gross value added including subsidy has an average of 382.372 million VND. Besides, the average gross cash flow of the longliner was 160.419 million VND. Including subsidies, the average gross cash flow of the longliner increased to 190.167 million VND. Profits are also markedly different in two scenarios: with 63.363 million VND without subsidies and 93.111 million VND with subsidies in 2008. Furthermore, table 5 presents key economic ratios such as a profit margin and return on investment. In 2008, profit margin was 7.5% and it increased to 10.6% including direct subsidies. Excluding fuel subsidies, return on investment was 16.0% and this figure reached to 23.46% if subsidies are taken into considerations. Consequently, the vessel owner of an average longline performer is not only capable of covering all of costs, but also has a significant reward for the operating year.

Table 5 also shows the labor cost was, on average, about 192.205 million VND, equivalent to the average annual crew share of more than 21.228 million VND in 2008. An average number of labors in a longliner is 8-10 labors. Thus the average crew share per month was about 1.8 million VND.

Table 5: Economic performance indicators of 37 offshore longliners in 2008

Gross revenue:	845.123		
Subsidy (S):	29.748		
Gross Revenue	845.123	Gross Revenue + S	874.871
Operating costs:	492.499		
Gross Value Added	352.624	Gross Value Added + S	382.372
Labor cost	192.205		
Gross Cash Flow	160.419	Gross Cash Flow + S	190.167
Drepreciation	51.039		
Loan interest payment	13.849		
Calculated interest on owner's capital	32.168		
Profit	63.363	Profit + S	93.111
Profit margin	7.5%	Profit margin	10.6%
Return on investment (ROI)	16.0%	Return on investment (ROI_s)	23.46%

Unit of measurement: million VND

Source: Own data and calculation

In addition, table 6 provides a comparison of some important economic performance indicators between three longline groups which are categorized according to engine capacity. We can see that the vessel group with engine capacity of less than 90 hp has a average gross cash flow of 128.026 million VND, translating into a profit of 55.593 million VND, profit margin of 7.9%, and return on investment of 32.6%. Direct support from government helps these two economic indicators of an average vessel in this group increased by 26 million VND, with profit margin and return on investment also going up to 11.2% and 47.9%

respectively. The results also show that without direct subsidies, an average vessel in a group with an engine size ranging from 90 hp to 140 hp has an average gross cash flow of 153.490 million VND and profit of 64.899 million VND, corresponding to a profit margin of 7.8% and return on investment of 17.5%. Thanks to government quasi - lump sum fuel subsidies, an average gross cash flow was 183.490 million VND and profit was 94.899 million VND - equivalent to a profit margin of 11 % and 25.6%. Moreover, an average gross cash flow and profit of the last vessel group were 206.041 million VND and 76.883 million VND respectively. Excluding subsidies, profit margin was 7.8% and return on investment was 11%. With subsidies, these two ratios reached 10.6% and 16.4%. Overall, we can summarize that vessel group with the engine capacity of larger than 150 hp gets the highest gross cash flow and profit but its profit margin and its return on investment are the lowest.

These positive results shed some lights over the fishery under open access. First, the offshore tuna-longline fishery is inherently risky because of distance and weather. This can imply that the more risk fishermen have, the more income they may get. Second, due to high capital investment and operational expenses incurred, there are few fishermen who can afford shifting to offshore tuna longline operations. Third, the total amount of catch and fish market prices in 2008 is higher than in the previous years. Four, vessel owners receive additional support from the government. Finally, the positive profit of an average longliner may also be explained by the theory of the fishing vessel economics in open access fishery. It means that in a group of heterogeneous vessels, the profit is generated by vessels that are the cost efficiency (called them intra-marginal vessels) than the marginal vessel that breaks even or extra-marginal vessels that performed poorly in economic terms (this final explanation will be demonstrated in the section 6.4).

Table 6: Economic performance indicators of three vessel groups in 2008

Offshore longliners (engine (hp))					
$hp < 90$		$90 \le hp \le 150$		$hp > 150$	
Gross revenue 702.140		Gross revenue 835.522		Gross revenue 981.543	
Subsidy (S) 26.000		Subsidy (S) 30.000		Subsidy (S) 30.000	
Gross revenue 702.140	Gross revenue + S 728.140	Gross revenue 835.522	Gross revenue + S 865.522	Gross revenue 981.543	Gross revenue + S 1011.543
Operating costs 412.819		Operating costs 494.947		Operating costs 542.835	
Gross value added 289.181	Gross value added +S 315.321	Gross value added 340.575	Gross value added +S 370.575	Gross value added 438.708	Gross value added +S 468.708
Labor cost 161.155		Labor cost 187.085		Labor cost 232.667	
Gross Cash Flow 128.026	Gross Cash Flow + S 154.166	Gross cash Flow 153.490	Gross Cash Flow + S 183.490	Gross Cash Flow 206.041	Gross Cash Flow + S 236.041
Drepreciation 40.677		Drepreciation 49.915		Drepreciation 62.457	
Loan interest 20.000		Loan interest 5.885		Loan interest 22.176	
Calculated interest on owner's capital 11.756		Calculated interest on owner's capital 32.791		Calculated interest on owner's capital 44.525	
Profit 55.593	Profit + S 81.733	Profit 64.899	Profit + S 94.899	Profit 76.883	Profit + S 106.883

Profit margin 7.9%	Profit margin 11.2%	Profit margin 7.8%	Profit margin 11.0%	Profit margin 7.8%	Profit margin 10.6%
Return on investment (ROI) 32.6%	Return on investment (ROI_s) 47.9%	Return on investment (ROI) 17.5%	Return on investment (ROI_s) 25.6%	Return on investment (ROI) 11.8%	Return on investment (ROI_s) 16.4%

Unit of measurement: million VND

Source: Own data and calculation

6.2. Results of Econometric model

6.2.1. Results of Fishing Effort function

By performing regression analysis of the proxy, gross revenue by means of some technical and operational characteristics of the vessels such as hull length (L), horse power (hp) and fishing day (d) as independent variables, we show the result of ordinary least square (OLS) estimation in table 7. According to table 7, we can see that the sign of the estimated coefficients are positive and the coefficients of horse power, length of vessel and fishing days are 0.305, 0.559 and 0.458 respectively. It means that if increasing horse power, length of vessel and fishing days partially by 1%, the fishing effort will go up by 0.305%; 0.559% and 0.458% respectively, with other variables are kept constant. In addition, $\alpha + \beta + \gamma = 0.305 + 0.559 + 0.458 = 1.322 > 1$, at least $\alpha + \beta = 0.864 < 1$. This can indicate that if all hull length of vessel and engine power increased by 1%, the fishing effort will increase by less than 1% (about 0.864%). Moreover, T- value is performed to test that each of these estimated parameters is significantly different from zero at 5%. Furthermore, from F test (Joint test) (F-value =121.267 with P- value = 0.000), the estimated model is significant at the 5% level. Overall, they indicate that horse power, length of vessel and fishing days of Khanh Hoa long line fleet have statistically significant effects on fishing effort.

Table 7: Parameter estimate and test statistics of fishing effort function

	Estimated coefficient	T-value	P-value
α_0	8.562	16.173	0.000
α	0.305	9.149	0.000
β	0.559	2.461	0.019
γ	0.458	13.803	0.000
R^2	0.917		
F	121.267		0.000

Source: Own data and calculation

R^2= 0.9168 shows that 91.68% of the variation in fishing effort is explained by the variance in horse power, by the variance in length of vessel and by fishing days.

Some various tests for errors are performed in this case: Jarque-Bera test for the normality of errors, Ramsey-Reset test for error specification and White test for the heteroscedasticity of the errors (shown in table 8).

Table 8: Some tests for Errors

Some tests	Test statistics	P-value
1. Test for Normality (Jarque –Bera (JB) test)	0.172	0.918
2. Test for Error specification (Ramsey- Reset test)	2.995	0.065
3. Test for Heterocedasticity (White test)	0.444	0.844

Source: Own data and calculation

As can be revealed from the table 8, Jarque –Bera (JB) test is performed to test the normality. We can see that JB-value is equal to 0.172, equivalent to P-value of 0.918. This probability value is much larger than 5%. Thus we can accept the hypothesis that the errors are distributed normally. Test for error specification is also performed by using Ramsey-Reset test, with a test statistics of 2.995 and P-value of 0.065. Thus this may conclude that the model do not have error specification when P-value is larger than 5%. Finally, White test is performed to test heterocedasticity. We can see that White test value is 0.444, equivalent to P-value of 0.844. This probability is larger than 5%. Therefore we accept the hypothesis that error variances are homogenous.

Table 9: The correlations between the independent variables.

	L	HP	FD
L	1.000	0.413	0.265
HP	0.413	1.000	-0.091
FD	0.265	-0.091	1.000

Source: Own data and calculation

In addition, table 9 represents the correlation between the independent variables. The partial correlations of hull length with horse power (HP) and fishing days are 0.413 and 0.265 respectively. The correlation of horse power and fishing days is -0.091. We can see that the correlation of horse power and fishing days is the highest. This may indicate the nearly collinearity between them. However, when the model is estimated, the results of the regression parameters such as the sign of estimated coefficients and value of the estimated coefficients are in sync with our expectations. T-test and F-test are also performed to test a significance of a single coefficient and the overall significance of the model, respectively. The results show that all variables are significantly at the 5% level and the estimated relationship is a significant one. Thus this can indicate that the estimated coefficients are statistically significant. Therefore, we may reject the multicollinarity in this study (Hoai, 2007). In general, these tests indicate that the estimated models are well specified.

6.2.2. Results of average revenue per relative standardised effort function

In this section, we present the results of the regression analysis of average revenue per relative standardized effort by means of the relative standardised effort for Khanh Hoa' longliners in 2008 (shown in table 10). The econometric software used is EVIEWS 4.0 (Hoai, 2006). Ordinary Least Squares (OLS) method is used to estimate regression parameters.

Table 10: Parameter estimate and test statistics of average revenue per relative standardised effort function

	Estimated coefficient	T-value	P-value
β_1	13.646	1,537.716	0.000
β_2	0.000	0.000	0.999
R^2	0.000		
F	0.000		0.999

Source: Own data and calculation

According to the table 10, T-test is performed to test the hypothesis whether there is a linear relationship between the average revenue per relative standardised effort and relative standardised effort or not. With T -test of 0.000 and P-value of 0.999, this probability is much higher than 5% so that we allow the hypothesis that relative standardised effort does not affect the average revenue per relative standardised effort. In addition, T-test is also performed to test whether the intercept of this model is significantly different from zero. We also can see that T-value is 1,537.716 and P-value is 0.000. This may indicate that the intercept of this model is significantly different from zero at the 5% level or higher. Overall, the average revenue per relative standardised effort for all vessels is homogenous and it is shown by the graph below

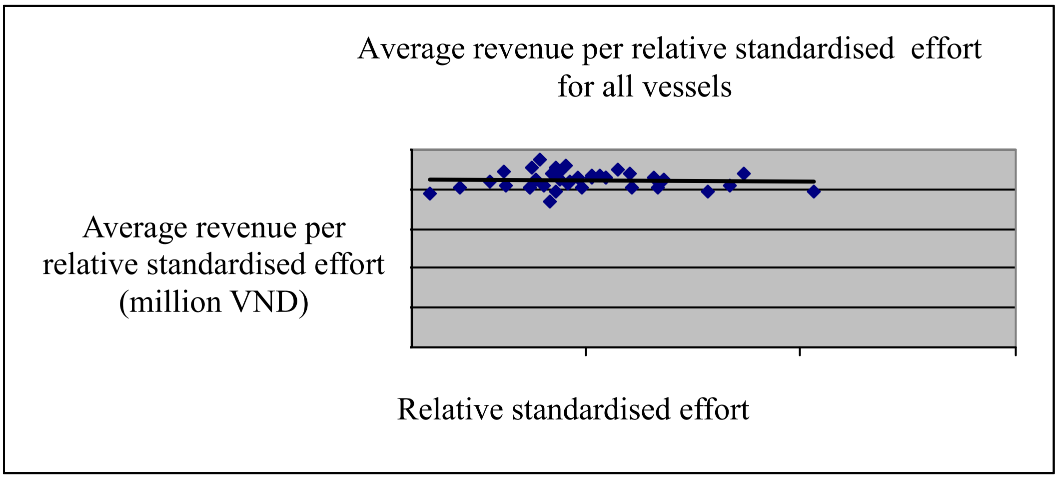

Figure 5: Graph of average revenue per relative standardised effort

6.3. The cost efficient vessels

After estimating the fishing effort function, we can calculate relative standardised efforts for each vessel. In this section, we will examine which vessel will have the lowest cost. This is derived from dividing the total cost of each vessel by relative standardised efforts of each vessel. After that, we show a Salter diagram with the relative standardised effort along the horizontal axis and the average cost per relative standardised effort unit along the vertical axis. In this study, total costs include operating costs, labor costs and capital costs of each vessel in 2008.

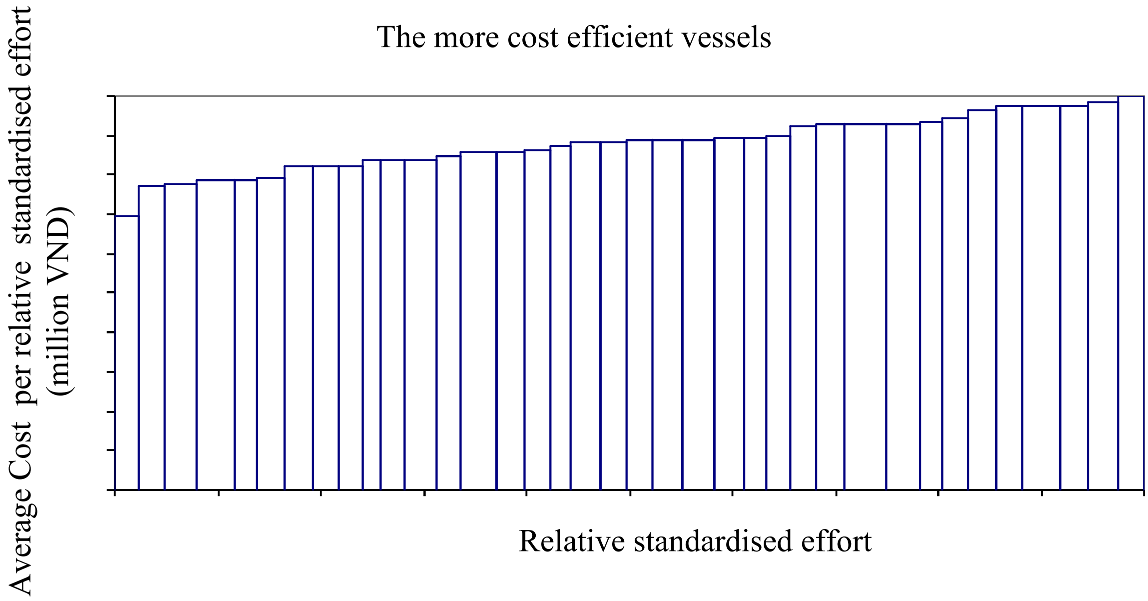

Figure 6: Graph of the more cost efficient vessels (Salter Diagram)

The figure 6 shows the research findings for 37 vessels. The average cost per relative standardised effort of each vessel is plotted against the relative standardised effort level of each vessel. The average cost per relative standardised effort is sorted based on cost efficiency, from the highest to the lowest levels. We can choose vessel 15 as the standard vessel against which the effort of the others are measured. The width of the columns represents the relative standardised effort of each longliner. Since the width of each vessel bar in the figure 6 illustrates the relative standardised effort of each vessel, we notice that for example vessel 4 produces 1.34 times as much effort as the standard vessel 15 but cost efficiency of the latter is less than the former. In addition, we may see that the average cost per relative standardised effort of vessel 15 is higher than that of vessel 7 even though this vessel produces as much efforts as the standard vessel 15. Figure 6 also presents that vessel 1 has highest cost efficiency and vessel 37 has the lowest cost efficiency.

Based on the average cost per relative standardised effort for 37 vessels of this sample calculated above, we can divide them into three vessel groups which are categorized according to an engine size and then calculating the average cost per relative standardised effort for an average longliner of each vessel group. This will help us to know what vessel group gets the most cost efficiency. This is explained by the figure 7. According to figure 7, we can see that vessel group with an engine size less than 90 hp has the most cost efficiency while the vessel group with an engine size larger than 150 hp has the least cost efficiency.

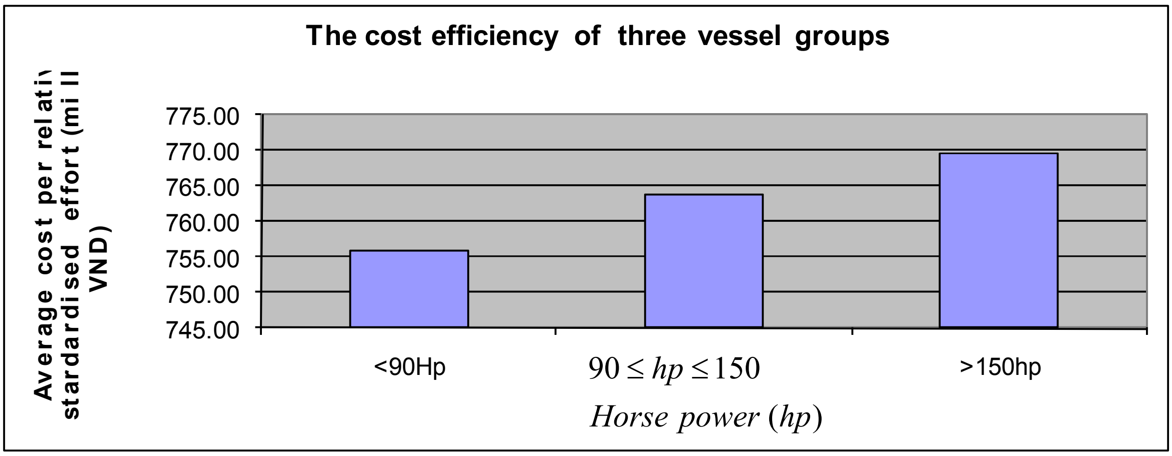

Figure 7: The cost efficiency among three vessel groups

6.4. The profit under open access regime

A combination between the average cost per relative standardised effort and average revenue per relative standardised effort of each vessel will help us to explain more clearly why the profit is still generated in the open access fishery (shown in figure 7). Figure 7 represents the average revenue per relative standardised effort and average cost per relative standardised effort corresponding to each vessel along the vertical axis and number of vessels along the horizontal axis. We can see that any vessel has the average cost below the average revenue, they get the profit and vice versa. Apart from vessel 25 and vessel 28, the profit of the fishery in 2008 is generated by the remaining vessels. Vessel 25 and vessel 28 that made economic losses are termed extra-marginal while the remaining vessels that earn economic profits are intra-marginal (Coglan at al., 1999).

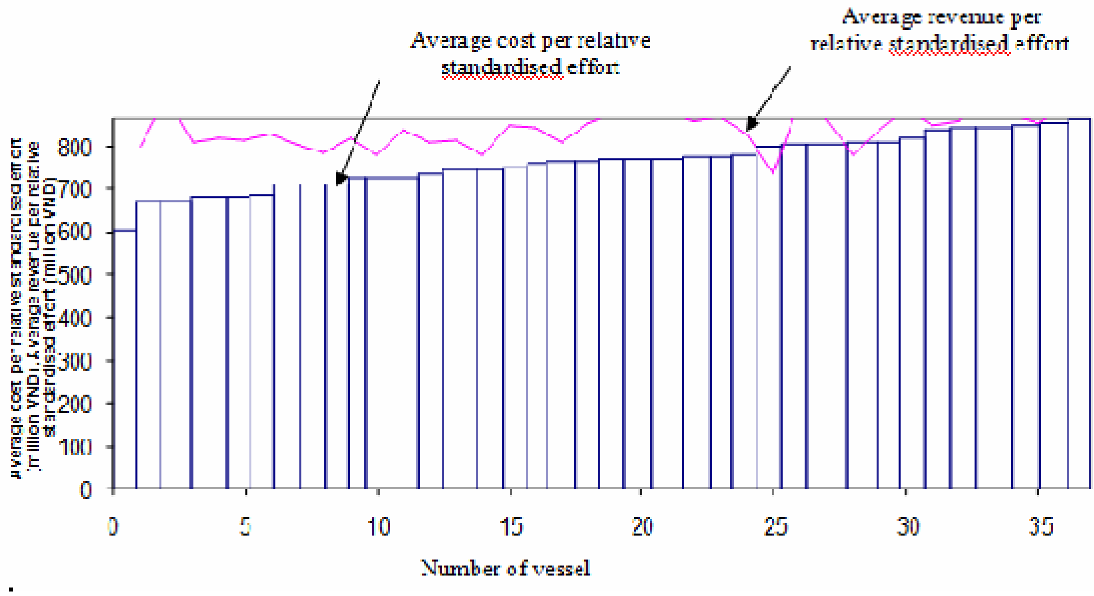

Figure 8: The estimated profit of 37 vessels.

Chapter 7 DISCUSSION

In 2008, profit margin without and with subsidy of an average longliner are 7.5% and 10.6% respectively. Compared to a profit margin of average longliner in 2004 (12.1%) (Long at al., 2008), both these figures are lower. Thus this may imply that Khanh Hoa offshore longline fishery in 2008 was less economically efficient than in 2004. However, an average crew share per month was about 1.8 million VND. Compared to the average income of a labor working for gill net fishery in 2008 (average income per labor of over 17 million VND per year, equivalent to about 1.5 million VND per month (Duy at al., 2010), we can see that the labor income in offshore longline fishery is higher than that in other fisheries. These interesting results, in the light of open access offshore fishery, may be explained by five reasons: the risky fishery, high operating expenses and capital investment, high demand for tuna, direct subsidies and the cost efficient vessels. This indicates that the Khanh Hoa's offshore longline fishery with tuna may continue expanding as well as attract the additional private investments in the near future.

During the last periods, due to an increase in fuel prices, the government supported an amount of cash for vessel owners. There is no doubt that subsidies can lead to an economically inefficient industry and an increase in the probability that fish stocks will be exploited beyond their biological limit (Sumaila at al., 2007). However, they do maintain employment in the fisheries sector and prevent the collapse of fishing communities. For that reason, given the negative side effects, government still decided to selectively subsidize the sector. In this case, subsidies may be considered acceptable if judged from the light of preserving biodiversity in the coastal areas. This is because offshore long line fishery targets catches in the EEZ of Vietnam and in international waters, which help to ease pressures on the coastal areas. According to Long at al., 2008, the offshore catch of the national fishing fleet within its EEZ is estimated at 0.6 million metric tonnes but the maximum sustainable yield is 1.1 million metric tonnes (FAO, 2005). Therefore, it can be concluded that at the moment, subsidies do not collapse stock balance in this offshore long line fishery. Hence, if the management system allows the additional effort to enter this fishery, as under open-access, the policy aim of improving the income and profitability of the fishing industry by use of financial transfers can be achieved only in the short-term (Flaaten at al., 2010). If this assistance is going to sustain without gradual phasing out, the wrong incentives from subsidies can lead to the depletion of the offshore fish stock in the long run (Flaaten at al., 2000 and Steenblik at al., 2007), and this type of subsidies are obviously put under the red flag. Hence, whether it is necessary for direct subsidies, such as cheap loans, fuel subsidy for offshore longliners, is really a question for policy –makers in Vietnam.

Surprisingly, these empirical results have shown that the lowest ROI is for the biggest hp vessels while the highest ROI is for the vessel group of lowest hp. This can be explained as follows: it can be seen from table 6 that the repair and maintance cost of this vessel group is lowest while this kind of cost for the smallest hp vessels is highest. This can indicate that almost all of the vessels with a largest engine size are relatively new. The investment into the fishing business can be originated from some vessel owners made profit for the operating years, cheap offshore project loans from the government and fishermen working in other fisheries before access to fish at offshore grounds under a survey of 37 samples in Khanh Hoa Province. However, these big investments in the large vessel are insufficient because some of them, especially fishermen with few years of fishing experience have just entered this fishery, are not equipped with enough information on offshore resources and advanced fishing technologies. This can cause them to have lower fishing efficiency. In addition, because of seasonal effects, some largest-size longliners may not fish in certain months if their trip revenue does not cover variable costs or some other large vessels still catch tuna or other fish in the sub season but most of them incurred an economic loss while the small vessels may change to fishing squid or still operate longline owing to lower trip variable costs. Further, due to the limitation of vessel owners'finance, some fishers were capable to invest into the small vessels. All of vessels were purchased in the mid-1990s and utilized up to now but fishermen usually improve both vessel and equipments during the fishing operations along with many experiences in fishing at offshore grounds so that the fishing efficiency of the small vessels is higher. Hence, ROI for the vessel group with an engine size of less than 90 hp is highest while ROI for the vessel group with an engine size of larger than 150 hp is lowest.

Overall, fishing capacity is larger. This leads to higher amount of fishing efforts and higher cost per relative standardised effort, as can be revealed from figure 6 and figure 7. It makes sense in the context of Vietnam's offshore fishery. All expenses for offshore fishing remain high. This may originate from some main reasons: first, tuna, which are dominantly distributed in offshore grounds, has high economic values. To target this specific species, thus, fishermen have to invest high amount of capital into purchasing large vessel and modern fishing equipment. This investment depends on fishermen' affordability. Big vessels with large engine capacity often operate in the EZZ of Vietnam and in international sea waters where tuna resources are abundant. In addition, the fishing time for a trip is long, about 20-25 days, so expenses incurred for a fishing trip will be high for the large vessels. Further, under the impact of seasonal factors, some big boats may not catch in the other season because their trip revenue may not be high enough to offset the trip variable costs. Whether it is better for these vessels to be idle with zero revenue and zero variable costs, than to operate with a negative result, which is an interesting question to vessel owners who earn a livelihood by fishing. Any way, they also have to suffer some fixed costs such as interest, depreciation and others from fishing business. For these reasons, the cost per relative standardised effort may be high for large boats.

The vessel operation considers stock level as constant, not affected by vessel's activities. This also applies to the market price of fish - seen from a vessel operator's point of view - the market price is considered unaffected by the landings of each vessel. Hence, average revenue per relative standardised effort unit for all vessels is the same and it has the horizontal shape in this case. Although the horizontal shape of this curve is tested (T test), we can see that the distributions of average revenue per relative standardised effort for all vessels of this sample are nearly homogeneous. This is due to ignoring other independent variables that we do not include in the estimated function of fishing efforts. R square of this model is 0.9168. It means that 8.32% of the variation in fishing effort is left unexplained and is due to variations in the error term or to variations in other variables that implicitly form part of the error term. Therefore, in future research, we need to add more independent variables such as the socio-economic characteristics of fishermen to calculate the average revenue per relative standardised effort with a perfectly horizontal shape. Overall, results of this curve should be adapted to the theory of the economic vessel behavior (Flaaten, 2010).

CONCLUSION

The study has been evaluated and measured the economic efficiency of the offshore long line fleets for tuna in Khanh Hoa Province, Vietnam through assessing and measuring the economic performance indicators and the cost efficient vessels based on the costs and earnings data collected in 2008. In general, the fishery in 2008 gets the relatively high economical efficiency. This may be explained by five reasons: the risky fishery, high operating expenses and capital investment, high demand for Tuna, direct subsidies and the cost efficient vessels.

By analysing the cost efficient vessels, difference in vessels' relative standardised fishing demonstrates vessels' cost efficiency is heterogeneous (given the same average revenue of relative standardised effort). In a sample of thirty-seven vessels, 35 owners have been made a positive profit, while 2 owners earned an economic loss. This provides interesting evidence why profit for an average longliner is still generated in open access fisheries in 2008.

This study has also been investigated that the vessel group with the largest engine capacity has the lowest cost efficiency while the smallest horse power (hp) vessel get the highest cost efficiency and return on investment (ROI). The main reasons for this are that the capital investment in the largest vessel is large but the ability of some fishers to capture on offshore grounds is limited and the impact of the seasonal factor also lead to the cost inefficiency of the largest hp vessels.

The policy implication of findings in this thesis is that government should give support that does not contribute to capacity and effort expansion, however, such as training fishermen to use the modern fishing equipments, providing information about the offshore resources, fishing grounds, the weather forecast and rescue and life-saving activities in high seas may be good for this fishery. In addition, this study also suggests that government should make the policy to help the fishers in this fishery to earn money from other jobs instead of fishing activity in the sub-season.

Although this study finds the interesting results as well as the surprising results along with the explanations under an survey of offshore longliners in Khanh Hoa Province with 37 samples, further work is recommended to collect more data to create time series data, include more socio-economic factors relevant to fishermen and use other stronger methods for in depth analysis of economic efficiency such as DEA (Data Envelopment Analysis), SFPF (Stochastic Frontier Production Function) to give the better suggestions for policy-maker, fishermen and other industry stakeholders.

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APPENDIX A

ANNUAL SURVEY ON FISHING VESSELS IN KHANH HOA PROVINCE, VIETNAM

(OFFSHORE LONGLINE FISHERY)

I. General information

1. Data of year:...................... the period of data from.....to....

2. Time of survey: Date............month...........year.................

3. Main fishery...Other......................................

4. Name of interviewee:...

5. Phone number of interviewee:..

II. Information about vessel

1. Registered vessel number ....   2. Vessel owner' name..   3.Address..Telephone.................   4. Length (m):..   5. Year of building vessel............................if owner does not know, please stick here   6. Engine power (HP):...

III. Information about labor

Skipper	Crew (including skipper)
1. Skipper information a. Does vessel owner rent a skipper? Yes/ No b. Skipper educational level:................................. c. Skipper age:... d. Skipper experience.. e. Skipper vocational training time (days):.................... f. Does skipper come from traditional household?	2. Average crew size (persons) 3. Income/person/trip (1000 VND) a. In main season.................... b. In sub season......................

IV. Information about the quantities of catch, season, fishing grounds and weather

	Main season	Sub season
1. Number of trips		
2. Average quantities of catch per trip	_	_
a. Tuna (kg)		
b. Other fish(kg)		
c. Fried squid(kg)		
d. Fresh squid(kg)		
e. Other (kg)		
3. Average number of days per trip (days)		
4. Number of operating months (months)		
5. Fishing grounds		
6. Special weather? (Storm)		

V. Capital items

	Year of purchase	Unit in terms of Value			Purchase (new/old)	Life span
		Purchase price (1000VND or gold)	Current price	Price if buy a new one		
1. Hull						
2. Main engine						
3. Auxiliary engine						
4. Mechanic equipment		-			-	-
a. Winch						
b. Lighting						
c. Squid lighting						
d. Other equipment						
4. Electronic equipments		-			-	-
a. GPS echo sounder						
b. Compass						

c. Short range radio						
d. Long range radio						
5. Fishing equipment		-			-	-
a. flying fish net						
b. Longliners						
c. Hooks		-				
6. Freezing equipment						

VI. Repair annual cost

	Costs (1000 VND)
1. Hull	
2. Main engine power	
3. Fishing equipments	
4. Others	
5. Total	

VII. Improvement cost (larger than 1 year)

	Last year of improvement	Costs (1000 VND)	Duration (years)
1. Hull			
2.Main engine			
3. Fishing equipment			
4. Others			
5. Total			

VIII. Insurance

	Costs (1000 VND)
Insurance	

IX. Loan

	Debt at the end of year (1000VND)	Interest payment	
		Interest payment per year (1000VND)	Interest rate per month (%)
1. Bank loan			
2. Private loan			
3.Project loan			

X. Variable costs per trip

	Main season		Sub season	
	Quantity	Value (1000 VND)	Quantity	Value (1000 VND)
1. Fuel				
2. Lubricant				
3. Ice				
4. Bait				
5. Provision				
6. Others				
Total				

XI. Average revenue (1000 VND) and crew share (%)

	Main season	Sub season
1. Total revenue for all (1000 VND)		
2. Average revenue per trip (1000 VND)		
3. Percentage earnings to labors after deducting variable costs per trip (%)		

4. Average price per year (1000 VND/kg)	-
a. Tuna	
b. Fried squid	
c. Fresh squid	
d. Others	

XIII. Comments from interviewer

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APPENDIX B

*** Sample representative**

Table 11: Sample representative

Variable	Sample			Mean of the population	T-Test statistics
	N	Mean	S.D		
Hull length	37	15.32	0.770	15.19	1.0269

Hull length was chosen to test for the representative of this sample. Application of T-Test statistics for sample representativeness tests is performed. Selecting the level of the significance of the test is $\alpha = 5\%$, then the critical values of t distribution for this two tail test are 2.5 percentile $t_{(0.025,36)} = 2.0281$. We can allow the hypothesis that average hull length of this sample may represent for the average hull length of population because T-test=1.0269< $t_{(0.025,36)} = 2.0281$

APPENDIX C

Table 12a: The data set for this study

No	Engine Power	Hull Length	Fishing days (days)	Gross revenue (million VND)	Subsidy (million VND)	Variable costs (million VND)	Maintance and Repair costs (million VND)	Insurance (million VND)	labor cost (million VND)	Depreciation (million VND)	Loan interest (million VND)	Calculated interest on owner's capital (million VND)	Calculated value of total assests (million VND)
1	90	15	90	700.00	30.00	250.25	20.00	2.16	224.88	14.34	0.00	14.20	157.77
2	120	15	91	873.60	30.00	311.90	24.00	2.65	280.85	17.63	0.00	4.76	52.88
3	160	16	108	950.00	30.00	425.40	3.50	0.38	262.30	54.71	12.00	30.01	533.42
4	320	16	95	1100.00	30.00	344.05	30.00	0.34	377.98	95.12	0.00	67.54	910.46
5	120	15	65	670.00	30.00	271.05	22.50	4.05	199.48	40.89	0.00	23.34	259.37
6	70	14	144	800.00	30.00	353.44	30.00	0.63	223.28	48.08	0.00	8.66	96.17
7	105	15	108	800.76	26.00	423.30	0.00	3.65	188.73	71.79	3.24	16.73	215.92
8	140	15	78	734.00	30.00	351.90	0.00	3.65	191.05	68.66	0.00	50.55	591.68
9	140	14	78	738.92	30.00	339.67	11.00	0.38	199.62	50.18	0.00	46.12	512.43
10	80	15	52	500.00	30.00	219.00	30.00	3.60	140.50	46.20	20.00	6.95	277.27
11	105	16	78	750.00	30.00	338.40	50.00	3.65	205.80	42.76	0.00	3.85	42.76

12	120	15	126	900.20	30.00	497.00	0.00	0.38	201.60	60.99	0.00	48.80	552.25
13	120	16	72	709.40	30.00	493.40	0.00	0.38	108.00	20.08	0.00	21.68	240.91
14	120	16	161	1010.57	30.00	710.57	42.00	4.02	150.00	38.58	0.00	13.89	154.33
15	165	16	78	870.00	30.00	417.90	20.00	3.65	226.05	48.94	0.00	43.57	484.13
16	100	15	105	812.00	30.00	431.20	0.00	4.20	190.40	53.44	0.00	45.81	509.03
17	90	15	60	576.00	30.00	233.84	25.00	0.38	171.08	81.25	0.00	27.97	310.73
18	160	17	78	900.00	30.00	444.30	0.00	3.60	227.85	65.36	10.56	55.54	717.16
19	120	16	78	812.00	30.00	414.90	20.00	4.50	198.55	50.74	12.00	9.71	207.92
20	70	15	126	840.00	30.00	497.00	0.00	0.34	171.50	42.87	10.56	15.62	173.61
21	140	16	104	970.00	30.00	501.50	30.00	4.50	234.25	45.28	0.00	26.86	398.46
22	140	15	126	1000.60	30.00	517.60	13.50	3.50	241.50	65.17	0.00	57.53	639.23
23	120	15	105	900.00	30.00	418.11	37.00	2.50	240.95	56.23	2.16	45.88	529.78
24	60	15	96	650.70	30.00	421.05	20.00	0.38	114.83	34.26	0.00	15.43	171.47
25	120	16	80	680.00	30.00	451.60	40.00	3.60	114.20	50.95	1.05	55.67	419.9
26	140	15	78	850.00	30.00	400.50	0.00	3.65	224.75	76.01	0.00	45.46	515.07
27	140	15	90	850.00	30.00	534.30	0.00	0.38	157.85	58.74	0.00	44.67	496.28
28	155	18	178	1200.00	26.00	993.01	35.00	0.42	103.49	41.59	23.52	41.18	597.53

29	100	15	162	1000.00	30.00	670.50	0.00	3.81	164.75	90.64	0.00	30.26	336.23
30	60	15	105	720.00	30.00	408.66	46.00	2.50	155.67	31.97	0.00	12.12	134.61
31	140	15	80	800.00	30.00	470.00	40.00	2.50	165.00	52.39	6.30	37.38	475.35
32	165	16	78	880.80	30.00	487.80	50.00	4.50	196.50	62.42	21.60	31.73	552.54
33	120	15	78	850.00	30.00	449.10	35.00	3.65	200.45	34.31	0.00	37.06	411.75
34	120	17	178	1200.00	30.00	993.01	35.00	0.42	103.49	15.68	0.00	14.11	156.79
35	140	15	105	900.00	30.00	572.60	25.00	2.50	163.70	45.01	0.00	81.70	907.83
36	200	16	78	970.00	30.00	501.00	30.00	5.00	234.50	69.06	43.20	42.11	767.85
37	90	15	92	800.00	30.00	487.60	55.00	2.80	156.20	46.13	0.00	15.77	175.17

Table 12b: The data set for this study

No.	Total cost (million VND)	Standardised fishing effort	Average cost per standardised fishing effort	Average revenue per standardised fishing effort
1	525.83	0.87	604.24	804.60
2	641.79	0.95	672.23	919.58
3	788.30	1.17	674.58	811.97
4	915.03	1.34	684.47	820.90
5	561.31	0.82	685.95	817.07
6	664.09	0.96	690.29	833.33
7	707.44	0.99	713.49	808.85
8	665.81	0.93	714.12	789.25
9	646.97	0.90	715.5	821.02
10	466.25	0.64	727.71	781.25
11	644.46	0.89	727.77	842.70
12	808.77	1.11	729.78	810.99
13	643.54	0.87	736.8	815.40
14	959.06	1.29	746.05	783.39
15	760.11	1.02	748.01	852.94
16	725.05	0.96	751.84	845.83
17	539.52	0.71	760.83	811.27
18	807.21	1.05	770.09	857.14
19	710.40	0.92	770.28	882.61
20	737.89	0.94	773.34	893.62
21	842.39	1.10	773.45	881.82
22	898.80	1.16	773.83	862.59
23	802.83	1.03	776.04	873.79
24	605.95	0.78	776.48	834.23
25	717.07	0.92	782.3	739.13
26	750.37	0.93	804.82	913.98
27	795.94	0.98	808.59	867.35
28	1238.21	1.53	809.38	784.31
29	959.96	1.19	810.02	840.34

30	656.92	0.81	811.04	888.89
31	773.57	0.94	820.14	851.06
32	854.55	1.02	840.96	863.53
33	759.57	0.90	847.53	944.44
34	1161.71	1.37	848.35	875.91
35	890.51	1.05	849.45	857.14
36	924.87	1.08	858.38	898.15
37	763.50	0.88	868.56	909.09