# THE ECONOMIC EFFICIENCY OF A TRAWL FISHERY IN NHA TRANG, KHANH HOA PROVINCE, VIETNAM

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## LIST OF ABBREVIATIONS

| Abbreviation | Explanation |
|---|---|
| AC | Average Cost |
| AR | Average Revenue |
| AVC | Average Variable Cost |
| CPUE | Catch Per Unit Effort |
| DARD | Department of Agriculture and Rural Development |
| DECAFIREP | Department of Capture Fisheries and Resources Protection |
| EEZ | Exclusive Economic Zone |
| GCF | Gross Cash Flow |
| GSO | General Statistical Organization |
| GVA | Gross Value Added |
| Hp | Horsepower |
| NTU | Nha Trang University |
| MC | Marginal Cost |
| MEY | Maximum Economic Yield |
| MPAs | Marine Protected Areas |
| MR | Marginal Revenue |
| MSY | Maximum Sustainable Yield |
| OA | Open-Access |
| RIA3 | Research Institute for Aquaculture No.3 |
| RIMF | Research Institute for Marine Fisheries |
| TC | Total Cost |
| TR | Total Revenue |
| UiT | University of Trumso |
| VC | Variable Cost |
| VND | Vietnamese Dong |

## ABSTRACT

Vietnamese fisheries have long traditional development. They are operating under an open access fisheries regime with small scale, multi-species and multi-fishing gears. The number of fishing vessels, the total engine power and the total yield have been increasing continuously overtime; meanwhile the CPUE (catch per unit effort) have been reducing seriously. Vietnamese fisheries are facing overexploitation and declining resources especially regarding the inshore resources. One of the reasons leading to these problems is trawler operation, especially with onshore bottom trawlers. However, trawlers also account for a huge proportion in the total number vessels and the total catch. Thus, this study focus on evaluating economic efficiency of trawl fleets in Vietnam – the case of trawl fleets in Nha Trang city, Khanh Hoa province. 57 trawlers in Nha Trang, accounting for 13.7% of the total trawlers were investigated on costs and earnings data. The empirical results have shown that the owners of heterogeneous trawlers earn an average profit of 89.4 million VND corresponding to a profit margin of 12.8%. On average, all economic indicators are positive although there are some trawlers showing losses. The medium group ($60 \leq Hp < 90$) is the most efficient group. The gross revenue was chosen as a proxy for fishing effort because of lack of catch information. The regression analysis shows that the numbers of fishing days, the circumference of the trawl mouth and engine power are the most important factors impacting on economic efficiency of Nha Trang trawl fisheries; meanwhile, the number of fishers is insignificant. Salter program application has shown that profit still generated in open access fisheries regime, particularly in the case of trawl fleets in Nha Trang. The study also shows the over investment on particular trawlers in Nha Trang which may lead to economic inefficiency.

**Key words:** Economic efficiency, Nha Trang trawl fisheries, cost and earning, economic performance, standardized fishing effort.

# Chapter 1 INTRODUCTION

Vietnam has many advantages for development in the fisheries sectors, including capture fisheries and aquaculture. It has 3,260 km coastline with over 4,000 islands and several big rivers through the country as well as more than 1 million square kilometer of EEZs (exclusive economic zones). The aquatic resources in Vietnamese water zones are very abundant and include many valuable species. We have found around 11,000 aquatic species distributed in over 20 typical ecosystems. Of which, there are about 6,000 bottom species, over 2,030 fish species with 130 valuable species, 657 plankton, 94 species in mangroves, 225 shrimps, 14 sea grasses, 15 marine snakes, 5 sea turtles, 43 marine birds and 12 other marine animals. The potential catch is estimated to be around 5 million tonnes with a sustainable catch being 1.8 to 2.1 million tones (DECAFIREP, 2010). Besides, almost all the provinces have contributions from the fisheries sectors in their income including marine fisheries and inland fisheries. Of these, 28 coastal provinces from a total of 64 provinces have developed marine fisheries (capture and aquaculture) with 5.2 million people working directly or indirectly on the fisheries sectors. The number of directly fishers is 1.4 million. The remainders work on associated industries such as shipyards, net making, processing, aquaculture, marketing and others logistics services (DECAFIREP, 2010). The fisheries sectors contributed 5.8% of the GDP (gross domestic product) to Vietnamese economy in 2010.

However, the fishery sector in Vietnam is considered to be made up of traditional fisheries with small scale, multi-species and multi-fishing gears. They operate under an open access fisheries regime. The numbers of fishing vessels and the total engine power as well as the total catch have been increasing continuously overtime; meanwhile the CPUE (catch per unit effort) have been declining significantly. Vietnam’s fisheries are facing with over capacity and overexploitation especially regarding the inshore resources (Chien et al., 2009; Pomeroy et al., 2009). Although the Vietnamese Government has set up a number of programs such as offshore fishing encouragements, the creation of MPAs (marine protected areas) and sustainable livelihoods for rural development etc, to improve the fishery management systems. The fisheries management is facing many difficulties and the results do not meet the expectations because of the living standard and educational level and the awareness of the local communities are very low (Chien et al., 2009).

In order to orient toward sustainable fisheries and contribute to the Vietnamese fisheries policy system, some studies related to the economic efficiency (economic performance) of fishing fleets were implemented such as gill net fleets (Kim Anh et al., 2006), offshore tuna long liners (Kim Anh et al., 2007) and long liners (Long et al., 2008). From the economic point of view, these authors used economic indicators to evaluate the key factors effect on gross revenue and income. Simultaneously, based on cost and earnings data, they showed that the large engine power of vessels does not automatically translate into a large profit (Kim Anh et al., 2007). Prior to 2008, Long et al.'s results emphasized this idea; they concluded that over investment may lead to inefficiency as in the case of long liners in the Eastern Sea (Long et al., 2008).

Khanh Hoa fisheries can be strongly represented by Nha Trang because of their long traditional development and the large number of fishing vessels. Nha Trang has nearly 2,000 fishing vessels which accounts for 20% of those in Khanh Hoa. The fisheries sector in Nha Trang is the driver of growth, responsible for 42% of the city's GDP (Kim Anh et al., 2006). Of this, trawl fisheries have contributes a huge catch and revenue. With 416 trawlers, it accounts for 33% of the total trawlers in Khanh Hoa and 21.5% of the total vessels in Nha Trang. Trawlers are ranked third, after gill nets and seine nets relations in Nha Trang. Trawl fleets play an important role in the development of open access fisheries in Nha Trang city, Khanh Hoa province. However, trawlers are a destructive gear type, especially bottom trawlers and "fly-trawlers" (Dong, 2004). In the scope of Khanh Hoa, several studies on economic performance using cost and earnings data have been conducted such as those by Duy et al. (2012) and Kim Anh et al. (2006) on gill net vessels and Kim Anh et al. (2007), Long et al. (2008) and Nga (2009) on offshore long liners. Therefore, a study of the economic efficiency of trawl fleets is necessary in Nha Trang. The following questions should be answered "Are trawl fleets in Nha Trang profitable or not?", "What are the economic indicators of trawl fleets?", "What is the income of the owners and crews in these fleets?", "Do larger engine power of vessels operate more efficiently than smaller vessels engine power?", "Do smaller gear size perform less efficient than the bigger one?" etc.

Three main objectives were set by the author in this thesis. The first is to understand the set of economic efficiency set of trawl fisheries in Nha Trang. An understanding of the economic performance of trawl fleets may be useful for research, managerial purposes and policy making. The second is to ascertain the main determinants that have strong effects on the economic performance of trawlers in Nha Trang. Investigations into the economic performance of trawl fisheries are necessary in order to strike balance between the costs and benefits in order to achieve effective management and sustainable fisheries in the future. The last is to determine which vessel groups attain intra-marginal rent.

# Chapter 2 BACKGROUNDS

## 2.1. Vietnam capture fisheries

The fisheries sector plays an important role in the Vietnamese economy. Million of people in Vietnam depend fully or partly on the country's aquatic resources for food, livelihood and employment. From 1990 up to now (2010), the GDP contribution of fisheries sector to the economy increased continuously by on average 6 – 10% annually. Meanwhile, only 1.2% of the GDP came from fisheries in 1990; this figure in 2000 was 3.4% and reached a peak of 5.8% in 2010. Fisheries contribute around 10% to the national export annually. The total fisheries production of Vietnam increased continuously overtime from 1990 to 2010. From Figure 2.1, we can see that the total fisheries production was the highest at 5,127.6 thousand tonnes in 2010 of which the products from aquaculture accounted for 52.8%. This translated into 145,973.0 million VND in value and the capture fisheries constituted 42.4% of total value. Regarding capture products, almost all come from marine capture 92% in 2010 and the remainder are caught by inland capture (GSO, 2011) (See Appendix 2 for details).

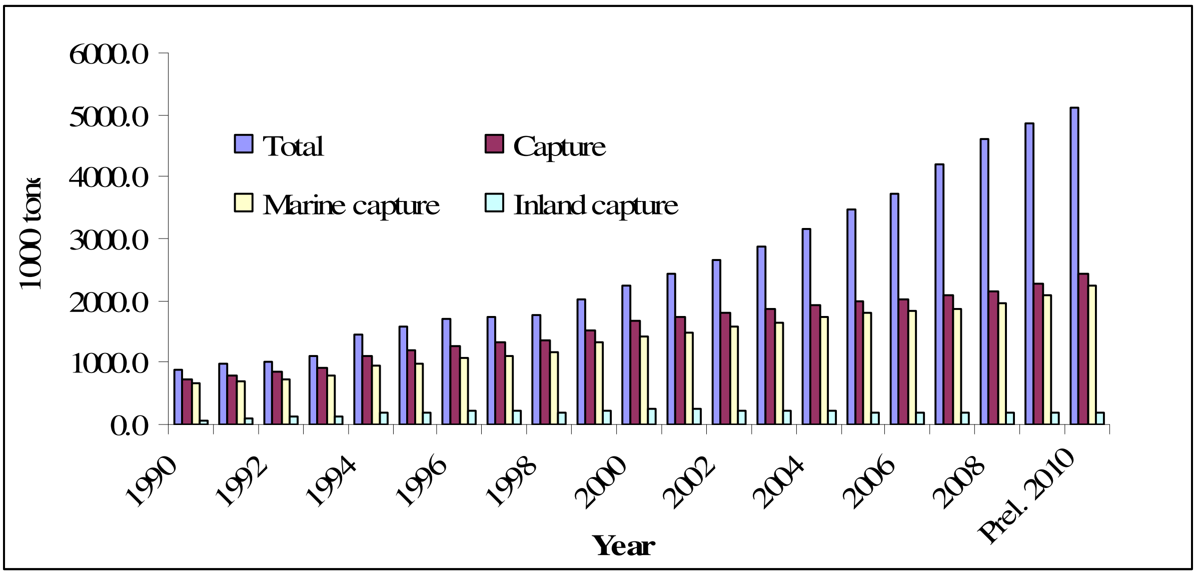



Figure 2.1. Fisheries production in Vietnam during 1990 to 2010

Source: GSO (2011); (unit: thousand tonnes)

Moreover, the numbers of fishing vessels and the total engine power have increased rapidly. In 2000, Vietnam had 84,861 fishing vessels (of which 88.5% was inshore vessels); ten years later, in 2010, there were over 135 thousands fishing vessels (of which 25,346 offshore vessels (GSO, 2011) and 109,966 inshore vessels (Chien et al., 2010)). So, in comparison with 2000, the numbers of vessels and total engine power (in 2010) have increased 0.72 and 0.92 times, respectively. There are around 65 thousands inshore vessels are less than 20 Hp. These vessels have not been managed by provincial fisheries departments since 2008. As Table 2.1 shows, the inshore vessels increased faster than offshore vessels. Especially, after the fuel subsidy in 2008, inshore vessels had increased by nearly 20% and offshore vessels rose by 9% (DECAFIREP, 2010).

**Table 2.1. The fishing fleets and total engine power in Vietnam.**

| Year | Inshore vessels * | Inshore Hp * | Offshore vessels ** | Offshore Hp ** | Total vessels |
|---|---|---|---|---|---|
| 2000 | 75,095 | 3,278.8 | 9,766 | 1,385.1 | 84,861 |
| 2001 | 72,704 | 3,477.1 | 14,326 | 1,613.3 | 87,030 |
| 2002 | 71,175 | 3,786.4 | 15,988 | 1,947.5 | 87,163 |
| 2003 | 71,286 | 4,277.6 | 17,303 | 2,192.9 | 88,589 |
| 2004 | 67,724 | 4,646.1 | 20,071 | 2,641.8 | 87,795 |
| 2005 | 70,041 | 5,161.1 | 20,537 | 2,801.1 | 90,578 |
| 2006 | 71,769 | 5,530.2 | 21,232 | 3,046.9 | 93,001 |
| 2007 | 74,157 | 5,720.1 | 21,552 | 3,051.7 | 95,709 |
| 2008 | 88,087 | 5,942.8 | 22,729 | 3,342.1 | 110,816 |
| 2009 | 108,324 | 7,314.1 | 24,990 | 3,721.7 | 133,314 |
| 2010 | 109,966 | - | 25,346 | 4,498.7 | 129,504 |

Source: * Chien et al. (2010); ** GSO (2011); unit of horse power: thousand Hp

Most fishing vessels are constructed in wood and use the second hand engines. Using an old machine is a method to save invested capital for owners. However, it leads to a short life span and increased annual repair costs. Thus, although the numbers of fishing boats and the total engine power have increased quickly overtime, the CPUE of fishing fleets has decreased. This figure decreased from 0.92 tonnes per Hp in 1981 to 0.82 tonnes per Hp in 1991 and greatly reduces to 0.4 tonnes per Hp in 2005. Now (2010), this indicator is 0.33 tonnes per Hp (DECAFIREP, 2010).

Besides, Vietnamese fisheries are considered to follow a small scale and open access fisheries regime with multi-species and multi-fishing gears and have to face with many problems such as overexploitation, overcapacity, destroyed marine habitats and conflicts with fishing operations (Chien et al., 2009; DECAFIREP, 2010). Moreover, more and more laborers are participating in fisheries sector; meanwhile the natural aquatic resources, especially the inshore resources are being overexploited.

In summary, the fisheries sector plays an important role not only in the economy but also in the life of coastal communities. The fishery productions, number of vessels as well as engine power have increased continuously overtime. Fisheries provided million of local people with employment and contribute a huge proportion of the GDP. However, Vietnam's fisheries are small scale, multi-species; multi-gear types and operates in an open-access fisheries regime. The CPUE is becoming lower and lower. All this is producing a negative effect on the coastal communities. Therefore, sustainable development is very necessary for Vietnam's fisheries.

## 2.2. Marine capture fisheries in Khanh Hoa

Khanh Hoa is a coastal province located in South Central Vietnam. It covers nearly 5,200 km$^2$ area with a coastline of 385 km and more than 200 islands. In 2010, Khanh Hoa had 10,024 fishing vessels with the total engine power of over 328 thousands Hp. The number of offshore vessels was 755, accounting for 7.5%; the remainder were inshore vessels, of which around 50% had less than 20 Hp (Khanh Hoa DECAFIREP, 2010). The total production of fisheries was 93 thousand tonnes, of which the capture fisheries accounted for 73 thousand tonnes or 78.5% of the total (Khanh Hoa DARD, 2009). Khanh Hoa fishery assumes an important position in the local economy, achieving a high growth rate during the 2000 – 2010 periods. This growth has contributed to the overall development of Khanh Hoa's economy and affected positively the socioeconomic conditions of local communities. The fishing gears often used by fishers in Khanh Hoa are gill net, trawl (single or pair trawl), seine net (with or without light), hook and line (hand line and long line and others. The main fishing grounds of Khanh Hoa fisheries are divided into two parts: offshore include the South Eastern Sea, Truong Sa and South of Hoang Sa and inshore includes the Cam Ranh long beach, Nha Trang Bay, Van Phong Bay and Dai Lanh areas (Khanh Hoa DECAFIREP, 2010).

**Table 2.2. The structure of fishing vessels by gears and engine power in Khanh Hoa**

| **No.** | **Fishing gears** | **Engine power** (Hp) | | | | |
|---|---|---|---|---|---|---|
| | | **Under 20** | **20 – 49** | **50 – 89** | **Over 90** | **Total** |
| 1 | Trawl | 350 | 505 | 253 | 132 | **1,240** |
| 2 | Gill net | 2,288 | 467 | 182 | 207 | **3,144** |
| 3 | Seine net | 879 | 707 | 101 | 138 | **1,825** |
| 4 | Long line and hook | 1,315 | 155 | 65 | 160 | **1,695** |
| 5 | Others | 1,519 | 291 | 117 | 107 | **2,034** |
| 6 | Services | 17 | 38 | 20 | 11 | **86** |
| | **Total** | **6,368** | **2,163** | **738** | **755** | **10,024** |

Source: Khanh Hoa DECAFIREP, 2010

## 2.3. Trawl fisheries in Nha Trang.

Besides being an attractive destination for tourists, Nha Trang has a long tradition of fisheries development. With nearly 2,000 registered fishing vessels in 2010, the fisheries sector contributes a huge amount to city's GDP (42%). Many gear types are registered in Nha Trang such as seine net (purse seine with or without light), gill net, trawl, lines and the others. Almost all vessels in Nha Trang operates inshore areas (which have engine power of no more than 90 Hp), accounting for 66.2% of the total vessels. Of these, trawl fishery is one of the most important gear types. In 2010, Nha Trang had 416 registered trawlers (accounting for 21.5% of the total vessels in Nha Trang) is located in Vinh Luong (52%), Vinh Truong (24%) and some other wards along the coast. Trawlers, here, are often equipped engine from 20 to 630 Hp with an average is 100 Hp, a high average engine power in comparison with other gears. The number of offshore trawlers is 157 vessels, equivalent to 37.7% of the total number of trawlers in Nha Trang.

**Table 2.3. The distribution of vessels by fishing gears and engine power in Nha Trang**

| Gears | Trawl | Gill net | Seine net | Line | Services | Others | **Total** |
|---|---|---|---|---|---|---|---|
| 20 – 45 Hp | 133 | 208 | 290 | 176 | 37 | 14 | **858** |
| 46 – 89 Hp | 126 | 79 | 127 | 42 | 41 | 9 | **424** |
| Over 90 Hp | 157 | 191 | 177 | 93 | 30 | 7 | **655** |
| **Total*** | **416** | **478** | **594** | **311** | **108** | **30** | **1,937** |

Source: Khanh Hoa DECAFIREP, 2010; Notes: * The number of vessels with over 20 Hp.

There are many species and sizes in a trawl catch, such as squid, shrimp, crabs, many valuable kinds of fish and trash fish. Thus, the catch was grouped by the author in the questionnaires depending on fish price including big and small squid, marketed fish (fish that will be sold in local markets), shrimp and trash fish. Almost all trawlers in Nha Trang operate in three bays: Nha Trang, Van Phong and Cam Ranh. Only offshore trawlers (over 90 Hp) catch in the South Eastern Sea, from Binh Thuan to Vung Tau. The popular mesh size of trawlers in Nha Trang is 12 to 17 mm. This is very less than regulated mesh size (28 mm). Thus, the scale of trash fish in the trawl catch is very high, from 40 to 70% of the total catch.

Inshore trawlers operate typically for one to three days each trip; bigger vessels often have longer trip of three to five days, or even seven days. The number days at sea depend on the catch; they will come back to the mainland at any time if they have archived a full yield. Therefore, the number of fishing trips fluctuate a lot between vessels depends on engine power, the time of year and their luck. The trawlers often operate intensely from March (the beginning of the Lunar New Year) to September yearly.

## Chapter 3 FISHERIES ECONOMIC THEORIES

### 3.1. Literature reviews

The evaluations of economic efficiency of fishing fleets are very important to vessel owners as well as fisheries managers. By using the economic indicators, these evaluations can provide basis information on operation of fishing fleets about their outcome and economic performance. Fishery managers can base on these to make fisheries policies or build fishery management tools. And, investors also can take a look on that for further investment (Rose at al, 2000). Therefore, the economic efficiency of fisheries has been studied in many nations for many kinds of fishing gears as a method to access their economic performance's fisheries. Before 1990s, there were some studies on profitability and the economic performance of some fisheries industries such as Huvanandana (1973) who estimated the production function for Thai fisheries. He also compared and accessed the costs and earnings of Thai and Chinese purse seine. Until 1978, Domingo (1978) and Baun (1978) were studied on costs and earnings of trawlers and purse seines in the North Coastal of Java. However, their approaches were different. Domingo collected the data in May, 1978 and presumed this month was an average month of the year in catch and operation. Therefore, the revenues and costs could be extrapolated from this. Meanwhile, Baun calculated the costs and revenues mostly based on the secondary data. Also, the different methods for depreciation and the opportunity costs resulted in different valuations. Baun's estimates of the profits of both purse seines and trawlers were much lower than those found in Domingo results, but both of them agreed that the profit of purse seine fishery was higher than that of trawl fishery.

In 1987, Panayotou and Jentanavanich investigated the profitability of the fishing fleets in the Gulf of Thailand. From these studies, the economic indicators were illustrated such as the gross revenue, the fishing costs (the variable cost except the labor cost), the CPUE (catch per unit effort) and the rate of return to capital as well. According to these, the gross profits was equal the revenue subtract the operating costs and the net profit was the gross profit minus the fixed costs. They also concluded from their studies that almost all indicators were positive for an average vessel by type of scale in different regions. However, the gross profits, net profits and the economic rents of some types of fishing gear were negative (Panayotou and Jentanavanich, 1987).

There are more researches related to the economic efficiency of fisheries after 1990s. Flaaten et al. (1995) studied on the economic efficiency of the Norwegian purse seine fleets. They compared the profitability of the purse seine vessels which received the free licenses from the Government and the vessels have to purchase for their licenses with costs and earnings data on 1983 and 1984. And they concluded that those vessels which received the free licenses have significant higher profitability than the other groups because they have highest capital costs.

In 1997, Marcia S. Hamilton and Stephen W. Huffman had studied on costs and earnings of small boat pelagic fisheries in Hawaii. Data was surveyed through both direct and mail back surveys from vessel owners and operators which consisted of the information on vessel operations and characteristics, the investment and fixed costs, trip costs, annual catch, gross revenue, and general operating information. The surveys were divided into four groups based on fishermen's motivations and on fishing income. Fulltime fishermen are who receiving over 50% of their income from fishing profits, part-time fishermen received under 50% of their income from fishing, expense fishers just sold fish only to cover trip costs, and the recreational fishermen did not sell any fish during period. The results showed clear differences among groups on fishing intensity, catch rates, and gross revenues were highest for fulltime fishermen and lowest for expense fishers. The average annual fixed costs accounted for large rate in total cost. Fixed costs were higher for pelagic vessels as compared to non-pelagic vessels across all motivations. Average trip costs were similar across groups, with fulltime fishermen spending more on ice and bait than others. An examination of the data on pelagic vessels by vessel length was also carried out by authors (Hamilton and Huffman, 1997).

Almeida et al. (2001) had an economic analysis of the gill net fisheries in Santarem, Brazil based on 50 interviews in 1997. The fishing fleets were homogeneous in terms of gear and hull design, but different in capacity of the vessels. They concluded that the smaller fleets were less efficient in term of CPUE, catch per unit effort (kg per fisher per day) but more economically efficient, earning more for each invested unit of capital than larger groups. And the focusing here is most of fishing vessels in Santarem is small one, accounted for 87% of total direct employment and 73% of total income. And the smaller groups have variety species in their catch and supply for local market. Meanwhile, larger groups tend to specializing a small number of valuable species and supply for processing companies. Therefore, author emphasized the importance of small fleets in term of food security, local fishers' income and employment (Almeida et al., 2001).

On 2001, FAO was published a technical paper on techno-economic performance of marine capture fisheries which was studied from 1999 to 2000 and conducted data from 1995 to 1997 of 15 countries. Their results showed that, 105 of 108 type of fishing vessels had positive gross cash flow accounted for 97% (FAO, 2001). They also had economic conclusions of individual gear types of each participated countries.

Floch et al., 2008 investigated on comparison of economic performance of capture fisheries in Brittany, France. They computed economic indicators by using two sources of data including from surveys (technical and financial information) and from log book databases. The economic performance is measured by using term of gross surplus in short run and the cost of capital in long run.

In Vietnam, there are only some studies related to economic efficiency of fisheries and most of them concentrate on economic indicators, cost and earning as well as finding the main factors affect on economic performance of offshore fishing fleets. Kim Anh et al. (2006) studied on cost and earning of gill net fisheries in Nha Trang. Based on 50 surveys was collected in 2004 and 2005 (accounted for 17.5 % of population), they concluded that the average net profit of small vessels (hull length less than 15.5 m) is much higher than large groups (more than 17m) but contrary on gross revenue for both 2004 and 2005. About rate of return on equity, the medium group (hull length 15.5 to 17m) is considered poorest vessels meanwhile small group is best (Kim Anh et al., 2006). To 2007, the similar methodology was applied for offshore tuna long line fisheries in Nha Trang. Through this study, they found that the vessels with high engine power do not automatically convert into large profit. The group vessels of 90 – 140 Hp is the best performer among the capacity group sampled (Kim Anh et al., 2007). Long et al. (2008) studied on economic performance of Vietnamese long liners in Eastern Sea. With 32 surveys representing for 16% of offshore long liners in Khanh Hoa, they concluded that vessels of hull length 15.9 and 15.1m would maximize gross revenue and income, respectively. The annual average crews' income equals 93% of labors earning of most productivity sectors in Khanh Hoa province. The average profit of owners long liners have profit margin of 12.1% (Long et al., 2008). Trawl fleets in Nha Trang was investigated on economic efficiency and affected of the MPA (marine protected area) in 2009. Based on 65 surveyed trawlers in Nha Trang in 2005 and 2006 and by using stochastic frontier analysis, they concluded that engine power, the size of household and operative characteristics of trawlers strongly affect technical efficiency. The number of fished days is the most important factor affecting the gross revenue (Ngoc et al., 2009).

## 3.2. The definition of economic indicators.

**Table 3.1. The calculations of economic indicators**

| | |
|---|---|
| | ***Gross Revenue*** |
| **-** | ***Variable costs*** |
| **=** | ***Income*** |
| **-** | ***Fixed costs*** |
| **=** | ***Gross value added*** |
| **-** | ***Labors cost*** |
| **=** | ***Gross cash flow*** |
| **-** | ***Depreciation*** |
| **-** | ***Interest loans payment*** |
| **=** | ***Profit*** |
| **-** | ***Calculated interest on owners' capital*** |
| **=** | ***Net profit*** |

***Gross revenue*** (GR) is computed as the average value of each fishing trip multiplied with the estimated fishing trip in a year. In this study, several surveys collected fish quantity of each group species which have equivalent price and their price. After that, the value of each group species is calculated by quantity times its price. Since that, the gross revenue of a fishing trip is summed of all value of species groups. Almost all these surveys were interviewed at fishing port, the remainders were asked at owners' house. These remainders were not including catch volume. In the reality, the price of fish fluctuates among period time of the year and depends on harvested quantity as well. Therefore, author assumed that fish price is constant across time and quantity.

***Variable costs*** (VC) here include fuel, lubricant, food, ice and some other expenses for fishing trips but exclude labors cost.

***Income*** is just simple that as difference between gross revenue and variable cost.

***Fixed costs*** (FC) are the sum of the annual repair and the maintenances of vessel, gears and other equipments and the annual insurance for vessel and crews.

***Gross value added*** (GVA) is referred to as the annual gross revenue minus variable cost and fixed cost but not include labor cost.

***Labor cost*** (LC) is the total salaries for all crew members of fishing trip include owner if he participated in this trip. This salary is based on the shared system of community's regulation. This trawl fleet's regulation in Nha Trang to calculate the salary for crews is 50% of income divided by number of crews. Some fleets share crews' in come every fishing trip but almost all owners share income monthly or even quarterly.

***Gross cash flow*** (GCF) is subtracting between the annual revenue and variable cost, fixed cost and labor cost or GVA minus labor cost.

***Depreciation*** is the loss in the value of asset. In this case, the asset is vessel and all used equipments during fishing operations. In this study, because of limited on time and information in data set, therefore, the author use linear depreciation based on owners' estimated lifespan and present value of vessel.

***Interest loans payment*** (ILP) is the cost to pay for loans interest in year 2011 of owners. Because of the various loan sources, the rates of interest among the owners have differences. The loan come from relatives may be very low or even without interest. The source come from some programs also may be low in interest rate but source from commercial banks is 18% to 22% annually. Moreover, some owners borrow capital from private sources will have to pay a very high interest except borrow from mid-man. As an unspoken regulation, all product of fishing operations have to sell for mid-man if owner borrow capital from him/her. And in this case, this loan may be without interest rate.

***Profit*** is remaining of revenue minus all expenditures except calculated interest on owner's capital. It also equals GCF subtract depreciation and interest payment on loans.

***Calculated interest owner's capital*** is considered as the interest of owner capital on vessel and equipments. It can be counted as the total owner's capital paid on vessel and equipments multiplied with the governmental bank's interest rate in 2011. The bank's interest rate can get from State Bank of Vietnam is 14% yearly and available at www.sbv.gov.vn.

***Net profit*** (NP) is net value of revenue after minus all expenses of fishing operations include interest owner's capital. It is considered as net economic profit of using capital on operating capture fisheries.

The fisheries in Nha Trang are very diversity with many fishing gear types, kinds of vessels and a lot of fishing activities. Moreover, the information on economic performance of fishing fleets is quite limited. So it is difficult to define rate of return. However, when the yield hardly effected to fish price in the competitive market where there are many sellers, buyers and mid-man. In this study, author assumed that the fish price is the same for all vessels in a short run (at the surveyed time; January and February, 2012). Since that, the gross revenue can be considered as an indicator of harvest (Flaaten, 2010). And this assumption is suitable with the results that annual gross revenue as a proxy of annual production with the assumption of fixed price of fish (Long, 2008).

***Gross profit margin*** (GPM) is defined as the ratio of gross cash flow (GCF) to gross revenue (GR). This figure illustrates what is left as compensation to capital in relation to gross revenue as percentage of gross revenue. This ratio can be expressed as:

$$Gross\_Profit\_Margin = \frac{Gross\_Cash\_Flow}{Gross\_Revenue} * 100\% \qquad (3.1)$$

***Profit margin*** (PM) is referred as the ratio of profit to gross revenue. This ratio expresses what is left as compensation to the vessel owner's capital in relation to gross revenue as percentage of gross revenue. The profit margin is illustrated as:

$$Profit\_Margin = \frac{Profit}{Gross\_Revenue} * 100\% \qquad (3.2)$$

***Return on owner's capital*** is calculated as rate of profit to total owner's capital of the vessel. This ratio reflects what is left to the vessel owner as compensation to the opportunity cost of owner's capital in relation to owner's capital of the vessel as percentage of owner's capital of the vessel. The return on owners' capital is calculated as:

$$Return\_on\_Owners' capital = \frac{Profit}{Total\_Owners' Capital} * 100\% \qquad (3.3)$$

### 3.3. Economic fisheries theories.

#### 3.3.1. The traditional open access bio-economic model

The traditional bio-economic model was studied by Gordon (1954). This model was developed from population dynamic model and based on the assumptions that the fishing fleets are homogeneous and operating on perfectly competitive market, of which some technical and economic variables were added. And the market price is assumed not fluctuate during the year 2011 and not to be affected by harvested quantity (Gordon, 1954).

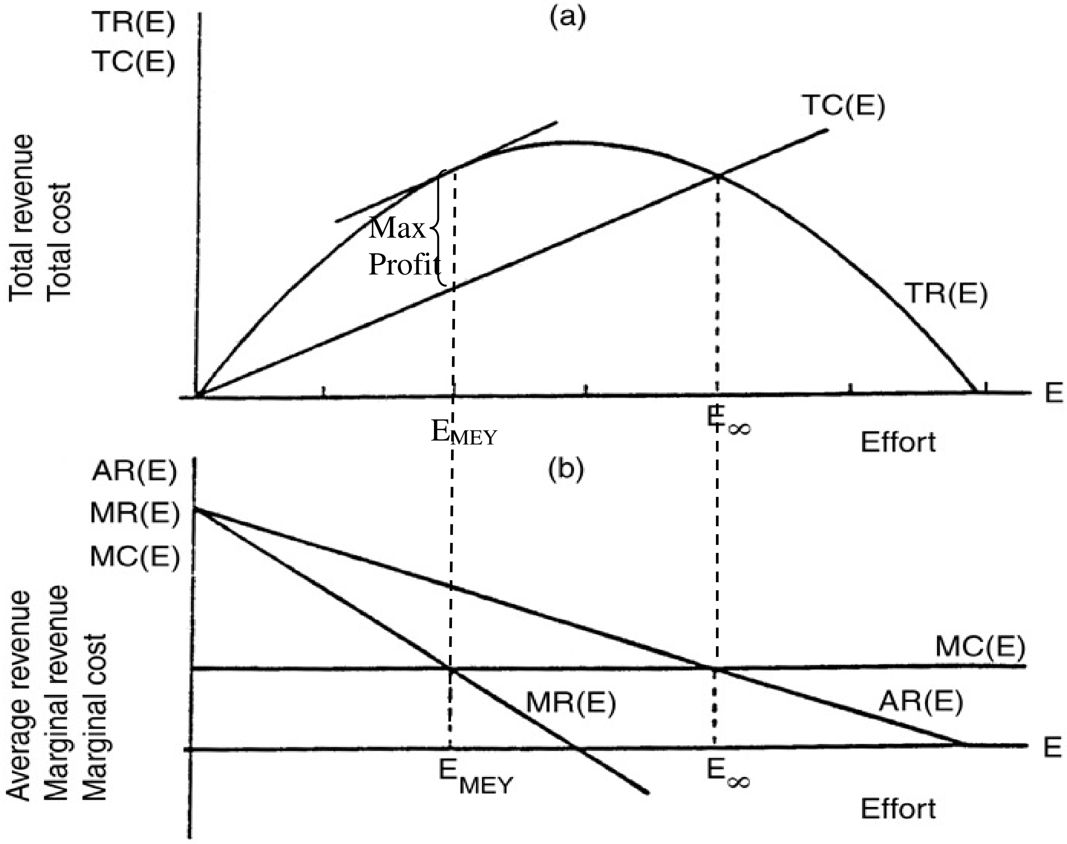


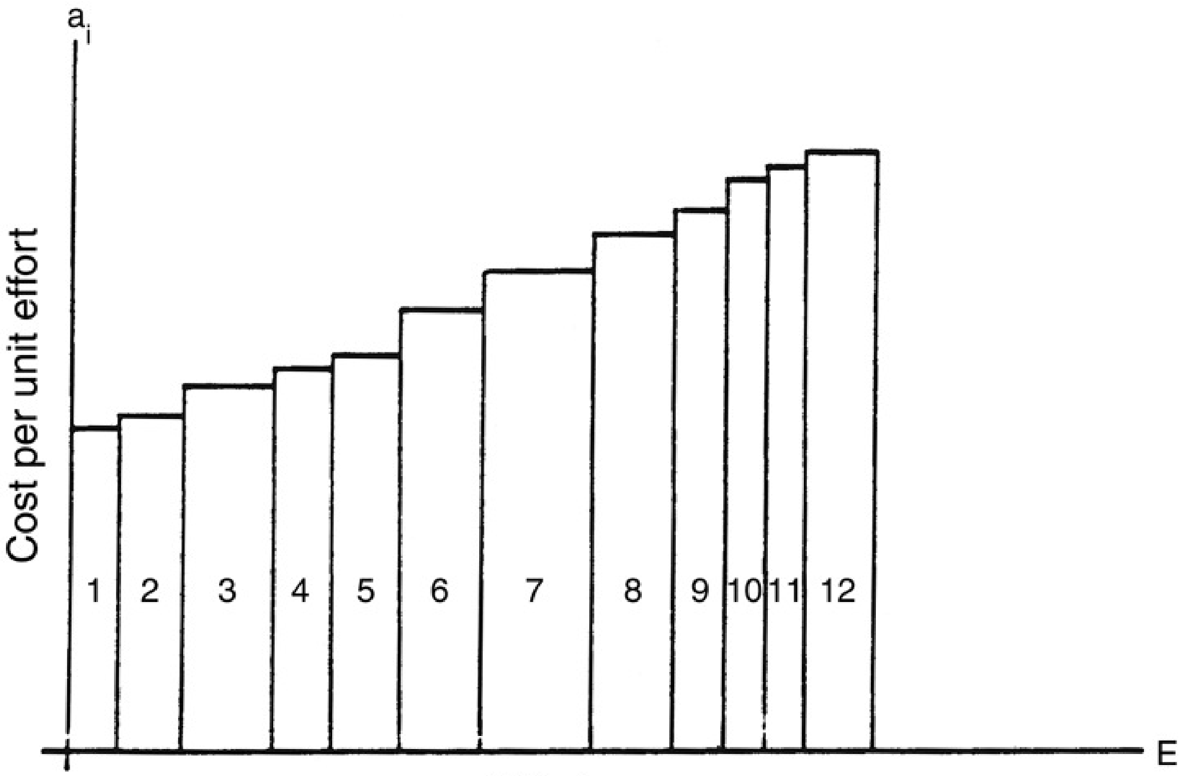

Figure 3.1. The traditional bio-economic model

Source: Flaaten (2011, p.26)

In the open access conditions where fishery resources is not managed, the vessels owners will decide go to the sea for fishing if total revenue, TR (E), is more than total cost, TC (E), otherwise they will leave out of the fishing operation. And an economic equilibrium will appear where total cost equals total revenue (see Figure 3.1a). In this figure, the level of effort under open access equilibrium is shown as $E_{\infty}$ where TR (E) equals TC (E). The relationship between total revenue and fishing effort in long run is illustrated by sustainable yield curve which have a unique maximum point, defined MSY – Maximum Sustainable Yield. In another word, there is an open access equilibrium point of effort $E_\infty$ where the average revenue of effort, AR (E), equals the marginal cost of effort, MC (E) (see Figure 3.1b). To simplify, the market prices are assumed not to be effected by harvested yield and not fluctuated so much during 2011 and the total cost is increased linear as well. The economic profit is defined as the vertical distant between total revenue and total cost (see Figure 3.1a). The fishing operation at this level of effort is without profit under open access fishery condition. And at any lower levels of this effort, individual vessels still make economic profit, is called resource rent (Flaaten, 2011). Because of existence of positive profit, many new vessels will be attracted into this unregulated fishery. And it is called as super normal profit, leading to reduce average revenue from this fishery until equals zero as known as normal profit (Flaaten, 2011). As consequence, the resource rent will be disappeared under unmanaged open access fisheries (Gordon, 1954; Flaaten, 2011).

### 3.3.2. The open access bio-economic model with heterogeneous vessels.

The Figure 3.2 has shown the relationship between standardized effort and the cost efficiency of 12 heterogeneous fishing vessels. Of which, the average cost per unit effort and standardized fishing effort are illustrated by vertical and horizontal axis, respectively. Thereby, the height of the bar measures cost efficiency whereas standardized effort is measured by the width of the bar. The vessels are arranged from the left to the right according to their cost efficiency. Since that, the vessel no. 1 is the most cost efficient and vessel no. 12 as the least. A vessel can be chosen as the standard vessel against which the effort of the others is measured. Since the width of each vessel bar illustrates the relative standardized effort of each vessel, we will consider fishing efficiency as well as the cost efficient vessels through comparison of relative standardized effort and cost per relative standardized 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 standardized effort is lowest for vessel no. 1 even though this vessel no. 1 produces the same relative standardized effort as the standard vessel no. 9.




Standardized fishing effort

Figure 3.2. The relationship between standardized fishing efforts and cost efficiency of heterogeneous efforts

Source: Flaaten (2011, p.108); Notes: the fishing effort is measured by the width of the bar whereas the height measures cost efficiency.

With a given number of vessels in a fishery, the cost bar in Figure 3.2 may be substituted by a curve enveloping the bars. This curve is defined as marginal cost curve of effort and is shown in Figure 3.3 panel (b) as MC(E). In panel (a) of this figure, the total cost of effort, TC (E), is derived from the MC(E) curve. In this case, the TC (E) curve is increasing progressively, since the MC (E) curve is upward sloping. And the TR(E) curve is the sustainable long run total revenue curve and the corresponding average revenue, AR(E), and marginal revenue, MR(E), curves are shown in panel (b) of this figure (Flaaten, 2011). As discussed above in 3.4.1 on traditional bio-economic model, at lower effort level, the average revenue, AR(E), is higher than marginal cost of effort, MC (E), the new vessels will be attracted into the fishery under open access condition. By contrast, some vessels have to leave out of fishing ground since AR(E) is smaller than MC(E). And open-access equilibrium will appear and is demonstrated in Figure 3.3 as $E_\infty$ where MC(E) = AR(E). In this figure, the total revenue equals the square $AGOE_\infty$ and the total cost equals quadrilateral $ADOE_\infty$ below the MC(E) where the level of effort is $E_\infty$. From that, it's easy to see an economic surplus, called intra-marginal rent which equivalent to the area AGD since $AGOE_{\infty}$ is bigger than $ADOE_{\infty}$ or the line segment R in panel (a) (Flaaten, 2011).

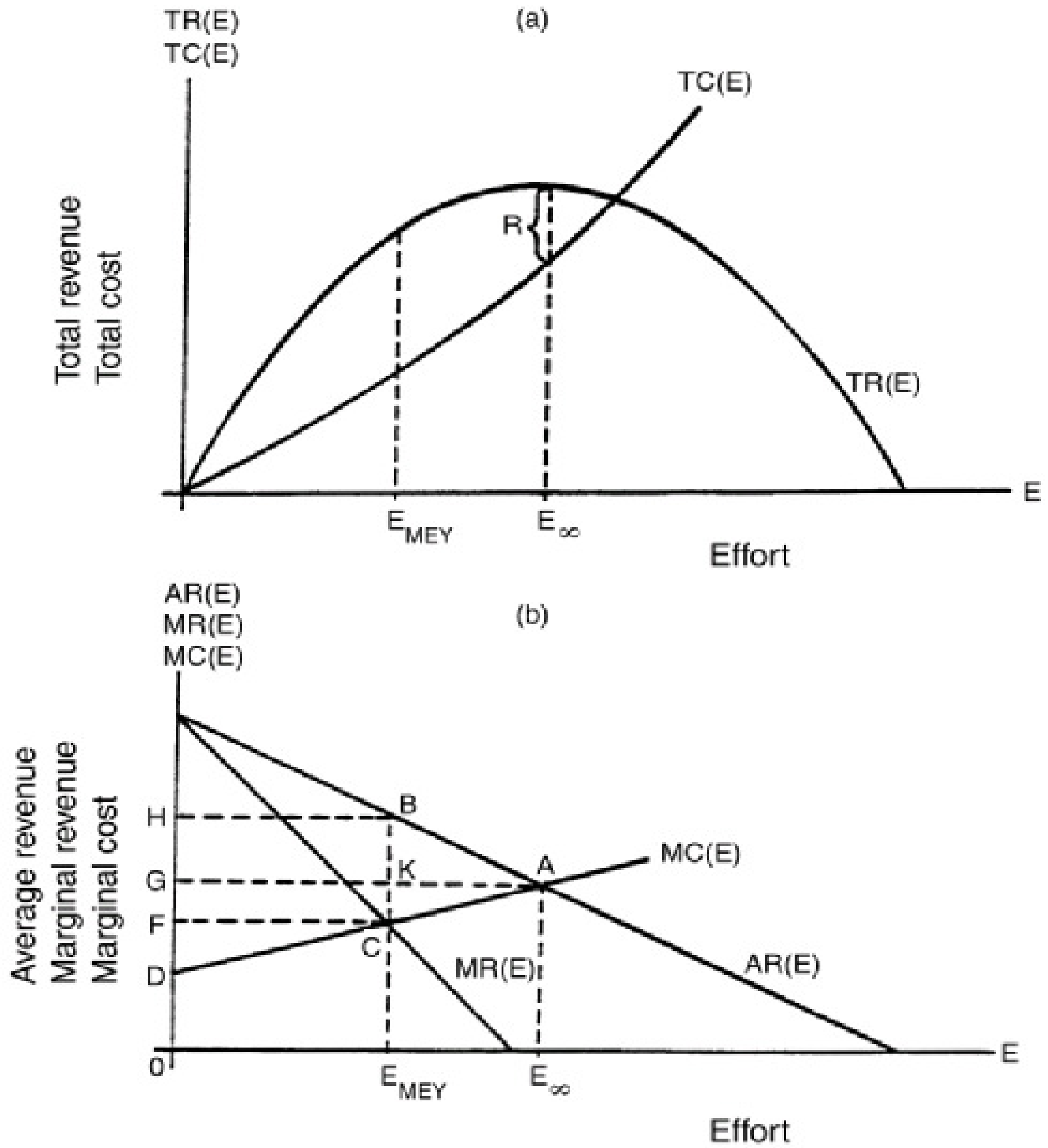



Figure 3.3. The bio-economic model with resource rent, intra-marginal rent under unregulated open access and under maximum economic yield of heterogeneous effort.

Source: Flaaten (2011, p.109)

### 3.3.3. Heterogeneous fishing vessel economics

In the traditional bio-economic model, we assumed that the fishing fleets from fisheries are homogeneous; the average cost is same for all vessels. However, the fishing fleets, in reality, in almost all fisheries are heterogeneous; the fishing vessels differ with respect to size, engine power, gear types, cost, experiences of crews and captains and other technical and economic characteristics as well (Flaaten, 2011). Hence, these assumptions are not reasonable in this case study of trawl fisheries in Nha Trang as well as in fisheries of many other countries. The trawler fleets in Nha Trang are heterogeneous which vary in size, engine power, cost structure; different in efficiency of effort, other technical characteristics and crews skills as well. Therefore, they always differ with respecting to efficiency and cost perspective. However, when the catch of each vessel is reckoned as a small portion enough in the total landed of fish in a competitive market. It means that, the market price is not to be impacted by each individual vessel in the competitive market and fish price is the same in all vessels. Beside that, in the short run the biomass and fish stock is considered not to be effected by activities of each individual vessel and they are constant from an individual vessel's point of view. Moreover, for the adaptation of single vessel's analysis, we also assume that, there are no significant effect on stock level and market price. Therefore, the vessel harvest function is a function of its effort, given period of time and the stock level, and assumes that this function is the Schaefer harvest function. Supposed that, "*e*" is used unit to measure effort level of a vessel and any vessel's effort can be expressed by using of a standardized efficiency measurement of fishing effort. The effort, e, is a technical term depends on fishing gears (Flaaten, 2011). It could be number hauling hour of the trawl; number of net or operating hours of gill net; the number of hooks in long line… Since that, total cost of fishing effort is $tc(e) = vc(e) + fc$ where $vc(e)$ is total variable cost of effort and $fc$ is fixed cost. The average cost ac (e) equals total cost divided by effort, $ac(e) = tc(e)/e$ and marginal cost of effort $mc(e)$ is addition to total cost due to the addition of one unit to effort and is calculated as $mc(e) = d\,tc(e) / d\,e$.

Since that, the Schaefer harvest function is $h(e;X) = qeX$ (3.4)

Where: - h (e;X) is harvest function

- q is the catch-ability co-efficiency
- e is effort of individual vessel
- X is given stock level

The profit of vessel operation is $\pi(e;X) = p^*h(e;X) - tc(e) = p^*qeX - tc(e)$ (3.5)

Where: p is fish price in the market. In the short run, total cost is only variable cost, *vc (e)*, so this profit is operating profit. In the long run, the total cost includes variable cost and fixed cost. Assume that, the vessel owner focus on maximizing operating profit in equation (3.5), the first condition for this is:

$$\frac{d\pi(e;X)}{de} = \frac{d(pqeX)}{de} - \frac{dtc(e)}{de} = 0 \Leftrightarrow \pi'(e;X) = pqX - mc(e) = 0 \Leftrightarrow mc(e) = pqX \quad (3.6)$$

The equation (3.6) shows that, the operating profit of vessel is maximized when the marginal cost of effort equals marginal revenue. The right hand side of equation (3.6) is marginal revenue include fish price, p, catch-ability, q, and stock level, X, whereas the traditional theory of product just have only fish price, p. So, for a given p, q and stock level, X, the vessel's optimal effort is completely give by equation (3.6) (Flaaten, 2011).

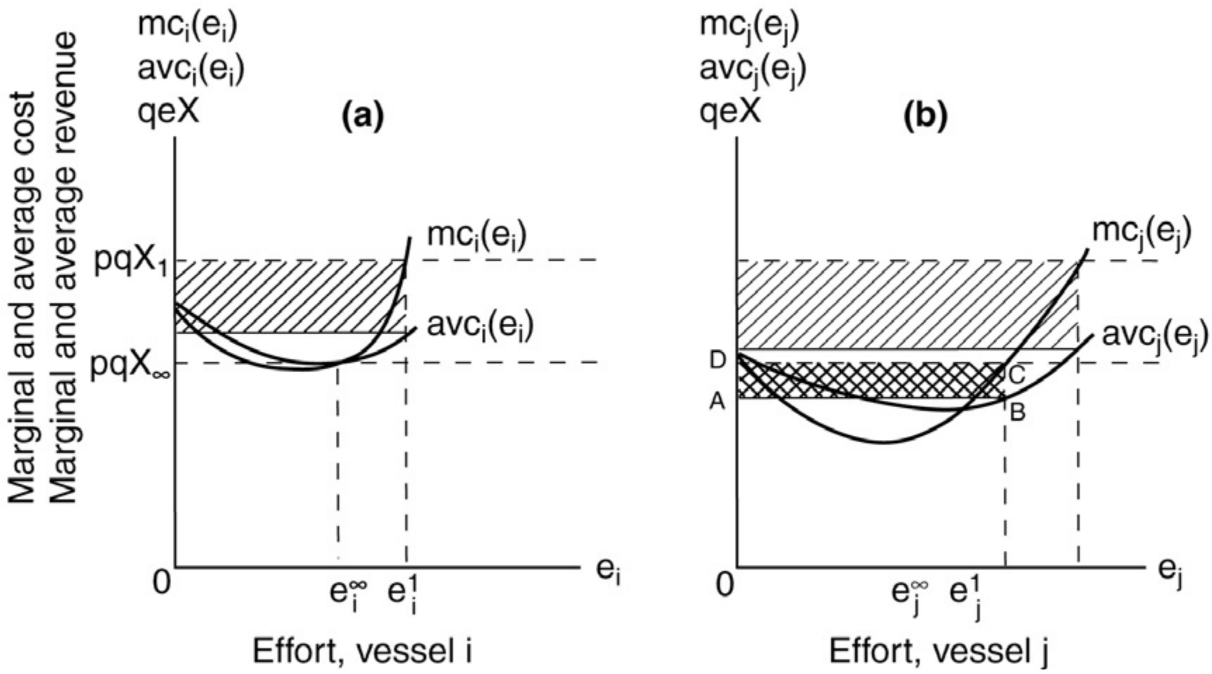



Figure 3.4. Two fishing vessels are heterogeneous: short run adaptation of effort for given cost structure, fish price, catch-ability and stock level.

Source: Flaaten (2011, p.93)

In the production theory, the enterprises can control all product process, including total needed inputs and their cost. However, a fisheries firm, they can not control important input, fish stock. It does not like fuel, bait or other operating cost that can be bought in the market. And fishers know the cost per unit effort, cost per trawling hour, for example. And we suppose that, fishers also know how the catch varies with the present stock level. Thus, the cost per unit of harvest will depend on inputs cost, stock level as well as catch-ability

(Flaaten, 2011). And we will see the comparison's adaptation of optimal effort of vessel i and vessel j to maximize their profit in Figure 3.4.

This figure illustrates average variable cost curve (in short run, total cost is only variable cost) and marginal cost curve of vessel i in panel (a) and vessel j in panel (b). In panel (a), marginal revenue of effort, pqX, have been shown at two level fish stock namely $X_1$ and $X_\infty$. At $X_\infty$ stock level, $e_i^\infty$ is optimal effort of vessel i where marginal cost equals marginal revenue effort. In this case, vessel i do not have any profit, just breakeven where marginal revenue equals average cost. Suppose that, if stock level go down lower than $X_\infty$, vessel i have to stop fishing because of the marginal revenue will be below the minimum point of average cost. So, vessel i is a marginal vessel for stock level $X_\infty$ when a small decreasing of stock will lead to negative revenue (Flaaten, 2011). In contrast, vessel j in panel (b) maximized its profit for $e_j^\infty$ at stock level $X_\infty$ and is illustrated as area ABCD. This profit is called intra-marginal rent. In this case, vessel i is a marginal vessel at stock level $X_\infty$ whereas vessel j is intra-marginal at this stock level. So, vessel j can operate at stock level lower than $X_\infty$ with positive profit (Flaaten, 2011).

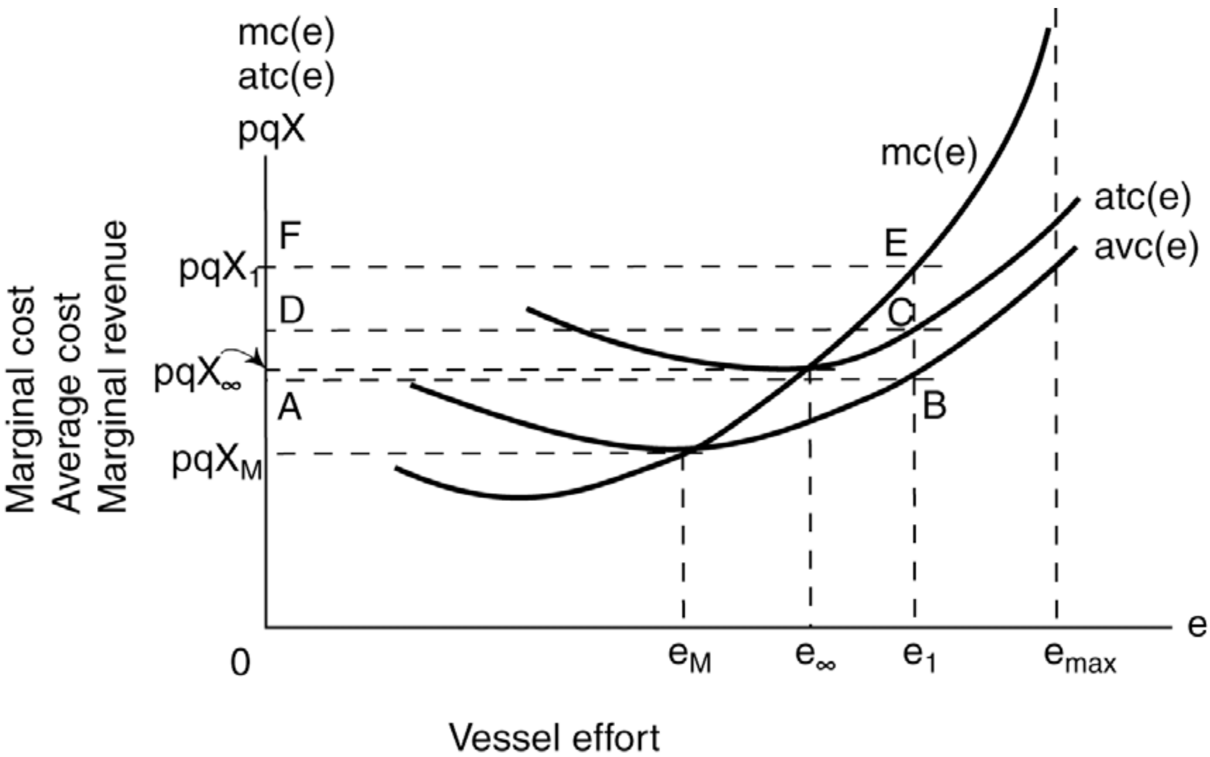



Figure 3.5. The adaptation of fishing effort may differ due to fixed costs of vessels' behavior in short run and long run.

Source: Flaaten (2011, p.95)

### 3.4. The econometric model

In fisheries, the fishing effort is a popular concept which includes many factors that may impact on efficiency of fishing vessels such as the length of the vessel, the engine power, the fishing time, the crew size, the experiences of captain or crews, fishing gear (FAO, 2003). So, fishing effort measure the level of activities of the vessels. In the case of trawl fisheries in Nha Trang, the engine power, fishing gear (circumference of the mouth of the trawls) and the number of fishing days are chosen as variable inputs in this model because of following reasons:

The trawlers have to dredge the net. How large of the trawl or how fast of dredging is depend on engine power. Therefore, the power of the engine is a very important factor on trawl fisheries operations. Thus, engine power was chosen as an independent variable in this model. It is expected that engine power have positive affect on the catch or revenue of the trawl fleets.

Gear in this model is the circumference of the mouth of the trawl. It is calculated by the number of meshes multiply with the mesh size at the mouth of the trawl and measured by meter. The effort of trawlers is swept area that equals circumference of the trawl multiplied with the trawled line (The trawled line equals speed of the vessels multiply with the trawled time). In this case, the density of fish is assumed equally in whole fishing ground. So, beside the engine power, the number of fishing days, the circumference of the trawl also show swept areas that the trawl dredged. Or in another word, the circumference of the trawl mouth effect directly on the catch. Therefore, it is also chosen as input variable in this model. And it is expected that this independent variable have strong effect on the trawl fleets' revenue.

Fishing days are the total number days at sea of trawl fleets in Nha Trang in 2011. This information will be getting from questionnaires by calculation from average fishing days per trip multiply with total trips in 2011. If trawlers operate one more day, it means that they put more effort on their operation, their catch will increase and as consequence their gross revenue also going up. Therefore, this independent variable is expected that may have strongest impact on trawlers' gross revenue.

In the traditional production function, $Y = f(K;L)$, labor is one of major factor affect on out put results, Y. However, labor is not included in this model because of following reasons: Firstly, the trawlers in Nha Trang had equipped quite fully equipments such as roller, GPS and at least 2 trawls per vessel. Almost all manpower in fishing activities was replaced by machine (rollers). That why, they do not need more manpower on fishing operations. Secondly, the numbers of crew on trawlers are often varied only from 3 to 5 members including captain, a small variation.

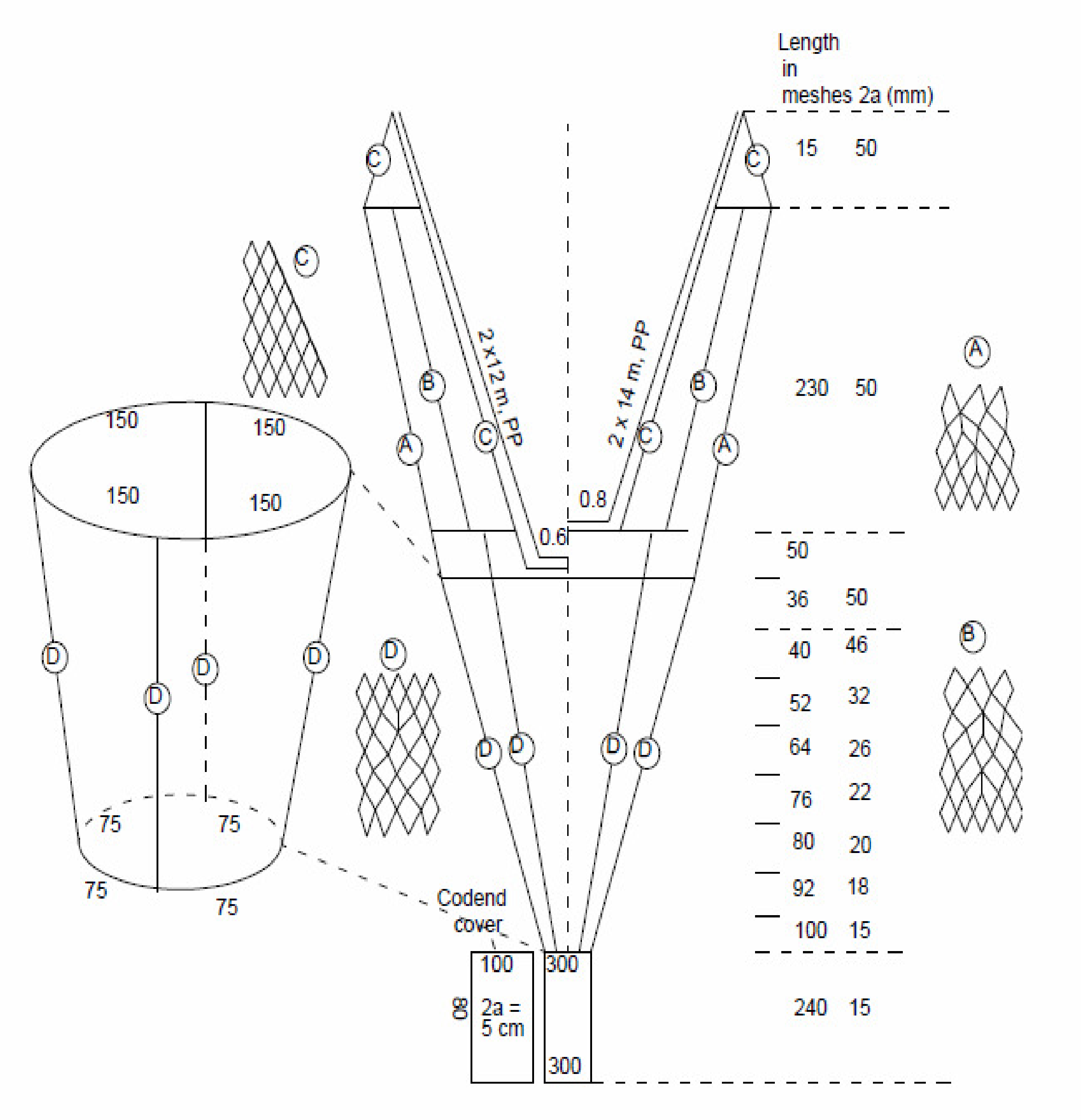



Figure 3.6. The technical drawing of a trawler in Nha Trang

Source: Hai et al., 2011

Engine power, Fishing gear and the number of fishing days are all considered as major factors affecting to economic efficiency of trawl fleets. Since that, the function of fishing effort will be built based on technical and operational characteristics of vessels and is illustrated in this model as:

$$EFFORT_i = A * Hp_i^{\alpha_1} Gear_i^{\alpha_2} Day_i^{\alpha_3} \qquad (3.7)$$

On which:

- $Effort_i$ is the fishing effort of vessel i where gross revenue (measured by million VND) is chosen as proxy.
- $Hp_i$ is the engine power of vessel i (measured by Horse power).
- $Gear_i$ is the circumference of the mouth of the trawler (measured by meter) which vessel i is using.
- $Day_i$ is the number of fishing days of vessels i
- $\alpha_1$, $\alpha_2$, $\alpha_3$ are estimated coefficients
- i ranked from 1 to 57 vessels.
- A is a constant.

***The model in specification***

From equation (3.7), log linear gross revenue for vessel i can be illustrated as follow:

$$LnEFFORT = \alpha_0 + \alpha_1 LnHp + \alpha_2 LnGear + \alpha_3 LnDay + \varepsilon \qquad (3.8)$$

Where $\alpha_0$ = LnA is a constant and ε is random error term.

## 3.5. The fishing effort standardization

By using the production function method, the standardized fishing effort has to be estimated and the catch per unit effort (CPUE) is often used as fishing effort. However, because lack of data on yield of fisheries as well as individual vessel. So, the gross revenue is used to analyze regression as proxy for fishing effort. In this case, the fish price is assumed as fixed prices for all vessels, the total landing is not impact to fish prices and the time operation is within one year in 2011.

Since that, the standardized fishing effort (SFE) of each vessel will be estimated from Equation 3.8 and the average standardized fishing effort ($\overline{SFE}$) of all samples also be computed. And the relative standardized fishing effort (RSFE) will be calculated by dividing the standardized fishing effort of each vessel for the average standardized fishing effort: $RSFE_i = \frac{SFE_i}{\overline{SFE}}$ (3.9)

On which:

- RSFE is the Relative Standardized Fishing Effort of each vessel
- SFE is the Standardized Fishing Effort of each vessel
- $\overline{SFE}$ is the Average Standardized Fishing Effort of sample
- vessel i is ranked from 1 to 57

# Chapter 4 DATA AND DESCRIPTIVE STATISTICS

## 4.1. The method of collecting data

The secondary data was focused on fishing fleets in Nha Trang and used published information from Khanh Hoa DECAFIREP, GSO and other researches (see Chien at al., 2009; Dong, 2004). The primary data was collected by author on costs and earnings data, technical and operational characteristics as well as other information in Vinh Luong and Vinh Truong Communes, Nha Trang city, Khanh Hoa province (see Figure 4.1). All information is collected base on the questionnaires which designed by the NORAD project. The author also based on some previous studies' questionnaires (see Duy, 2010; Nga, 2009) to add some necessary technical information to suit with the contents of this study (see Appendix 1).

Based on the secondary data from Khanh Hoa Department of Capture Fisheries and Resources Protection (Khanh Hoa DECAFIREP), trawls in Nha Trang are mainly registered in Vinh Luong and Vinh Truong communes (51.9% and 23.8%, respectively). Thus, 60 samples in a population of 416 trawlers in Nha Trang were interviewed directly and randomly between author and mostly owner vessels and/or crew members at the ports (Vinh Luong and Vinh Truong fishing ports) or their house. However, three samples were removed from this data set because lack of information (two samples in Vinh Luong and one in Vinh Truong commune). All 2011 data was collected in January and February, 2012. In trawl fleets case, because trawls operate during the year, they do not separate the main season and the other seasons like gill net, purse seine, long line (Thanh Thuy at al., 2008; Nga, 2009; Duy, 2010). Therefore, the author decided asks detail average fishing days of each month on 2011 (see section V on questionnaire).

**Table 4.1. The distribution of trawls in surveys by registered locals**

| Communes | Population | | Sample | |
|---|---|---|---|---|
| | Vessels | Rate in % | Vessels | Rate in % |
| Vinh Luong | 216 | 51.9 | 35 | 58 |
| Vinh Truong | 99 | 23.8 | 25 | 42 |
| Others* | 101 | 24.3 | 0 | 0 |
| **Total** | **416** | **100** | **60** | **100** |

Source: Khanh Hoa DECAFIREP, 2010

Note: * remaining of 101 trawlers from other locations is registered quite equally in Vinh Tho, Phuoc Dong, Vinh Hai, Xuong Huan, Vinh Nguyen, Vinh Hoa

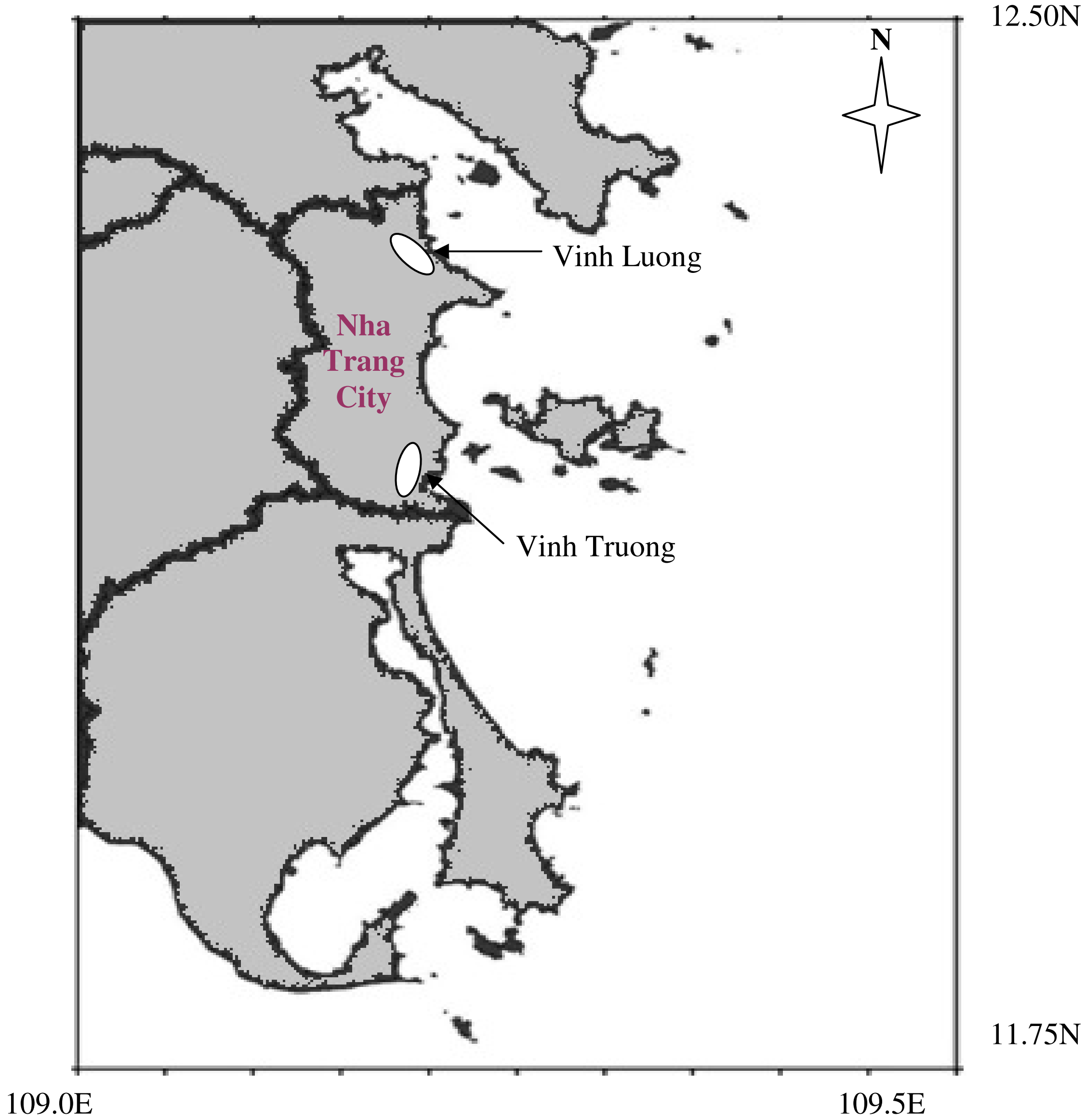



Figure 4.1. Map of research areas

The collected data includes costs and earnings, technical and operational information such as the size of vessels, mesh sizes of fishing gears, crew sizes, fishing costs, number days at sea per trip and per month…etc. About revenues, the author collected the average yield per trip following grouped species and their price. Because there are many species in the trawl catch, therefore, the author grouped species which have equivalent market price, is called "*marketed species*", big and small squid, shrimp as well as trash fish. So, the trawl catch was divided by five groups. From this information, the fishing trip's revenue will be easily calculated by quantity of grouped species multiplied with their prices. Besides that, some trawlers did not have fish quantity; the author asked the average total revenue (gross revenue) of each trip and then multiplied the average numbers of fishing trips annually.

In order to test the representative of the samples, the hull length and the engine power of the trawlers were available in the database of Khanh Hoa DECAFIREP. Therefore, they were chosen as key criteria to test population mean by T-test statistic. The steps to test mean of population will be conducted base on theories “Principles of Econometrics” by Hill et al., 2008, page 518 as following:

A null hypothesis is here that the population mean is μ = c and the alternative hypothesis is μ # c. The test statistic is $t = \frac{\overline{X} - c}{\delta / \sqrt{N}}$ ~ t (N-1) if the null hypothesis is true.

In which: $\overline{X}$ is the mean of sample, c is the population mean, $\delta$ is the standard deviation of the sample, N is the number of observations in the sample. The significant level is 95% (α = 0.05 → α/2 = 0.025) was chosen. The samples are 57 observations in a population of 416 trawlers in Nha Trang.

**Table 4.2. T-test statistic of samples.**

| Variable | Samples | | | Mean of population * | T-test statistic |
|---|---|---|---|---|---|
| | N | Mean | S.D | | |
| Hull length | 57 | 13.9 | 1.5 | 13.8 | 0.503 |
| Hp | 57 | 82.5 | 46.5 | 77.6 | 0.796 |

Source: Own data and calculation

The results of T-test for the hull length and engine power have shown in Table 4.2 that: T-test for hull length = 0.5033 and T-test for engine power = 0.796 < $t_{(0.025,\ 56)}$ = 2.009. We can conclude that, 57 surveyed samples can represent for the population. Thus, these 57 samples in this study can be used to analyzes and evaluate the economic efficiency of 416 trawlers in Nha Trang.

## 4.2. The descriptive technical characteristic of data

In 2011, there were 416 trawlers in Nha Trang. The Table 4.3 presented a summary of operational and technical information for trawler fleets in Nha Trang. From this table, we can see that, the trawlers in Nha Trang are quite heterogeneous in terms of technical and operational characteristics such as engine power, hull length, number days at sea and the captain’s experiences as well. And in comparison with themselves in 2006, the fishing capacity of trawl fleets in Nha Trang was improved significantly. In 2011, the engine power of the fleets was varied from 40 to 250 Hp, with the mean of 80.5 Hp. The hull length for the sample trawler fleets in Nha Trang ranged from 9.4 meters to 16.3 meters, with an average length of 13.8 meters. Meanwhile, the average engine power and hull length of trawlers in 2006 were only 35.3 Hp and 11.6 meters, respectively. The experience of captains (skippers) is the fishing experience and measured by number of years they participated in fishing operation. The average captain's experiences are 16.9 years which ranked from 7.0 to 25.0 years. The average circumference of the mouth of the trawl is 32.5 meters with the biggest and smallest mouth is 67.5 and 13.7 meters, respectively.

**Table 4.3. The descriptive statistics of technical information of trawl samples.**

| Criteria | Units | Min | Max | Mean | S.D |
|---|---|---|---|---|---|
| Engine power | Hp | 40 | 250 | 82.5 | 46.5 |
| Hull Length | m | 9.4 | 16.3 | 13.9 | 1.5 |
| Hull Width | m | 2.4 | 5.0 | 3.7 | 0.57 |
| Captain's experiences | Years | 7 | 27 | 16.9 | 4.7 |
| Mesh size at the cod end | mm | 12 | 25 | 16.7 | 3.3 |
| Circumference of the mouth of the trawl | M | 13.7 | 67.5 | 32.5 | 12.9 |
| Days at sea in 2011 | Days | 153 | 269 | 225 | 29.5 |
| Days per trip in 2011 | Days | 1 | 7 | 4.6 | 1.5 |
| Number of trips in 2011 | Trips | 32 | 110 | 54 | 18.6 |
| Crews (include captain) | People | 3.0 | 5.0 | 3.9 | 0.9 |
| Captain's experience | Years | 7.0 | 25.0 | 16.9 | 4.6 |

Source: Own data and calculation

The sizes of the meshes at the cod-end (the position that fish will be caught) of trawlers in Nha Trang is very small. The popular mesh sizes at the cod-end were 15 to 17 millimeters and ranked from 12 to 25 millimeters with an average of 16.7 millimeters. These are very small mesh sizes in comparison with the regulated mesh sizes, 28.0 millimeters (Circular No.02/2006 TT-BTS and No.62/2008 TT-BNN from Fisheries Ministry and Agriculture and Rural Development Ministry, now). It's reality not only in Nha Trang but also for all trawl fisheries in Vietnam. The circumference of the net mouth fluctuates from 13.7 to 67.5 meters with an average of 32.5 meters. The mouth of trawlers is varied greatly with standard deviation of 12.9 meters. The crew sizes on trawlers in Nha

Trang mostly were three or five fishers, including captain. Almost all small trawlers (under 90 Hp), three members was best suitable for fishing operation. Some other big vessels, they may have five members, and pair trawlers often have seven to nine fishers, divided two vessels, with a number three and four or five and four on each vessel (one of them works as chief cook).

The trawl fleets in Nha Trang operate during the year; they do not separate main season and other seasons like gill nets, purse seines, long liners (Thanh Thuy at al, 2008; Nga, 2009; Duy, 2010). They catch more from March to September (after traditional Tet holidays), with around 20 to 25 days each month. And the other month, they work from 12 to less than 20 days monthly. Thus, the average days at sea in 2011 are 225 days and vary from 153 to 269 days annually. It's translated to 32 to 110 trips per year with average is 54 trips. Almost all trawlers in Nha Trang are small vessels, so they often go to the sea from one to three days each trip. Only some big vessels, they go to the sea for three to five days, or even 7 days each trip depending on the their catch.

**Table 4.4. Descriptive technical statistics of trawlers in Nha Trang in 2011 among Hp**

| Criteria | Units | Hp < 60 (n=26) | | 60 ≤ Hp < 90 (n=14) | | Hp ≥ 90 (n=17) | |
|---|---|---|---|---|---|---|---|
| | | Mean | S.D | Mean | S.D | Mean | S.D |
| Engine power | Hp | 49.2 | 5.3 | 72.9 | 8.0 | 141.2 | 43.9 |
| Length | m | 13.2 | 1.7 | 14.2 | 1.1 | 14.8 | 0.8 |
| Width | m | 3.3 | 0.4 | 3.9 | 0.4 | 4.2 | 0.4 |
| Captain's experiences | Years | 16.4 | 4.8 | 18.9 | 4.1 | 16.1 | 4.8 |
| Mesh size at the cod end | mm | 13.9 | 1.3 | 17.4 | 1.8 | 20.5 | 2.0 |
| Circumference of the mouth of the trawl | m | 23.3 | 5.9 | 44.0 | 15.3 | 37.1 | 8.2 |
| Days at sea in 2011 | Days | 206 | 30.6 | 240 | 16.1 | 242 | 17.6 |
| Days per trip in 2011 | Days | 3.5 | 1.0 | 5.0 | 0.8 | 5.9 | 1.2 |
| Number of trips in 2011 | Trips | 64.2 | 20.9 | 49.6 | 11.7 | 42.4 | 9.7 |
| Crews (include captain) | People | 3.0 | 0 | 4.2 | 1.0 | 4.9 | 0.5 |

Source: Own data and calculation

On another hand, the Table 4.4 presents a comparison of technical characteristics between three groups of the trawlers in Nha Trang, which are categorized according to engine power including small group (Hp < 60); medium group (60 ≤ Hp < 90) and big group (Hp ≥ 90). These three groups are quite heterogeneous in terms of technical characteristics. The mean of engine power have significant differences between groups. From this table, it's easy to see that, in term of technical characteristic, there are no significant differences between medium group and the big one, except engine power, of course. This may show that, the vessels in these two groups work equally in term of operation. The smaller and smaller vessels is more and more fishing trips, it shows that their trips is shorter than the bigger groups.

## 4.3. Descriptive operational characteristic of data

### 4.3.1. The fishing season, number days at sea and trips of trawl fleets in 2011

As mentioned on item 2.3 "Trawl fisheries in Nha Trang", the trawlers in Nha Trang operate during the year. They fish from 12 to 25 days monthly, equivalent 153 to 270 fishing days annually. In average, trawlers in Nha Trang were at sea 18 to 20 days each month and 225 fishing days in 2011. On which, fishers focus on around six months, from March to September for trawling (as beginning February to the end of August follow Vietnamese Lunar Year, after Tet holidays). In this period, they were at sea over 20 days each month meanwhile the remaining time only fish around 12 to 15 days monthly (see Figure 4.2).

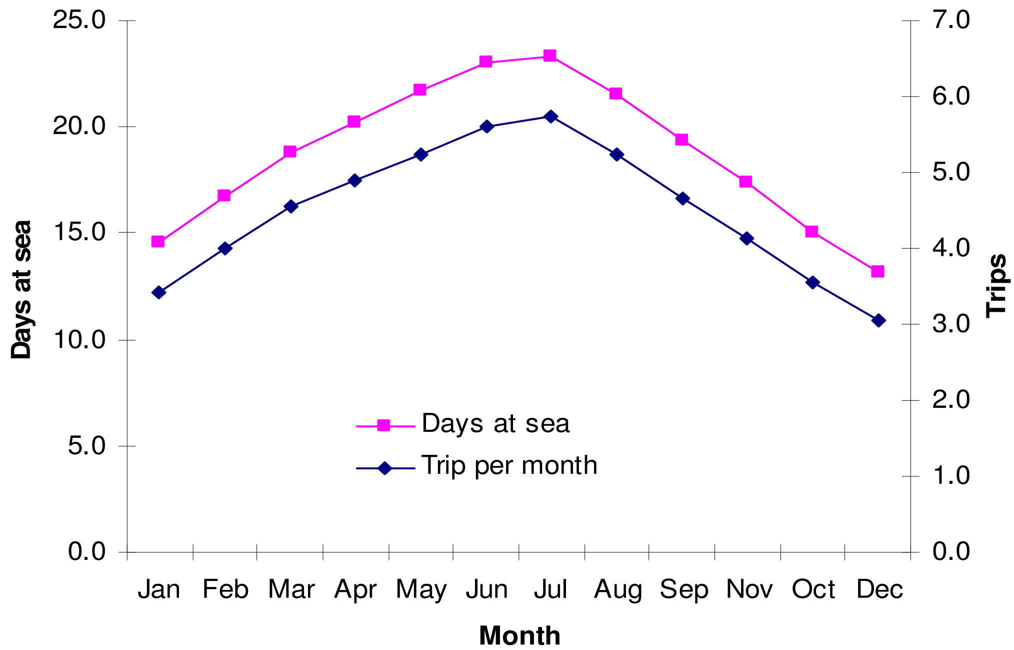



Figure 4.2. The average number fishing days per month and trips of trawlers in 2011

Source: Own data and calculation

### 4.3.2. Variable costs

The average variable costs here are costs for fuel, ice, food and other costs serve directly for the fishing trips. These costs are about 361.2 million VND in average, which ranged from 168.9 to 752.2 million VND. Of which expenses for fuel and lubricant were highest with 278.4 million VND (accounted for 77% of annual variable costs). It varies from 125.6 to 590.9 million VND. The remaining variable costs are including ice, food…

**Table 4.5. Structure of the variable costs of the trawlers in Nha Trang in 2011**

| Criteria | Min | Max | Mean | S.D |
|---|---|---|---|---|
| Fuel and lubricant | 125.6 | 590.9 | 278.4 | 119.2 |
| Ice | 11.9 | 60.5 | 30.1 | 10.9 |
| Food | 11.8 | 60.5 | 27 | 11.9 |
| Others | 11.9 | 44.0 | 26.0 | 8.7 |
| **Total variable cost** | **168.9** | **752.2** | **361.2** | **145.3** |

Source: Own data and calculation; Unit: million VND

### 4.3.3. Fixed cost

The fixed costs included repair and maintenance (hull, gear and equipment), insurance and registration fee. The average fixed costs of trawlers in Nha Trang in 2011 are 48.9 million VND and lays from 30.8 to 101.9 million VND. Of which, they mostly are repairing costs (hull and trawls). These two costs are accounting for 95%. A small cost in registration fee has to pay as a tax for government on management. This cost only takes 0.5 and 0.7 million VND corresponding to vessels under 90 Hp and vessels 90 Hp or more, respectively.

**Table 4.6. Structure of the fixed costs of the trawlers in Nha Trang in 2011**

| Criteria | Min | Max | Mean | S.D |
|---|---|---|---|---|
| Hull repair | 20.0 | 70.0 | 33.5 | 12.6 |
| Gear repair | 10.0 | 25.0 | 13.7 | 4.5 |
| Equipment repair | 0.3 | 2.0 | 0.5 | 0.4 |
| Insurance | 0 | 5.0 | 3.0 | 1.1 |
| Registration fee | 0.5 | 0.7 | 0.6 | 0.1 |
| **Total fixed cost** | **30.8** | **101.9** | **48.9** | **17.9** |

Source: Own data and calculation; Unit: million VND

### 4.3.4. Depreciation, Interest loan payment and calculated interest owners' capital

The depreciation is the loss in value of asset. In this case, the asset is vessel and all used equipments during fishing operations. In this study, because of limited on time and information in data set, therefore, the author use linear depreciation based on owners' estimated lifespan and present value of vessel. Interest loans payment (ILP) is the cost to pay for loans interest in year 2011 of the owners. Calculated interest owner's capital is interest of owner's invested capital on vessel, gears and equipments. It can be counted by total asset that owner paid on vessel, gear and equipments multiplied with the governmental bank's interest rate in 2011. Thus, the results on these are illustrated on Table 4.7 as following:

**Table 4.7. Structure of Depreciation, interest loan payment and calculated interest owners' capital of the trawlers in Nha Trang in 2011**

| Criteria | Min | Max | Mean | S.D |
|---|---|---|---|---|
| Depreciation | 12.0 | 45.0 | 23.5 | 9.6 |
| Interest loan payment | 1.8 | 15 | 7.5 | 4.3 |
| Calculated interest owners' capital | 16.8 | 123.2 | 47.7 | 25.4 |

Source: Own data and calculation; Unit: million VND

## 4.4. Data analysis tools

All data was analyzed by using Microsoft Excel version 2003, including Salter Program and statistical package Eviews version 6.0

## Chapter 5 EMPIRICAL RESULTS

### 5.1. Economic efficiency indicators

In 2011, Nha Trang has 416 trawlers, and their key economic efficiency indicators were illustrated in Table 5.1. They are including the gross revenue, the operational costs (variable costs, maintain, repair and insurance costs), the labor cost, the fixed costs (annual repair and maintains, insurance and registrations fee), the depreciation, the loan interest payment and the calculated interest on owner's capital.

**Table 5.1. The economic performance indicators of trawl samples**

| Criteria | Min | Max | Mean | S.D |
|---|---|---|---|---|
| **Gross Revenue** | **304.4** | **1,286.2** | **691.2** | **254.1** |
| Variable costs | 168.9 | 752.2 | 361.2 | 145.3 |
| **Income** | **95.2** | **638.6** | **330.0** | **133.8** |
| Fixed costs | 30.8 | 102.0 | 49.0 | 18.0 |
| **Gross value added** | **59.4** | **572.7** | **281.0** | **121.8** |
| Labors cost | 47.7 | 387.0 | 166.9 | 87.8 |
| **Gross cash flow** | **- 19.6** | **236.0** | **114.2** | **51,7** |
| Depreciation | 12.0 | 45.0 | 23.5 | 9.6 |
| Interest loans payment | 1.8 | 15 | 7.5 | 4.3 |
| **Profit** | **- 34.6** | **221.2** | **89.4** | **50.1** |
| Calculated interest on owners' capital | 11.2 | 91.0 | 33.9 | 16.5 |
| **Net profit** | **- 57.5** | **197.5** | **55.5** | **49.2** |
| Gross profit margin (%) | - 5.3 | 29.8 | 16.6 | 6.8 |
| Profit margin (%) | - 9.3 | 25.0 | 12.8 | 6.9 |
| Return on Owners' capital (%) | - 13.0 | 60.5 | 26.0 | 14.8 |
| Annual income per fisher | 15.9 | 56.6 | 31.8 | 10.8 |

Source: Own data and calculation; Unit: million VND

From this table, we can see that, the annual gross revenue of trawl fleets in Nha Trang in 2011 was varied from around 304.4 million to 1,286.2 million VND, with an average of 691.2 million VND. In comparison with the gross revenue of themselves in 2005 and 2006, it is three times greater. The average revenue of trawler fleets in Nha Trang in 2006 was only 205.83 million VND (Ngoc et al., 2009). This can be explained that, compared to trawl fleets in 2005 and 2006, the trawl fleets in Nha Trang in 2011 was improved in term of capacity of the trawlers. The average engine power or hull length were significant developed; the average engine power and hull length in 2006 only 35.3 Hp and 11.6 meters (Ngoc, et al., 2009) meanwhile, these figures are 82.5 Hp and 13.9 meters in 2011, respectively. Besides, the depreciative value of currency is also reasonable. Regarding to the revenue of long liners and gill net fleets in Nha Trang, this figure is smaller. The annual gross revenue of long liners and gill net vessels is 845 million VND and 1,073.7 million VND, respectively (Nga, 2009; Duy 2010). The reason behind this is that the long liners and gill net fleets may catch more valuable species.

The variable costs ranked greatly from nearly 170 to over 750 million VND, with an average of 360 million VND. This number is equivalent around 17 thousands US$ and much smaller than variable cost of gill net fleets in Nha Trang in 2005 with more than 35 thousands US$ (Kim Anh et al., 2006). The income is difference between the gross revenue and the variable costs. This number is ranked widely from 95.2 to 638.6 million VND. The average income in 2011 was 330 million VND. The average fixed costs were 49.0 million VND, with a range from 30.8 million to 102.0 million VND. The gross value added is the results of gross revenue minus variable costs and fixed costs with out labor costs. The gross value added varies from 59.4 to 572.7 million VND with an average of 281 million VND. The costs to pay for crew members are huge amounts; with the mean was nearly 170 million VND each vessel and varied from 47.7 to 387 million VND in 2011. After subtracting labors costs, the mean of gross cash flow is 114.2 million VND which corresponding to 16.6% of the gross profit margin. The average depreciation of vessels under surveys also varied from 12 million to 45 million VND, with an average amount of about 23.5 million VND. Besides that, the average loan interest was 7.5 million, with a range from 1.8 million to 15 million VND. Finally, the calculated interest on owner's capital for an average sample vessel were 47.7 million VND; with a range from 16.8 million to 123.2 million VND.

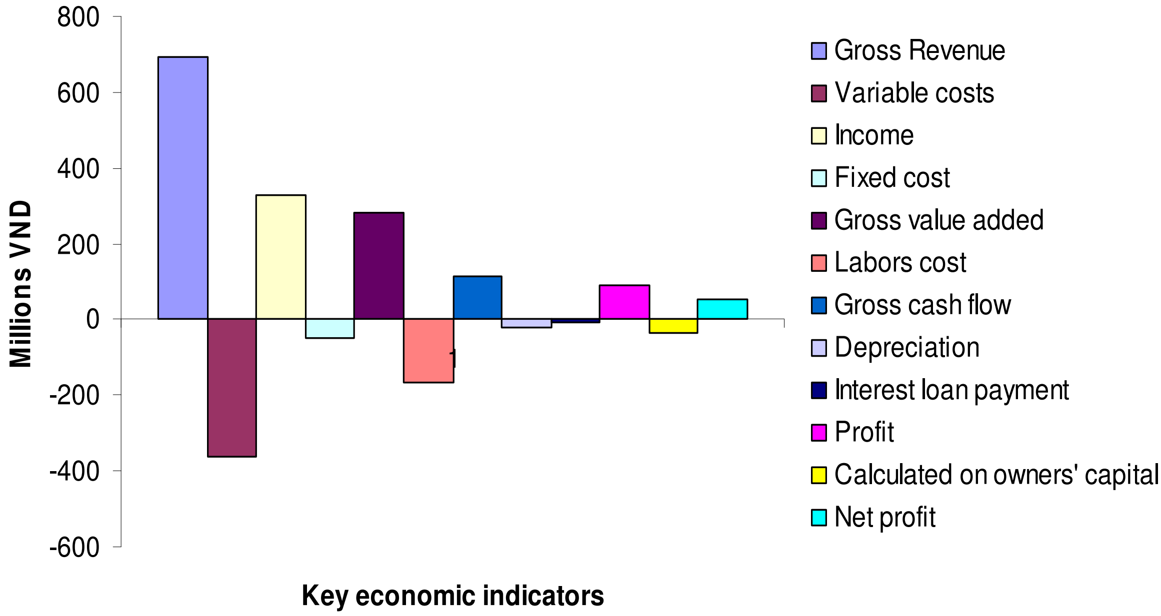



Figure 5.1. Main average economic indicators of a trawler in Nha Trang in 2011

Source: Own data and calculation; Notes: items of costs are signed the negative

By set opposite sign as Figure 5.1 (variable costs, fixed costs, labor costs… are negative and revenue, income, profit… are positive). We can easy to see that, all important average economic performance indicators of trawl fleets in Nha Trang such as the gross revenue, the income, the gross value added, the profit and net profit are positive. The average profit was varied from -34.6 to 221.2 million VND in 2011 with an average number of 89.4 million VND – corresponding to 12.8% of profit margin. As consequence, the owner of trawlers in Nha Trang is not only capable of covering all expenses and depreciation, but also has a significant net reward for whole fishing operations. In open access fisheries regime, the positive results above are quite surprised. However, there were 3 vessels operating on the negative gross cash flow, the profit before minus depreciation, pay of loan interest and calculated owners' capital. And to the end, the net profit was below zero with 4 vessels corresponding to trawler number 25, 46, 53 and 56 (See appendix 4)

The Table 5.2 has shown the key economic indicators following trawler groups among engine power. In order to have deep insight on costs and earnings of trawler fleets, we should focus on costs (variable costs and fixed costs) as well as earnings (the gross revenue, the gross cash flow and the net profit) of trawler among horse power groups. From Table 5.2, we can see that, the larger engine power of trawlers, the higher in variable costs, mainly fuel cost. The reason for this is that bigger vessels often have longer trips or in other words, the higher engine can go further on the sea and that is why their costs are more expense. Consequently, their catch was more, lead to a higher gross revenue (assumed that the fish price is fixed in a short term at January, 2012 and fish landing quantity has no effect on fish price). Although, they catch more and achieve more gross revenue; the variable costs is also higher. That is why, the average income of medium group (60 ≤ Hp < 90) is quite the same of the big one (Hp ≥ 90). And after subtracting all expenses, the medium group's net profit was higher than the bigger one. This can be explained that, fishing costs (variable costs, labors cost…) are more and more increased over the time; meanwhile, fish price is also gone up but have not reached the increased speed of costs. As consequence, the overinvestment may lead to inefficiency in the case of trawl fisheries in Nha Trang, in particularly.

**Table 5.2. Economic performance indicators of trawlers among groups**

| **Criteria** | **Hp < 60 (n=26)** | | **60 ≤ Hp < 90 (n=14)** | | **Hp ≥ 90 (n=17)** | |
|---|---|---|---|---|---|---|
| | **Mean** | **S.D** | **Mean** | **S.D** | **Mean** | **S.D** |
| Gross Revenue | 508.3 | 162.1 | 758.3 | 176.0 | 915.5 | 219.2 |
| Variable costs | 283.4 | 110.2 | 345.3 | 74.7 | 491.3 | 145.6 |
| **Income** | **224.9** | **72.0** | **413.0** | **125.1** | **421.2** | **96.7** |
| Fixed costs | 34.3 | 4.3 | 54.0 | 9.6 | 67.2 | 17.2 |
| **Gross value added** | **190.7** | **73.0** | **359.0** | **120.4** | **354.0** | **88.8** |
| Labors cost | 215.6 | 62.6 | 216.1 | 111.1 | 108.5 | 43.0 |
| **Gross cash flow** | **82.1** | **42.8** | **142.9** | **42.7** | **138.5** | **45.6** |
| Depreciation | 17.4 | 4.1 | 22.2 | 8.4 | 33.7 | 8.3 |
| Interest loans payment | 6.2 | 2.8 | 11.3 | 5.3 | 6.3 | 6.4 |
| **Profit** | **63.8** | **41.8** | **119.1** | **43.8** | **104.0** | **49.2** |
| Calculated interest on owners' capital | 21.3 | 5.3 | 36.3 | 9.0 | 51.1 | 16.0 |
| **Net profit** | **42.5** | **40.6** | **82.8** | **44.9** | **52.9** | **57.7** |
| Gross profit margin (%) | 15.8 | 8.5 | 19.3 | 4.9 | 15.5 | 4.3 |
| Profit margin (%) | 11.9 | 8.6 | 16.0 | 4.8 | 11.6 | 4.6 |
| Return on Owners' capital (%) | 23.4 | 17.2 | 34.8 | 10.5 | 22.4 | 10.6 |
| Annual income per fisher | 36.2 | 14.3 | 49.8 | 19.5 | 44.2 | 11.9 |

Source: Own data and calculation; Unit: million VND

The average economic performance indicators of a trawler fleets in Nha Trang was illustrated in Figure 5.2. From this, we can see that, medium group ($60 \leq Hp < 90$) has highest efficiency in all terms: the gross profit margin, the profit margin or the return on onwers' capital.

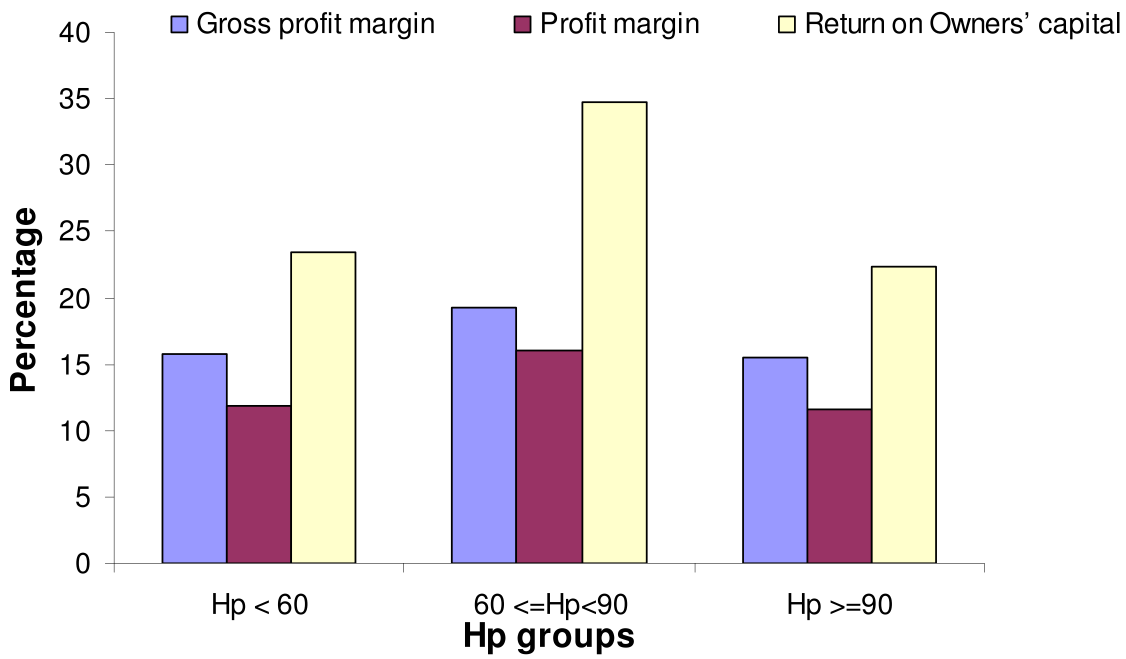



Figure 5.2. Average economic performance indicators of a trawler fleets in Nha Trang among engine power.

Source: Own data and calculation

## 5.2. Econometric results

### *5.2.1. Fishing effort function*

In this section, the regression analysis is performed for proxy. The horse power (Hp), the circumference of the mouth of the net (m) and the number fishing days in 2011 were independent variables. The results were presented in Table 5.3. According to this table, we can see that the sign of the estimated coefficients are positive. The coefficients of horse power, gear and fishing days are 0.29, 0.33 and 0.65 respectively. It means that if increasing horse power, circumference of the trawl and fishing days partially by 10%, the fishing effort will go up by 2.9%; 3.3% and 6.5% respectively, with other variables are kept constant. Moreover, T-values were performed that estimated parameters were significant at 5%. So, in general, the engine power, the circumferences of the trawl and numbers of fishing days of Nha Trang trawler fleets have statistically significant effects on fishing effort.

**Table 5.3. Estimated parameter and test statistics of standardized effort function**

| Variable | Coefficient | Std. Error | T-value | P-value |
|---|---|---|---|---|
| Ln(Hp) | 0.29 | 0.09 | 3.18 | 0.002 |
| Ln(Gear) | 0.33 | 0.11 | 2.98 | 0.004 |
| Ln(Day) | 0.65 | 0.28 | 2.26 | 0.022 |
| Constant | 7.49 | 1.31 | 5.69 | 0.000 |

Dependent variable: Ln (Effort);

R-squared = 0.601; F-statistic = 26.57 (P-value (F-statistic) = 0.000);

DW-statistic = 1.943

Source: Own data and calculation

Also from Table 5.3, we can see that R-squared = 0.601 has shown that 60.1% of variation in fishing effort can be explained by engine power, circumference of trawl and number fished days. The calculated Durbin Waston statistic was d = 1.943. The value of d near to 2 and d = 1.948 > 1.4 suggest no autocorrelation in this model (Hill et al., 2008, p.239). In this case, Jarque Bera (JB) test and White test were conducted for the normal distributions and the heteroskedasticity. The results were illustrated that the JB-value is 2.70, equivalence P-value of 0.259 (25.9%) is greater than 5%. Thus, we can conclude that the errors are normal distributions. The White test was also conducted for heteroskedasticity, and the results had shown that the White test value is 2.877 with p-value equals 0.318. This probability is greater than 5%, so we can conclude that the errors variances are homoskedasticity.

### *5.2.2. Estimate standardized fishing effort and relative standardized fishing effort*

As mentioned on fisheries economic theories part, fishing effort as a proxy for performance of trawlers. Thus, from the results in part 5.2.1 and combined the equation (3.7), we have formulation for standardized fishing effort of each trawler as following:

$$EFFORT_i = Exp(7.49) * Hp_i^{0.29} * Gear_i^{0.33} * Day_i^{0.65} \quad (5.1)$$

On which:

- $Effort_i$ is fishing effort of trawl fleets and the gross revenue is considered as proxy effort of vessel I, which is measured by million VND.
- $Hp_i$ is Engine power of vessel i measured by horse power

- $Gear_i$ is circumferences of trawl operating on vessel i and measured by meter.
- $Days_i$ is number of fishing days of vessel i
- i is vessels i and was ranked from 1 to 57
- A is a constant.

The estimated results of standardized fishing effort and relative standardized fishing effort for 2011 was illustrated on Table 5.4 following:

**Table 5.4. Descriptive Statistics of the standardized effort and the relative standardized effort of trawl fleets in Nha Trang in 2011**

| Criteria | Min | Max | Mean | S.D | Observations |
|---|---|---|---|---|---|
| Standardized fishing effort | 338.8 | 124,5.3 | 670.6 | 198.6 | 57 |
| Relative standardized fishing effort | 0.51 | 1.86 | 1.00 | 0.30 | 57 |

Source: Own data and calculation

The average standardized fishing effort is 670.6 (unit of effort). The vessel number 46 has the minimum standardized effort of 338.8 (units of effort), whereas the maximum standardized effort of 1,245.3 unit effort is amount of fishing efforts of the vessel number 53. The average relative standardized fishing effort is 1.00. The minimum and maximum relative standardized fishing efforts are 0.51 and 1.86, corresponding with vessels number 46 and vessel ID 53, respectively. There were 32 vessels had relative standardized fishing effort less than 1 whereas 25 remaining trawlers is greater than 1. Vessels ID 27, 54 and 60 had relative standardized fishing effort were 1.018, 0.988 and 0.987, respectively which most closely as average standardized effort, equally 1. Thus, vessel ID 54 is the most closely to 1.00, thus it was chosen as standard vessel in order to compare with the others (More details on appendix 3).

Table 5.5. The information of standard vessel

| Vessels ID | Relative standardized fishing effort | Engine power | Trawl circumference | Fishing days | Crew sizes |
|---|---|---|---|---|---|
| 27 | 1.018 | 100 | 31.5 | 208 | 5 |
| **54** | **0.988** | **65** | **27.5** | **258** | **3** |
| 60 | 0.987 | 65 | 28.5 | 253 | 3 |

Source: Own data and calculation

## 5.3. The cost efficiency of trawlers

After estimating the fishing effort functions and calculates relative standardized fishing efforts for each trawler. In this section, we will determine which trawler will have the lowest or highest cost. This is derived from dividing the total variable cost of each trawler by relative standardized fishing efforts of each trawler. After that, we show a Salter diagram as Figure 5.5.

The Figure 5.5 has shown the relationship between relative standardized fishing effort and cost efficiency of 57 heterogeneous surveyed trawlers in Nha Trang in 2011. Of which, the average cost per unit effort and relative standardized fishing effort are illustrated by vertical and horizontal axis, respectively. Thereby, the height of the bar measures cost efficiency whereas relative standardized fishing effort is measured by the width of the bar. The trawlers are arranged from the left to the right according to decreasing their cost efficiency. From that, the trawler no. 29 and trawler no. 9 were the most and the least cost efficient in a short run, with 354.1 million and 812.8 million VND per unit effort, respectively. These trawlers are corresponding to relative standardized fishing effort of 1.41 and 0.70, respectively (See Figure 5.5 and Appendix 5). In additionally, trawler no. 54 was chosen as the standard vessel (with $AVC_{54}$ was 404.7 million VND per unit effort) which has relative standardized fishing effort most closely to 1.00 to against which the effort of the others is measured. Since that, there were 25 vessels with relative standardized fishing effort more than 1.00. Of which, 17 vessels had average variable costs less than 404.7 million VND ($AVC_{54}$) including vessel ID 42, 26, 39, 19, 12, 40, 52, 30, 31, 18, 34, 14, 11, 8, 32, 29 and 35. These trawlers were considered as have more cost efficiency than standard vessel (ID54) on fishing operation under open access fisheries condition.

## 5.4. Profit under open access fisheries regime

In this section, the profit of each vessel was illustrated by calculate the average gross revenue per relative standardized fishing effort of each trawler in Nha Trang in 2011. This feature was illustrated in Figure 5.6. This figure presented the average revenue per relative standardized effort corresponding to each vessel along the vertical axis and number of vessels along the horizontal axis. From this figure, we can see clearly that why profit still generated in open access fisheries regime, the particular case of trawl fleets in Nha Trang. Figure 5.6 had shown that, the minimum and maximum economic efficiency by gross revenue per relative effort were 430 and 1,176.2 million VND, which corresponding to vessel ID 56 and vessel no.10 respectively. And the average gross revenue per relative fishing effort was 720.3 million VND, corresponding to vessel ID 28 which had gross revenue per relative effort was 721.0 million VND, most closely to average number and relative standardized fishing effort was 1.22. Thus, the trawler no.28 was chosen as standard vessel on gross revenue in order to compare with the others. Since that, there were 33 trawlers had a smaller average gross revenue than vessel 28 and the remainder was higher.

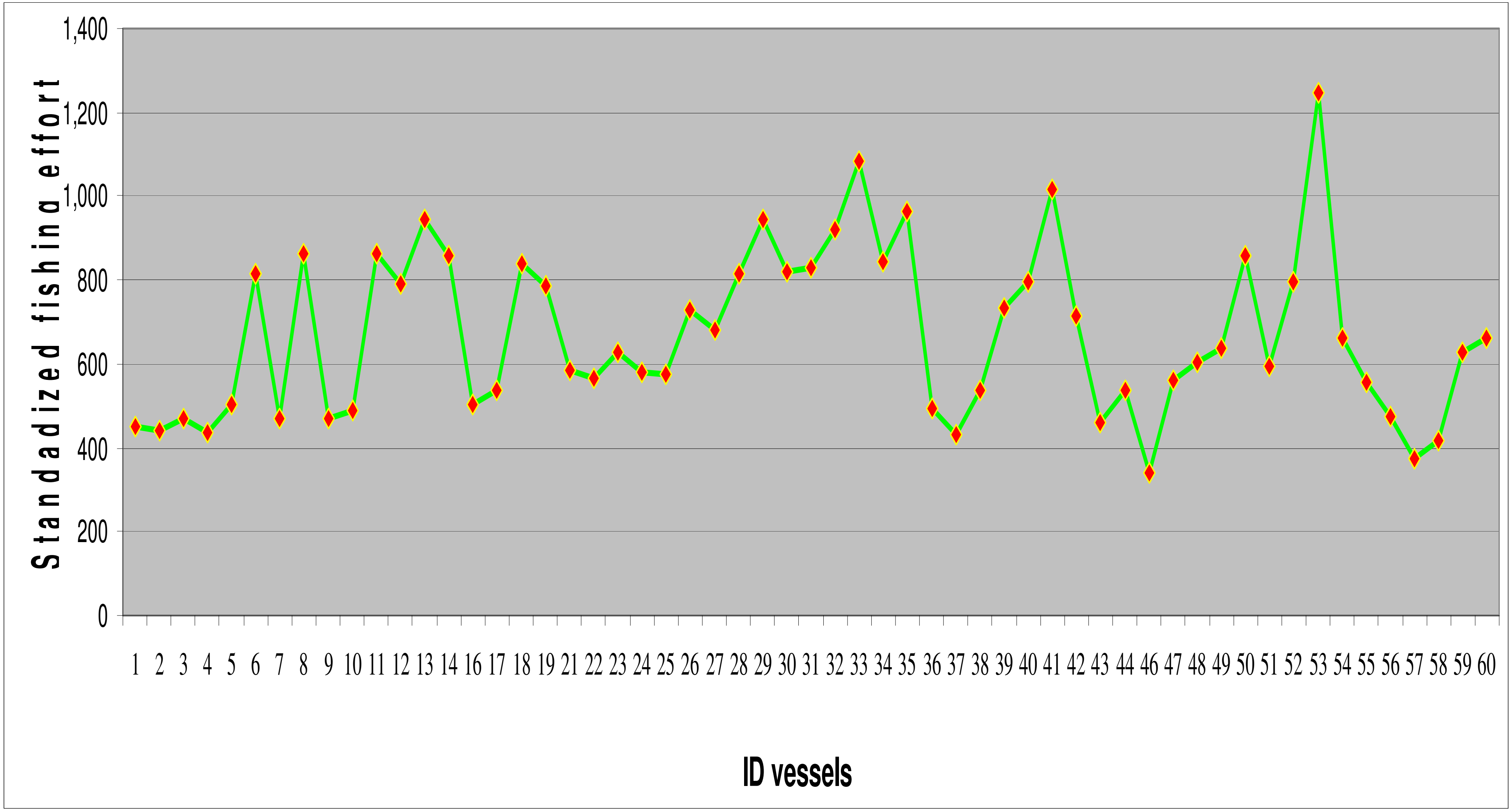



Figure 5.3. Standardized fishing effort of the 57 observed trawler in Nha Trang in 2011

Source: Own data and calculation

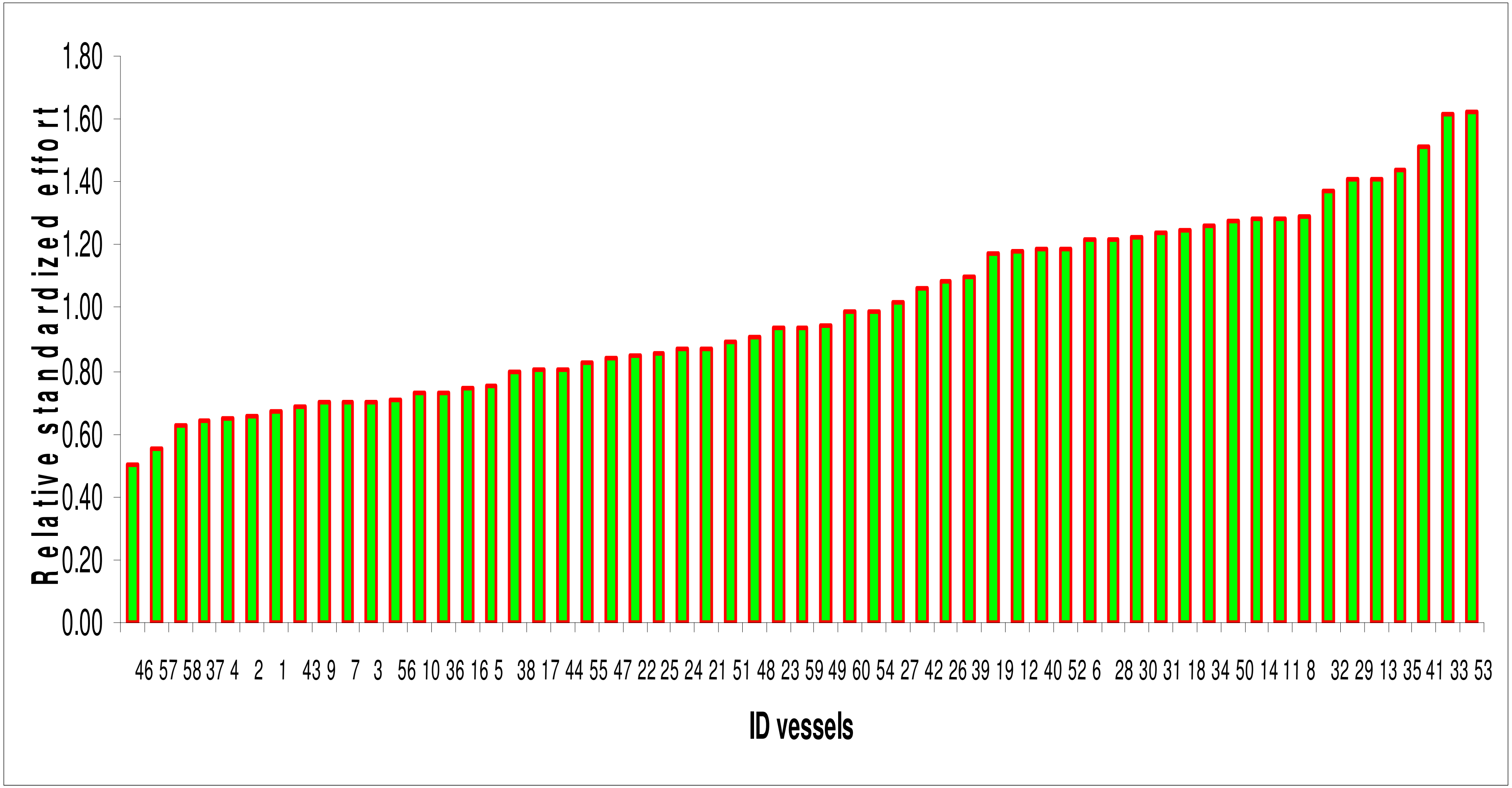



Figure 5.4. Relative standardized fishing effort of the 58 the gillnet vessels.

Source: Own data and calculation; Notes: The values were sorted from the lowest to the highest effort level

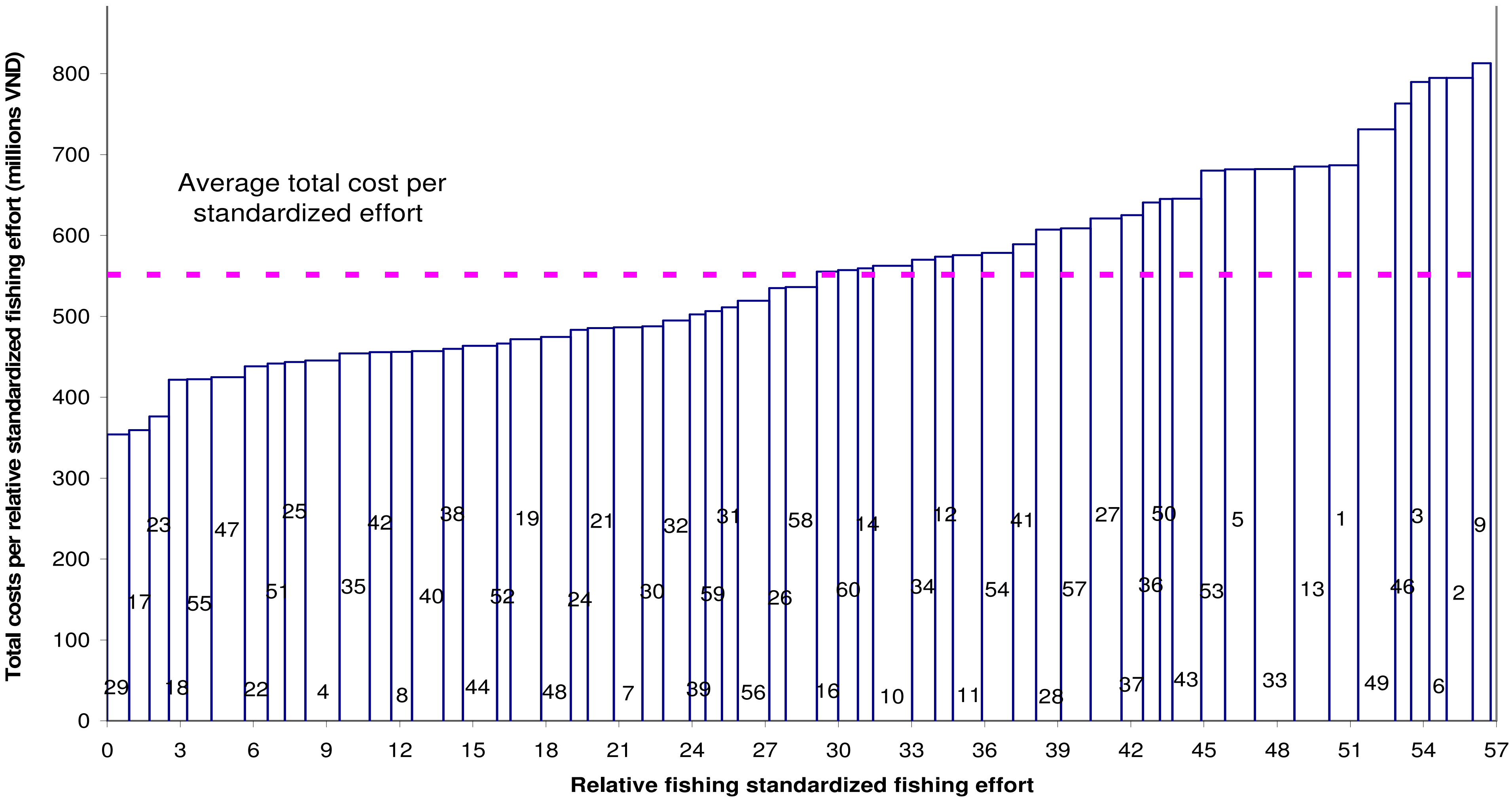



Figure 5.5. The cost efficiency of relative standardized effort in the short run*

Notes: * Salter diagram; Source: Own data and calculation

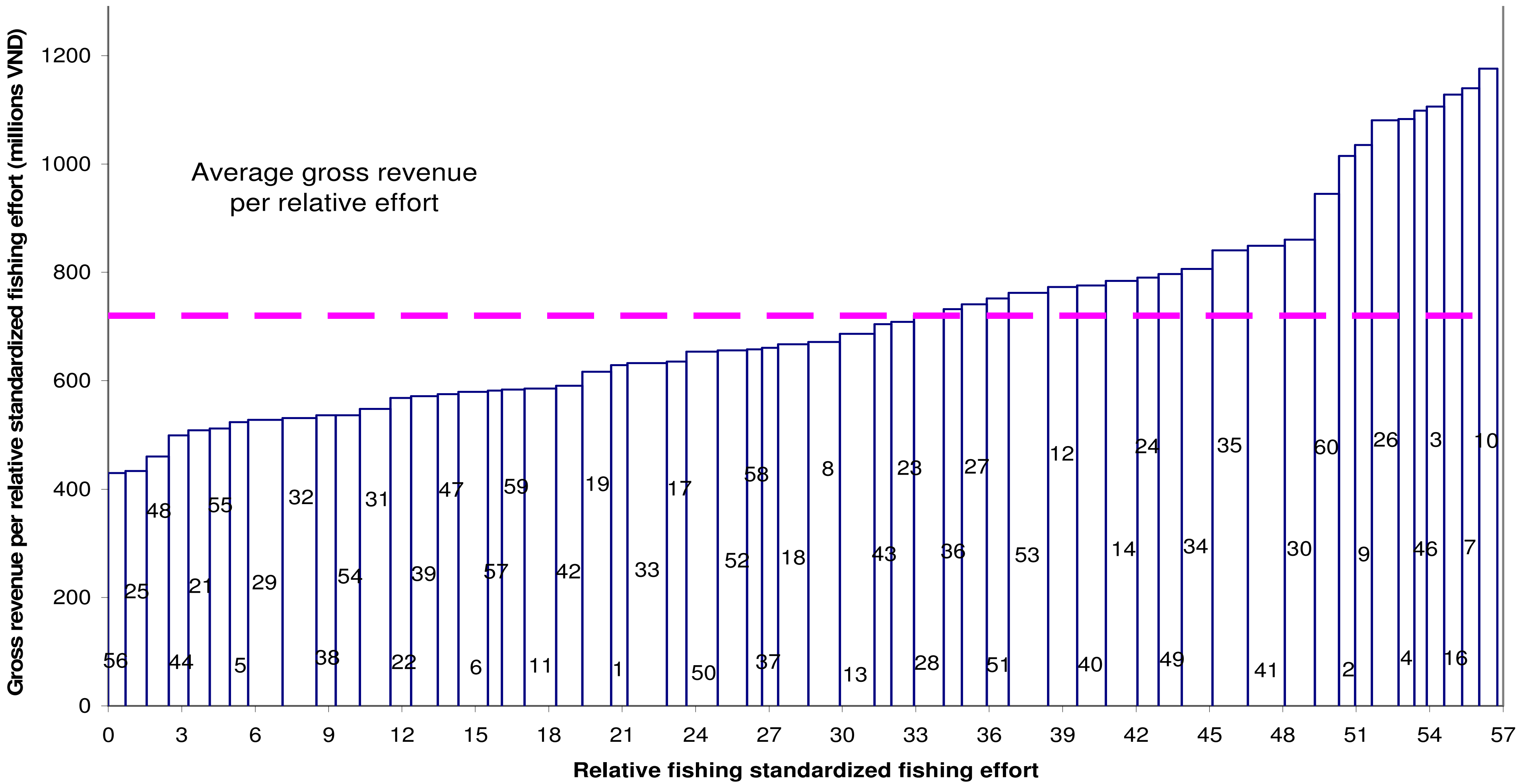



Figure 5.6. The gross revenue per relative standardized effort of trawl fleets in Nha Trang*

Notes: * Salter diagram; Source: Own data and calculation

# Chapter 6 DISCUSSIONS

## 6.1. The technical and operational characteristics of trawlers in Nha Trang

From average physical characteristics of trawlers in Nha Trang (hull length, hull width and engine power), we can see that the capacity of trawlers was improved considerably compared with the previous 5 years. The average engine power and hull length of trawl fleets in Nha Trang was increased from 35.3 Hp and 11.6 meters in 2005 (Ngoc, et al., 2009) to 82.5 Hp and 13.9 meters, respectively. Notwithstanding, they are much smaller than the other fleets such as long liners and gill nets. The average length and engine power of long liners are 15.1 m, 121.9 Hp (Long et al., 2008) and gill net fleets are 16.4m and 249.6 Hp (Duy, 2010). From this, we may have a primary conclusion that the trawl fleets in Nha Trang are smaller than long liners and gill net fleets, in term of physical characteristics of vessels. As a consequence, the average annual numbers of fished days of trawlers are lower than these fishing gear types. The reason behind this is that the long liners and gill netters often go further to the sea and have long trips meanwhile trawlers usually operate nearer and have three to five fishing days each trip.

Trawlers in Nha Trang often went to sea 225 days, on average in 2011, corresponding 54 trips per year with an average of 4.6 days per trip. This feature is quite similar to gill net fleets in 2009, with 231 fished days (Duy, 2010), but much more than the case of long liners in 2008, with 100 days at sea, in average (Nga, 2009). Of which, the medium group have 206 days and two other groups often catch during approximately 240 days, annually. As per the results in 5.2.1, the coefficient of the number of fishing day variance was 0.65. It means that the number of fishing days were most effect on fishing effort (if increasing 10% on fished days, the effort will go up 6.5%). The explanation is that, the fishing effort of trawlers, actually, is the swept areas that trawlers towed. And the swept areas equal the circumference of the mouth multiplied by the dredged line. Of which, the dredged line equals the speed of vessels multiplied by towed time. In other words, the fishing effort of trawlers equal the circumference multiplied vessel speed multiplied by dredged time. That is why the gear or the circumference of the month was the variance which has the second effect on trawler effort.

## 6.2. The key economic efficiency indicators

This study has been evaluated and measured the economic efficiency of trawl fleets in Nha Trang, based on 57 surveys on costs and earnings data in 2011. The results have shown key economic performance indicators as follows:

The input indicators, the average variable costs of trawlers in Nha Trang in 2011 are 361.2 million VND. This figure, in comparison, is lower than the case of offshore gill net fleets in 2009, 604.4 million VND (Duy, 2010) and offshore long liners in 2008, 460.7 million VND (Nga, 2009). The reason for this, as mentioned, is that trawler often have shorter trips and nearer fishing grounds. Of which, the fuel cost was accounted for a huge scale on variable costs, 76% in average. And almost all gill nets and long liners had more fished days, 230 days and 245 days and the machine is more power than trawlers, 250 Hp and 126 Hp, respectively. That is why their operating cost is higher than trawlers.

The output indicators, all indicators on average are positive. This result is quite surprising on an open access fisheries regime. However, this result is the same as with the case of tuna offshore long liners in Khanh Hoa in 2004 (Long et al., 2008) and offshore gill nets in Nha Trang in 2004 and 2005 (Kim Anh et al., 2006). This result can be explained by the following reasons: First, these indicators varied greatly, for example net profit was ranked from – 57.5 to 197.5 million VND, meanwhile the standard deviations are also high. In cases of profit and net profit, the standard deviation (49.2 million VND) approximately equals means values (55.5 million VND), or the value of standard deviations may even be twice as high as the average values, as in the cases of income, gross value added, gross cash flow (see Table 5.1). From this it is shown that, some trawlers can record good efficiency, saving fishing costs but the others suffer the high cost and low earnings, which results in massive losses. The second, the using of mesh size at the cod-end of local trawlers in Nha Trang is so small, the average value is 16.7 mm and varied from 12 to 25 mm, much smaller than regulations, 28 mm, (Circular No. 02/2006 TT/BTS and 62/2008 TT/BNN). This may catch more small fish, juveniles, trash fish and by-catch. Thus, from an economic point of view, a smaller mesh size can catch more fish, get higher yield and gross revenues (or fishers' profit) are increased, as a consequence. However, unregulated mesh size operated on an open access fisheries regime only gets profit on a short run and is unsustainable (Chien et al., 2009). Hence, unregulated mesh sizes of trawl fisheries are really problems for policy makers.

The average gross profit margin and average profit margin indicators are 16.6% and 12.8%, respectively. This implies that trawl owners in Nha Trang have managed well on fishing expenses (including depreciation, interest loan payment). However, there were three trawlers which can not recover the operating costs (variable costs, fixed costs and labors costs). In other words, their gross cash flow is negative. All of these three vessels are in small group (Hp < 60) which also had a lowest average gross cash flow, and average net profit.

Another interesting result is that the vessels which are over 90 Hp, or varied from 60 to 90 Hp have the same fished days. From the economic indicators of these two groups, we can see that, the bigger group has higher average gross revenue (915.5 million VND) than the remaining group (758.3 million VND), but also higher in variable costs and fixed costs as well (491.3 and 67.2 million in comparison with 345.3 and 54 million VND, respectively). As result, the profit (104 million) and net profit (52.9 million) of big group is less than medium group (119 and 82.8 million VND in orders). This has shown that in the case of trawl fleets in Nha Trang, bigger and bigger vessels may lead to catching more and more but may be not more and more efficient. So, a primary conclusion here is that overinvestment on particular trawlers may lead to inefficiency in trawl fisheries in Nha Trang. Beside that, the variable costs varied greatly between groups. The average numbers of small, medium and big group are 283.4, 345.3 and 491.3 million VND, respectively. It is also noteworthy that the bigger vessels often had longer trips and the variable cost is higher.

### 6.3. Econometric models.

The regression analysis results had shown that, the number of fishing days has strongest effect on standardized fishing effort of trawl fisheries with coefficient of 0.65. It means that the fished days are directly proportional to efficiency of trawlers. This result is somewhat reasonable from interviewing results. However in the reality, it is not true in an open access fisheries condition. Or if it is true, only in the short run because of following reasons: The number days at sea mostly depend on capacity of vessels and capital investment of owners. It is not all owners who have financial potentials to develop or improve their vessels. Thus, almost all trawlers in Nha Trang had 3 to 5 fished days each trip, or longest is only one week for very big trawlers. Moreover, the resources are limited, or even seriously decreasing. And in an open access fisheries regime, the profit is for the short run and unsustainable (Pomeroy et al., 2008; Chien et al., 2009).

Besides that, the trawl's mouth and engine power are significant variables on performance of trawl fisheries in Nha Trang. Of which, the mouth of the net are second independent variable impact to trawlers operation. As mentioned on 3.4 of Chapter 3, if we assume the fish densities in a certain fishing ground are fixed, the fishing effort of a trawler now is the swept areas that the trawl dredged. This areas equal the circumference of the mouth multiplies the dredged time and multiplies towed speed of vessel. This determines that the trawl performance not only is affected by circumference but again also focuses on dredged time or fished days.

### 6.4. Standardized fishing effort and relative standardized effort

This study also estimated the standardized fishing effort of each vessel in order to measure relative standardized effort of individual trawler by using production function. Since that, the relative standardized fishing effort is varied greatly from 0.51 to 1.86 with an average of 1.00. This is one more determinant that, trawlers in Nha Trang are heterogeneous in term of effort and cost structures. As a consequence, their economic efficiency and relative standardized effort are different. The reasons to explain for this are that vessels and trawlers were made by fishers' experiences; the levels of investment also depend on financial capability of individual owner; many fishing activities were also based on fishers' experiences.

# Chapter 7 CONCLUSIONS

By using economic performance indicators, this study evaluated and measured the economic efficiency of trawl fisheries in Vietnam in 2011; the case of trawl fleets in Nha Trang city, Khanh Hoa province based on 57 costs and earnings surveys. The descriptive statistics show that trawlers in Nha Trang are heterogeneous in term of technical and operational characteristics as well as cost and capital structures. The technical characteristics (engine power, length and width of hull) of trawlers are smaller than gill net, long liners (Long et al., 2008, Nga, 2009, Duy et al., 2012). The operational information of trawl fleets also varied greatly including costs and earnings structures.

Regarding economic efficiency, the trawl fleets achieved a high economic performance in 2011, generally. This result is close to what were expected based on fisheries economic theories. Therefore, the trawl fisheries in Nha Trang are forecasted that may continue expanding and attracting more in the near future. However, by using unregulated mesh sizes and destructive trawls will lead to unsustainable development and overexploitation (Pomeroy et al., 2008; Chien et al., 2009).

An interesting result is that the medium trawlers ($60 \leq Hp < 90$) are considered as the most efficient. The high operating costs are the main reasons lead to less efficient of bigger trawlers. So, an important conclusion from this study is that overinvestment on particular trawlers may lead to inefficiency in the case of Nha Trang trawl fisheries. Besides that, the econometric results illustrated that the number of fishing days was the strongest factor which effect to efficiency of trawl fleets in Nha Trang. And the engine power, the circumference of the net mouth had significant effects on fishing effort.

From the fisheries management point of views, the assessment of trawl fleets economic efficiency may consider as a key element to manage and develop sustainable fisheries. From the results of this study, policy implications on fisheries management were arisen including: The first, It is not high on investment will achieve high efficient on trawl fisheries. Thus, the Government should investigate more detail before decide to invest or subsidize on fishing activities. Moreover, overinvestment may lead to inefficient in case of trawl fleets. Secondly, the status of using unregulated mesh sizes may lead to overexploitation, marine resources destructions, increasing juvenile catch and conflicts between trawlers and other gear types also will be increased… Therefore, the governmental and local authorities have to manage, test, monitor and restrict the operation of illegal mesh sizes as well as destructive fishing gears.

Although this study found interesting results, with only 2011 data, the overall economic efficiency of trawl fleets is difficult to determine. Thus further researches are recommended to collect more data to create cross sectional and time series data, including socio-economic information of local communities. Simultaneously, future studies should use stronger analysis methods such as DEA (data envelopment analysis), SFPF (Stochastic frontier Production Function) for a comparison and give more exact suggestions.

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## LIST OF APPENDICES

Appendix 1: The questionnaires

UNIVERSITY OF TRUMSO NHA TRANG UNIVERSITY

**MASTER OF SCIENCES IN FISHERIES AND AQUACULTURE MANAGEMENT AND ECONOMIC PROGRAM – COHORT 4**

**QUESTIONAIRE ON INSHORE TRAWL FISHERIES IN NHA TRANG, KHANH HOA PROVINCE, VIETNAM**

**I. General information:**

Name of interviewer ..........................................................................................................

Address ..............................................................................................................................

Tel or E-mail.......................................................................................................................

Name of interviewee...........................................................................................................

Age…………… Vessel owner is captain or not? Yes □ No □ ..................................................

Address ..............................................................................................................................

Registered Number of vessel .............................................................................................

**II. Information about vessel and equipments.**

| **Items** | **Basic information** | **Purchased year** | **Value (1000 VND)** | **Estimated present value** (Mil VND) | **Built year** | **Estimated lifespan** |
|---|---|---|---|---|---|---|
| Hull | | | | | | |
| Engine | | | | | | |
| Trawl | | | | | | |
| Roller | | | | | | |
| Electronic equipments | | | | | | |
| Others | | | | | | |
| **Total** | | | | | | |

**III. Information about gear**

- The mesh size at the cod end (mm) ........................................................................
- The mesh size at the trawl's mouth (mm) ................................................................
- Number of mesh at the cod end (mesh).....................................................................
- Number of mesh at the mouth of the trawl.................................................................

..............................................................................................................................................

..............................................................................................................................................

**IV. Information about labor**

| Captain | Crew (including captain) |
|---|---|
| 1. Captain information<br>- Does Captain have certification? Yes ☐No ☐<br>- Captain's educational level........................<br>- Captain's age:..........................................<br>- Captain's experience.................................<br>- Captain vocational training time..............<br>- Does Captain come from traditional fishing household? Yes ☐No ☐ | 2. Average crew size (persons):…….<br>3. Income/person (1000 VND)<br>a. Average income/trip of owner:.........<br>b. Average income/trip of crew…:........<br>4. Income/household per month (Mil VND)<br>a. From capture fisheries………………..<br>b. From others………………………….. |

**V. Information about operating time**

| **Number of fishing days** | **Months** (Trip per month x days per trip) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Nov | Oct | Dec |
| 2011 | | | | | | | | | | | | |

**VI. Information about harvest and revenue of fishing operation.**

| **1. Average quantity of harvested species per trip** | **Yield (kg)** | **Price (1000VND)** |
|---|---|---|
| a. Species 1 (kg) | | |
| b. Species 2 (kg) | | |
| c. Species 3 (kg) | | |
| d. Species 4 (kg) | | |
| e. Trash fish (kg) | | |
| f. Others (kg) | | |
| 2. Total revenue for all (1000 VND) | | |
| 3. Average revenue per trip (1000 VND) | | |
| Describe how to share revenue? ……………………………………………………………..<br>……………………………………………………………………………………………….. | | |

**VII. Average variable costs/trip**

| **Items** | **Unit** | **Quantity** | **Price** (1.000 VND) | **Value** (Mil VND) |
|---|---|---|---|---|
| 1. Fuel | | | | |
| 2. Lubricant | | | | |

| | | | | |
|---|---|---|---|---|
| 3. Ice (pack) | | | | |
| 4. Food | | | | |
| 5.Minor repairs | | | | |
| 6. Others | | | | |
| Total | | | | |

**VIII. Annual repair and maintenance**

| **Items** | **Costs** (1000VND) |
|---|---|
| 1. Hull | |
| 2. Engine | |
| 3. Equipments | |
| 4. Fishing gear | |
| 5. Others | |
| Total | |

**IX. Insurance and fee**

| **Items** | **Costs** (1000 VND) |
|---|---|
| 1. Insurance for vessel | |
| 2. Insurance for crews | |
| 3. Annual registration fee | |
| 4. Other fee | |
| Total | |

**X. Loan**

| **Source of loans** | **Monetary value** | **Time of borrowing** | **Debt at end of year (1000 VND)** | **Interest payment in year** |
|---|---|---|---|---|
| 1. Program | | | | |
| 2. Bank | | | | |
| 3. Private | | | | |
| Total | | | | |

**XI. Income and characteristics of household**

| Source | 2009 | 2010 | 2011 |
|---|---|---|---|
| From fishing operation | | | |

| | | | |
|---|---|---|---|
| Others | | | |
| Total | | | |

Characteristics of family members:

- How many members in your family? ………………
- How many members who participate fishing operation? ……………………

**XII. Assessments of interviewer**

1. The harvest of this year compared with previous years:

More than:……..% Less than: ………% Unchanged:………….

2. Have you ever participated any training course on resources protection? Yes □ No □

If yes, is it effective? ..........................................................................................................

..........................................................................................................................................

3. Do you know about reducing fishing vessels policy of Gov, especially inshore vessels?........

..........................................................................................................................................

4. According to you, should we close inshore capture fisheries? Yes □ No □ Why?.................

..........................................................................................................................................

5. Fishing ground (longitude…………..……….…….latitude …………………………………)

Why is not a further ground?...............................................................................................

6. Operational expenses in this year compared with previous years:...................................

More than:……..% Less than: ………% Unchanged:………….

7. The income of crews from fishing in this year compared with previous years:

More than:……..% Less than: ………% Unchanged:………….

8. What reasons have the most effect on your fishing performance in the year (Numbered by increasing of effecting level) Input price (Fuel, food……..) □ Fish price: □ Harvest □ Engine power: □ Fishing gear □; Experience of Captain and crew □; Weather □

9. Which are the most important factors of trawl fisheries in order to increase fishing harvest?

□ Size of vessel or engine power □ Size of trawl □ Modern fishing equipments

□ Experience of crews and Captain □ Ability of finding fishing grounds

□ Cooperation among different vessel owners, middle buyers

***Thank you very much for your useful information!***

*Nha Trang, date…………………………*

**Interviewee** **Interviewer**

Appendix 2. The total product of capture fisheries in Vietnam from 1990 to 2010

| Year | Total fisheries products | | | | | |
|---|---|---|---|---|---|---|
| | Total | Aquaculture | Capture | Marine Capture | | Inland Capture |
| | | | | Total | Fish | |
| 1990 | 890.6 | 162.1 | 728.5 | 653.2 | 615.8 | 75.3 |
| 1991 | 969.2 | 168.1 | 801.1 | 694.2 | 614.6 | 106.9 |
| 1992 | 1016.0 | 172.9 | 843.1 | 730.0 | 627.4 | 113.1 |
| 1993 | 1100.0 | 188.1 | 911.9 | 785.3 | 660.0 | 126.6 |
| 1994 | 1465.0 | 344.1 | 1120.9 | 946.3 | 712.5 | 174.6 |
| 1995 | 1584.4 | 389.1 | 1195.3 | 990.3 | 722.1 | 205.0 |
| 1996 | 1701.0 | 423.0 | 1278.0 | 1058.7 | 808.2 | 219.3 |
| 1997 | 1730.4 | 414.6 | 1315.8 | 1098.7 | 835.3 | 217.1 |
| 1998 | 1782.0 | 425.0 | 1357.0 | 1155.2 | 856.7 | 201.8 |
| 1999 | 2006.8 | 480.8 | 1526.0 | 1314.6 | 974.7 | 211.4 |
| 2000 | 2250.9 | 590.0 | 1660.9 | 1419.6 | 1075.3 | 241.3 |
| 2001 | 2435.1 | 710.3 | 1724.8 | 1481.2 | 1120.5 | 243.6 |
| 2002 | 2647.9 | 845.3 | 1802.6 | 1575.6 | 1189.6 | 227.0 |
| 2003 | 2859.8 | 1003.7 | 1856.1 | 1647.1 | 1227.5 | 209.0 |
| 2004 | 3143.2 | 1203.2 | 1940.0 | 1733.4 | 1333.8 | 206.6 |
| 2005 | 3466.8 | 1478.9 | 1987.9 | 1791.1 | 1367.5 | 196.8 |
| 2006 | 3721.6 | 1695.0 | 2026.6 | 1823.7 | 1396.5 | 202.9 |
| 2007 | 4199.1 | 2124.6 | 2074.5 | 1876.3 | 1433.0 | 198.2 |
| 2008 | 4602.0 | 2465.6 | 2136.4 | 1946.7 | 1475.8 | 189.7 |
| 2009 | 4870.3 | 2589.8 | 2280.5 | 2091.7 | 1574.1 | 188.8 |
| Prel. 2010 | 5127.6 | 2706.8 | 2420.8 | 2226.6 | 1648.2 | 194.2 |

Source: GSO, 2011

Appendix 3. Technical characteristics of trawler fleets in Nha Trang in 2011

| ID | Hull | | | Hp | Mesh Size (mm) | Cir (m) | Captain Exp | Crews | Days | Days Per trip | Trips |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Length | Width | High | | | | | | | | |
| VL01 | 14.1 | 3.2 | 1.25 | 55 | 15 | 27.5 | 18 | 3 | 153 | 3 | 51 |
| VL02 | 13.9 | 3.5 | 1.3 | 55 | 13 | 24.7 | 20 | 3 | 156 | 3 | 52 |
| VL03 | 13.8 | 3.4 | 1.5 | 55 | 15 | 29.0 | 25 | 3 | 159 | 3 | 53 |
| VL04 | 9.4 | 2.4 | 1 | 40 | 13 | 20.0 | 20 | 3 | 199 | 2 | 99 |
| VL05 | 14.7 | 3.7 | 1.6 | 55 | 15 | 27.5 | 7 | 3 | 182 | 4 | 45 |
| VL06 | 14.5 | 3.8 | 1.5 | 80 | 17 | 56.0 | 20 | 4 | 225 | 6 | 37 |
| VL07 | 13.1 | 3.1 | 1.3 | 44 | 12 | 20.0 | 23 | 3 | 212 | 2 | 106 |
| VL08 | 14.9 | 4.2 | 2 | 80 | 18 | 61.2 | 20 | 5 | 236 | 5 | 47 |
| VL09 | 10.7 | 2.8 | 1.4 | 44 | 12 | 20.2 | 18 | 3 | 210 | 3 | 70 |
| VL10 | 13.8 | 3.4 | 1.5 | 44 | 13 | 21.6 | 17 | 3 | 219 | 2 | 109 |
| VL11 | 14.9 | 4.2 | 2.2 | 80 | 17 | 57.6 | 16 | 5 | 242 | 6 | 40 |
| VL12 | 14.7 | 3.6 | 1.5 | 70 | 16 | 52.5 | 20 | 5 | 236 | 4 | 59 |
| VL13 | 14.7 | 4 | 1.9 | 80 | 18 | 67.5 | 20 | 5 | 258 | 5 | 52 |
| VL14 | 12.9 | 4 | 1.8 | 80 | 17 | 52.5 | 12 | 5 | 253 | 5 | 51 |
| VL16 | 16.3 | 3.6 | 1.5 | 44 | 12 | 22.8 | 15 | 3 | 220 | 2 | 110 |
| VL17 | 12.9 | 3.2 | 1.5 | 44 | 12 | 27.0 | 20 | 3 | 225 | 3 | 75 |
| VL18 | 14.4 | 4.2 | 2 | 70 | 15 | 54.6 | 15 | 3 | 253 | 5 | 51 |
| VL19 | 14.9 | 4.4 | 2 | 70 | 13 | 47.6 | 13 | 5 | 247 | 5 | 49 |
| VL21 | 12.6 | 3.5 | 1.6 | 55 | 13 | 31.0 | 20 | 3 | 216 | 4 | 54 |
| VL22 | 13.5 | 3.8 | 1.7 | 50 | 15 | 26.1 | 12 | 3 | 235 | 4 | 59 |
| VL23 | 15.8 | 3.6 | 1.5 | 50 | 13 | 39.0 | 25 | 3 | 223 | 3 | 74 |
| VL24 | 14.6 | 3.5 | 1.6 | 50 | 15 | 32.0 | 15 | 3 | 220 | 3 | 73 |
| VL25 | 15.9 | 3.9 | 1.6 | 50 | 15 | 29.2 | 20 | 3 | 226 | 4 | 56 |
| VL26 | 14 | 4 | 2 | 90 | 20 | 40.6 | 25 | 5 | 211 | 3 | 70 |
| VL27 | 15 | 4.5 | 2 | 100 | 22 | 31.5 | 8 | 5 | 208 | 5 | 42 |
| VL28 | 14.5 | 4 | 2 | 120 | 20 | 36.0 | 12 | 5 | 236 | 5 | 47 |
| VL29 | 15 | 4.5 | 2 | 160 | 25 | 41.2 | 15 | 5 | 242 | 7 | 35 |
| VL30 | 16 | 4 | 1.8 | 140 | 20 | 28.5 | 15 | 5 | 250 | 5 | 50 |
| VL31 | 15 | 5 | 2 | 140 | 20 | 37.4 | 20 | 5 | 222 | 7 | 32 |
| VL32 | 15.4 | 4.5 | 2 | 140 | 20 | 39.6 | 15 | 5 | 253 | 7 | 36 |
| VL33 | 15 | 4.5 | 2 | 180 | 25 | 56.2 | 20 | 5 | 242 | 7 | 35 |
| VL34 | 15 | 4.5 | 2 | 140 | 18 | 31.3 | 20 | 5 | 250 | 5 | 50 |
| VL35 | 16 | 4.5 | 2 | 160 | 22 | 35.7 | 10 | 5 | 269 | 6 | 45 |
| VT36 | 12.4 | 3.2 | 1.2 | 44 | 15 | 21.0 | 15 | 3 | 223 | 3 | 74 |
| VT37 | 12.6 | 2.8 | 1.2 | 44 | 15 | 23.5 | 15 | 3 | 172 | 3 | 57 |
| VT38 | 15.8 | 3.9 | 1.7 | 50 | 15 | 22.5 | 7 | 3 | 232 | 4 | 58 |
| VT39 | 13.2 | 3.2 | 1.5 | 100 | 18 | 27.5 | 18 | 5 | 250 | 7 | 36 |
| VT40 | 15.7 | 4 | 2 | 120 | 20 | 29.0 | 12 | 5 | 253 | 5 | 51 |
| VT41 | 15 | 4 | 1.8 | 220 | 20 | 39.0 | 12 | 5 | 242 | 6 | 40 |
| VT42 | 14 | 4 | 2 | 110 | 18 | 29.2 | 15 | 5 | 222 | 7 | 32 |
| VT43 | 12.4 | 3.5 | 1.2 | 55 | 15 | 14.8 | 12 | 3 | 216 | 4 | 54 |
| VT44 | 11 | 2.7 | 1.2 | 55 | 15 | 20.2 | 20 | 3 | 236 | 5 | 47 |
| VT46 | 12.4 | 3.2 | 1.2 | 44 | 12 | 13.7 | 18 | 3 | 156 | 3 | 52 |
| VT47 | 11.8 | 2.8 | 1.2 | 55 | 15 | 20.2 | 10 | 3 | 253 | 5 | 51 |
| VT48 | 12.5 | 3.2 | 1.5 | 60 | 18 | 26.9 | 20 | 3 | 236 | 6 | 39 |
| VT49 | 13 | 3.8 | 1.5 | 80 | 20 | 30.0 | 27 | 5 | 211 | 5 | 42 |
| VT50 | 14 | 4 | 1.6 | 140 | 20 | 32.5 | 16 | 5 | 250 | 7 | 36 |
| VT51 | 14.5 | 4 | 2 | 80 | 20 | 25.5 | 20 | 5 | 208 | 5 | 42 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| VT52 | 14.3 | 3.5 | 1.5 | 90 | 20 | 43.2 | 25 | 3 | 236 | 5 | 47 |
| VT53 | 14.6 | 4.5 | 2.2 | 250 | 20 | 52.5 | 15 | 5 | 269 | 7 | 38 |
| VT54 | 12.4 | 3.3 | 1.5 | 65 | 18 | 27.5 | 17 | 3 | 258 | 5 | 52 |
| VT55 | 14 | 3.5 | 1.6 | 55 | 15 | 20.2 | 12 | 3 | 247 | 6 | 41 |
| VT56 | 11 | 2.5 | 1.2 | 55 | 15 | 15.2 | 14 | 3 | 225 | 5 | 45 |
| VT57 | 12 | 3 | 1.2 | 44 | 12 | 17.6 | 13 | 3 | 159 | 4 | 40 |
| VT58 | 12 | 3.5 | 1.2 | 44 | 15 | 19.2 | 16 | 3 | 182 | 3 | 61 |
| VT59 | 13.8 | 3.5 | 1.4 | 60 | 18 | 28.6 | 20 | 3 | 242 | 5 | 48 |
| VT60 | 16 | 4 | 2 | 65 | 18 | 28.5 | 25 | 3 | 253 | 3 | 84 |

Source: Own data and calculation

Appendix 4. Operational characteristics of trawlers in Nha Trang in 2011

| ID | Gross Revenue | TVC | Income | Fixed cost | Gross Value Added | Labor cost | Gross Cash Flow | Profit | Net Profit |
|---|---|---|---|---|---|---|---|---|---|
| VL01 | 421.3 | 219.3 | 202.0 | 43.6 | 158.4 | 76.5 | 81.9 | 61.4 | 36.2 |
| VL02 | 427.7 | 226.2 | 201.5 | 30.8 | 170.7 | 78.0 | 92.7 | 63.0 | 32.2 |
| VL03 | 410.2 | 254.4 | 155.8 | 35.8 | 120.0 | 47.7 | 72.3 | 41.3 | 16.1 |
| VL04 | 706.5 | 412.9 | 293.5 | 30.8 | 262.7 | 119.4 | 143.3 | 122.3 | 98.5 |
| VL05 | 392.7 | 207.0 | 185.6 | 40.8 | 144.8 | 68.3 | 76.6 | 56.0 | 39.2 |
| VL06 | 703.3 | 322.5 | 380.8 | 66.0 | 314.8 | 187.5 | 127.3 | 109.3 | 74.3 |
| VL07 | 796.6 | 498.2 | 298.4 | 30.8 | 267.6 | 159.0 | 108.6 | 90.6 | 73.8 |
| VL08 | 866.1 | 330.4 | 535.7 | 55.8 | 479.9 | 283.2 | 196.7 | 181.7 | 146.7 |
| VL09 | 668.2 | 325.5 | 342.7 | 37.3 | 305.4 | 84.0 | 221.4 | 202.4 | 181.4 |
| VL10 | 861.2 | 553.0 | 308.2 | 40.8 | 267.4 | 147.8 | 119.6 | 99.6 | 78.6 |
| VL11 | 752.4 | 284.4 | 468.1 | 60.8 | 407.3 | 242.0 | 165.3 | 149.3 | 115.7 |
| VL12 | 911.8 | 439.6 | 472.3 | 55.8 | 416.5 | 265.5 | 151.0 | 123.0 | 76.8 |
| VL13 | 968.8 | 330.2 | 638.6 | 65.8 | 572.8 | 258.0 | 314.8 | 292.3 | 243.3 |
| VL14 | 1,005.7 | 437.7 | 568.0 | 50.8 | 517.2 | 253.0 | 264.2 | 247.7 | 205.7 |
| VL16 | 843.2 | 572.0 | 271.2 | 35.9 | 235.3 | 132.0 | 103.3 | 89.3 | 65.5 |
| VL17 | 509.6 | 303.8 | 205.9 | 30.8 | 175.1 | 112.5 | 62.6 | 44.6 | 25.0 |
| VL18 | 833.4 | 399.7 | 433.6 | 68.3 | 365.3 | 121.4 | 243.9 | 219.9 | 177.9 |
| VL19 | 725.2 | 348.3 | 376.9 | 50.8 | 326.1 | 172.9 | 153.2 | 93.2 | 54.7 |
| VL21 | 443.6 | 248.4 | 195.2 | 35.8 | 159.4 | 113.4 | 46.0 | 32.7 | 13.1 |
| VL22 | 481.2 | 258.5 | 222.7 | 31.0 | 191.7 | 123.4 | 68.3 | 47.3 | 27.7 |
| VL23 | 661.9 | 345.7 | 316.3 | 30.8 | 285.5 | 156.1 | 129.4 | 112.7 | 80.5 |
| VL24 | 686.0 | 319.0 | 367.0 | 30.8 | 336.2 | 132.0 | 204.2 | 178.0 | 164.0 |
| VL25 | 371.5 | 265.6 | 105.9 | 40.8 | 65.1 | 84.8 | -19.6 | -34.6 | -48.6 |
| VL26 | 1,170.3 | 641.4 | 528.9 | 46.2 | 482.7 | 281.3 | 201.4 | 161.4 | 129.2 |
| VL27 | 754.0 | 400.2 | 353.8 | 51.2 | 302.6 | 166.4 | 136.2 | 112.2 | 66.0 |
| VL28 | 877.4 | 458.8 | 418.7 | 46.2 | 372.5 | 236.0 | 136.5 | 117.5 | 89.5 |
| VL29 | 742.4 | 382.0 | 360.4 | 71.7 | 288.7 | 172.9 | 115.9 | 84.9 | 31.7 |
| VL30 | 1,052.5 | 508.5 | 544.0 | 75.2 | 468.8 | 250.0 | 218.8 | 189.8 | 142.2 |
| VL31 | 678.7 | 300.3 | 378.4 | 71.7 | 306.7 | 190.3 | 116.4 | 83.9 | 25.1 |
| VL32 | 729.7 | 349.5 | 380.2 | 71.7 | 308.5 | 162.6 | 145.9 | 105.9 | 56.9 |
| VL33 | 1,019.9 | 617.1 | 402.8 | 82.2 | 320.6 | 207.4 | 113.1 | 80.6 | 24.6 |
| VL34 | 1,017.5 | 458.5 | 559.0 | 74.9 | 484.1 | 250.0 | 234.1 | 211.6 | 169.6 |
| VL35 | 1,208.3 | 661.3 | 547.0 | 76.7 | 470.3 | 246.6 | 223.7 | 183.7 | 134.7 |
| VT36 | 537.4 | 278.8 | 258.7 | 30.8 | 227.9 | 111.5 | 116.4 | 95.0 | 78.2 |
| VT37 | 425.1 | 206.4 | 218.7 | 30.8 | 187.9 | 86.0 | 101.9 | 86.6 | 58.6 |
| VT38 | 428.9 | 237.8 | 191.1 | 42.8 | 148.3 | 87.0 | 61.3 | 43.3 | 22.3 |
| VT39 | 626.8 | 368.6 | 258.2 | 49.2 | 209.0 | 125.0 | 84.0 | 60.5 | 11.5 |
| VT40 | 919.9 | 565.2 | 354.7 | 46.2 | 308.5 | 202.4 | 106.1 | 71.0 | 36.0 |
| VT41 | 1,286.2 | 752.2 | 534.0 | 92.7 | 441.3 | 262.2 | 179.1 | 127.3 | 43.3 |
| VT42 | 629.2 | 292.4 | 336.8 | 66.2 | 270.6 | 158.6 | 112.0 | 67.0 | 20.8 |
| VT43 | 481.4 | 218.7 | 262.7 | 33.3 | 229.4 | 113.4 | 116.0 | 103.3 | 82.3 |
| VT44 | 400.5 | 200.6 | 199.9 | 30.8 | 169.1 | 70.8 | 98.3 | 83.6 | 58.4 |
| VT46 | 316.4 | 215.8 | 100.6 | 32.0 | 68.6 | 78.0 | -9.4 | -24.4 | -38.4 |
| VT47 | 483.2 | 220.1 | 263.1 | 30.8 | 232.3 | 121.4 | 110.9 | 97.5 | 73.7 |
| VT48 | 416.0 | 208.5 | 207.5 | 40.8 | 166.7 | 70.8 | 95.9 | 72.9 | 44.9 |
| VT49 | 754.7 | 333.4 | 421.4 | 56.0 | 365.4 | 168.8 | 196.6 | 165.7 | 119.5 |
| VT50 | 835.4 | 416.8 | 418.6 | 71.7 | 346.9 | 196.4 | 150.4 | 119.4 | 63.4 |
| VT51 | 668.7 | 372.3 | 296.4 | 58.8 | 237.6 | 124.8 | 112.8 | 80.8 | 38.8 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| VT52 | 780.2 | 496.5 | 283.7 | 46.2 | 237.5 | 141.6 | 95.9 | 50.9 | 4.7 |
| VT53 | 1,235.1 | 734.0 | 501.1 | 101.9 | 399.2 | 269.0 | 130.2 | 86.2 | -4.8 |
| VT54 | 529.9 | 296.7 | 233.2 | 42.8 | 190.4 | 77.4 | 113.0 | 98.4 | 73.2 |
| VT55 | 423.2 | 175.0 | 248.2 | 35.8 | 212.4 | 86.5 | 126.0 | 106.0 | 83.6 |
| VT56 | 304.4 | 209.3 | 95.2 | 35.8 | 59.4 | 67.5 | -8.1 | -22.8 | -50.8 |
| VT57 | 323.6 | 168.9 | 154.6 | 30.8 | 123.8 | 59.6 | 64.2 | 47.2 | 29.0 |
| VT58 | 411.0 | 227.5 | 183.5 | 30.8 | 152.7 | 91.0 | 61.7 | 49.7 | 38.5 |
| VT59 | 547.6 | 254.1 | 293.5 | 40.8 | 252.7 | 116.2 | 136.6 | 118.6 | 97.6 |
| VT60 | 932.3 | 476.5 | 455.8 | 42.8 | 413.0 | 151.8 | 261.2 | 246.6 | 222.8 |

Source: Own data and calculation

Appendix 5. Standardized fishing effort and relative standardized effort of 57 surveys.

| **ID vessels** | Effort | **Hp** | Gear | Day | Standadized effort | Relative Standardized effort | Cost efficiency |
|---|---|---|---|---|---|---|---|
| 1 | 421,260 | 55 | 27.5 | 153 | 449,366 | 0.67 | 485.8 |
| 2 | 427,700 | 55 | 24.8 | 156 | 439,523 | 0.66 | 560.0 |
| 3 | 410,220 | 55 | 29.0 | 159 | 468,889 | 0.70 | 518.0 |
| 4 | 706,450 | 40 | 20.0 | 199 | 437,580 | 0.65 | 258.9 |
| 5 | 392,665 | 55 | 27.5 | 182 | 503,034 | 0.75 | 460.8 |
| 6 | 703,313 | 80 | 56.0 | 225 | 813,921 | 1.21 | 528.5 |
| 7 | 796,590 | 44 | 20.0 | 212 | 468,733 | 0.70 | 295.3 |
| 8 | 866,120 | 80 | 61.2 | 236 | 864,535 | 1.29 | 271.1 |
| 9 | 668,150 | 44 | 20.3 | 210 | 467,767 | 0.70 | 593.0 |
| 10 | 861,218 | 44 | 21.6 | 219 | 491,050 | 0.73 | 362.7 |
| 11 | 752,418 | 80 | 57.6 | 242 | 861,353 | 1.28 | 395.9 |
| 12 | 911,845 | 70 | 52.5 | 236 | 790,659 | 1.18 | 371.3 |
| 13 | 968,790 | 80 | 67.5 | 258 | 946,204 | 1.41 | 468.7 |
| 14 | 1,005,675 | 80 | 52.5 | 253 | 859,890 | 1.28 | 357.6 |
| 16 | 843,150 | 44 | 22.8 | 220 | 501,372 | 0.75 | 345.8 |
| 17 | 509,625 | 44 | 27.0 | 225 | 537,942 | 0.80 | 218.1 |
| 18 | 833,382 | 70 | 54.6 | 253 | 838,004 | 1.25 | 234.0 |
| 19 | 725,192 | 70 | 47.6 | 247 | 788,510 | 1.18 | 281.0 |
| 21 | 443,610 | 55 | 31.0 | 216 | 584,945 | 0.87 | 291.7 |
| 22 | 481,163 | 50 | 26.1 | 235 | 567,875 | 0.85 | 247.1 |
| 23 | 661,938 | 50 | 39.0 | 223 | 626,638 | 0.93 | 223.1 |
| 24 | 686,033 | 50 | 32.0 | 220 | 581,890 | 0.87 | 286.3 |
| 25 | 371,488 | 50 | 29.3 | 226 | 574,856 | 0.86 | 255.8 |
| 26 | 1,170,347 | 90 | 40.6 | 211 | 726,429 | 1.08 | 343.7 |
| 27 | 754,000 | 100 | 31.5 | 208 | 682,416 | 1.02 | 432.0 |
| 28 | 877,448 | 120 | 36.0 | 236 | 816,208 | 1.22 | 408.0 |
| 29 | 742,421 | 160 | 41.3 | 242 | 943,258 | 1.41 | 213.5 |
| 30 | 1,052,500 | 140 | 28.5 | 250 | 820,356 | 1.22 | 301.3 |
| 31 | 678,686 | 140 | 37.4 | 222 | 830,653 | 1.24 | 323.1 |
| 32 | 729,724 | 140 | 39.6 | 253 | 921,532 | 1.37 | 303.3 |
| 33 | 1,019,857 | 180 | 56.3 | 242 | 1,081,223 | 1.61 | 466.6 |
| 34 | 1,017,500 | 140 | 31.3 | 250 | 845,944 | 1.26 | 363.7 |
| 35 | 1,208,258 | 160 | 35.8 | 269 | 963,786 | 1.44 | 265.8 |
| 36 | 537,430 | 44 | 21.0 | 223 | 492,263 | 0.73 | 434.6 |
| 37 | 425,127 | 44 | 23.5 | 172 | 431,532 | 0.64 | 433.2 |
| 38 | 428,910 | 50 | 22.5 | 232 | 536,234 | 0.80 | 273.5 |
| 39 | 626,786 | 100 | 27.5 | 250 | 735,371 | 1.10 | 304.0 |
| 40 | 919,908 | 120 | 29.0 | 253 | 795,148 | 1.19 | 272.0 |
| 41 | 1,286,230 | 220 | 39.0 | 242 | 1,015,546 | 1.51 | 407.5 |
| 42 | 629,211 | 110 | 29.3 | 222 | 714,201 | 1.06 | 267.0 |
| 43 | 481,410 | 55 | 14.8 | 216 | 458,302 | 0.68 | 444.5 |
| 44 | 400,492 | 55 | 20.3 | 236 | 538,374 | 0.80 | 274.2 |
| 46 | 316,420 | 44 | 13.7 | 156 | 338,771 | 0.51 | 517.0 |
| 47 | 483,230 | 55 | 20.3 | 253 | 563,274 | 0.84 | 246.5 |
| 48 | 415,950 | 60 | 26.9 | 236 | 606,225 | 0.90 | 281.1 |
| 49 | 754,747 | 80 | 30.0 | 211 | 635,324 | 0.95 | 503.0 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 50 | 835,357 | 140 | 32.5 | 250 | 856,693 | 1.28 | 442.5 |
| 51 | 668,720 | 80 | 25.5 | 208 | 596,570 | 0.89 | 254.3 |
| 52 | 780,216 | 90 | 43.2 | 236 | 797,441 | 1.19 | 277.7 |
| 53 | 1,235,094 | 250 | 52.5 | 269 | 1,245,259 | 1.86 | 453.1 |
| 54 | 529,932 | 65 | 27.5 | 258 | 662,435 | 0.99 | 404.7 |
| 55 | 423,193 | 55 | 20.3 | 247 | 554,554 | 0.83 | 242.6 |
| 56 | 304,425 | 55 | 15.2 | 225 | 474,786 | 0.71 | 335.9 |
| 57 | 323,565 | 44 | 17.6 | 159 | 373,009 | 0.56 | 409.0 |
| 58 | 411,017 | 44 | 19.2 | 182 | 418,796 | 0.62 | 345.6 |
| 59 | 547,646 | 60 | 28.6 | 242 | 628,942 | 0.94 | 316.4 |
| 60 | 932,305 | 65 | 28.5 | 253 | 661,817 | 0.99 | 352.9 |
| | | | | Max | 1,245,259 | 1.86 | 593.00 |
| | | | | Min | 338,771 | 0.51 | 213.54 |
| | | | | Ave | 670,653 | 1.00 | 354.82 |
| | | | | Std | 198,642 | 0.30 | 97.58 |

Source: Own data and calculation