ECONOMIC PERFORMANCE OF OFFSHORE LONG-LINE VESSELS IN NHA TRANG, VIETNAM

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ABSTRACT

Economic performance indicators are needed in order to improve fisheries policy in Vietnam. The research project "Revenues and Costs of Fishing Vessels in the Nha Trang Area" has been established to meet these needs. A questionnaire about technical characteristics and economic data of vessel and gear in use in the Province has been developed. A convenience sample is used and data is gathered through interviews with vessel owners. This paper presents preliminary findings for about thirty-two vessels, representing 16 % of the estimated total population of such vessels in the Khanh Hoa province. The average overall length is 15.13 m, engine size 121.88 HP and crew size 9.16 men. The following indicators are presented: gross revenue, annual vessel productivity, gross value added, gross cash flow, net profit and crew share, both per vessel and per man. Crew shares are compared to that of earnings of other labour in this area of Vietnam. Regression analysis of gross revenue and simple partial productivity, using technical vessel characteristics as independent variables, is performed and the results are demonstrated. Further work will include the collection of more data. Data Envelopment Analysis (DEA) or Stochastic Production Frontier (SPF) techniques for in depth analysis may in the future be used.

***Keywords**: Economic performance, gross revenue analysis, partial productivity analysis.*

INTRODUCTION

With a long coastline, about 3260 km, and an EEZ of more than one million km^2, fisheries have recently been considered as a key sector in Vietnam economy. The total standing stock of marine fishes is about 3.1 million metric tonnes and the potential sustainable yield is almost 1.4 million metric tonnes. Approximately 3.4 million people involve in the sector, which is around 10% of the labour force. One-tenth of export earnings stem from fisheries products, about USD 2.24 billion in 2003.

Marine fish production has rapidly increased over the two last decades. The production from the marine sector amounted to about 1.5 million tonnes in 2001. 88 percent of the marine capture production comes from the coastal fisheries and 82 percent of the fishers in the country are fishing in this area. In 1985, the fisheries sector consisted of 29000 motorized fishing vessels with a total of 456796 HP, while by the end of 2001 the total number of motorized fishing vessels was around 79000 with a total capacity of 3722557 HP. More than 75% of the motorized vessels have an engine of less than 45 HP.

Since most of fishermen are poor, their capital investment is very limited. There are a few numbers of fishermen who are able to afford offshore fishing vessels. Fishing is thus concentrated in coastal water and this has resulted in heavy pressure on nearshore resources. Long [1] has traced the trends in fishing capacity and fishery output over the period. These indicated a nearly five-fold increase in aggregate horsepower of fishing fleet as against a catch increase of only half this amount. He also noted the recent decline of catch per unit of fishing effort. These lead to the increasing problems faced by citizens in coastal area, especially fisher-folk.

Since about the mid-1990s, the Government of Vietnam has made strenuous efforts to develop its offshore fisheries. These efforts have aimed at attaining two broad policy objectives: firstly, to expand marine fish production for domestic consumption and for export; and secondly, to reduce the pressure on coastal fisheries resources. However, the effectiveness of this programme was constrained by several factors such as insufficient information on offshore resources, the lack of understanding of economic realities of offshore fishing vessels, choosing unsuitable fishing technologies, etc. Hence, a large number of offshore vessels have performed poorly in economics terms and payment rates on loans have been very low [2].

In 2005, the catch in the offshore area is estimated to be 600 000 tonnes, while according to one estimate the maximum sustainable yield in the area is 1 100 000 tonnes [2]. This appears to indicate that there is scope for further development of the offshore fishery. Moreover, one important point of views of the national strategy for the sector development presented at the conference on the National Strategy for Marine Fisheries Management and Development in April, 2005 in Hanoi is the emphasis on enhancing offshore fishing. To reach the goal, policy makers need to know the economic realities of each offshore fishing fleet. Some questions such as ‘is the fleet profitable?’, ‘what is the main determinants on fishing vessel performance?’ and ‘do larger vessels perform better than smaller one?’ may arise. Fisheries managers, at macro level, may use this information to design and implement policy instruments which are more compatible with the goal of economic efficiency by constraining or expanding some vessels characteristics. Fishermen, at micro level, may get some advice to maximize their benefit.

For fisheries policy development in Vietnam, there are some researches involving in analyzing economic performance for offshore fishing. However, most of them are qualitative or overview analyses due to lack of detailed data on costs and earnings at vessel level. The research project “Revenues and costs of fishing vessels in the Nha Trang area” collected data through interview of vessel owners has been established to enable us to proceed further.

This paper presents preliminary findings for 32 vessels, representing about 16 % of longliners in the Khanh Hoa province. The following indicators are presented: gross revenue, annual vessel productivity, gross value added, gross cash flow, net profit and crew share, both per vessel and per man. Crew shares are compared to that of earnings of other labour in this area of Vietnam. Moreover, some main vessel technical determinants on fishing performance also are preliminary investigated. However, due to limitation of time, information and sample size, the paper only focuses on investigating whether the differences in technical vessel characteristics affect their individual revenue and efficiency which is proxied by the simple partial productivity, namely annual vessel productivity in Nha Trang off-shore longline fleet. Two regression equations between individual vessel annual revenue and its productivity and technical vessel characteristics such as size, HP, vessel age, onboard equipment are employed to answer the question. Future work will include the collection of more data and we may use Data Envelopment Analysis (DEA) or Stochastic Production Frontier (SPF) techniques for in depth analysis.

NHA TRANG’S OFFSHORE LONGLINE FISHERY [a]

Khanh Hoa is located in the south of the central coastal region of Vietnam. The total area of Khanh Hoa covers an area of 5197.5km^2 with a coastline of 520 km plus 135 km including islands. Khanh Hoa has over 200 islands both in near-shore and off-shore areas. Khanh Hoa’s long-line fleet plays an important role in its fishery. In 2001, there are 563 longliners, of which only 64 vessels are offshore fishing (engine size lager than 45 HP). They landed 9080 tones constituted 7.2% of total catch, with revenue of 360 259 million VND represented 37.4% of total revenue. The offshore longliners catch constituted 0.5% of total catch and 2.9% of total revenue in that year.

Khanh Hoa's off-shore long-line fleet is mainly found in Vinh Tho, Vinh Phuoc, Xuong Huan districts in Nha Trang city. The fishery has just been developed for over 10 years. The target species are mainly yellow fin tuna (*Thunnus albacares*) and big eye tuna (*Thunnus obesus*). Japan and the United States are the main our export markets for these species of tuna.

In 2004, there are almost 200 off-shore longliners in Khanh Hoa province which are mainly found in Nha Trang city. Most longline fishermen have good fishing experience and often come from traditional fishing households. They have high income compared to labours working in other fisheries in Nha Trang (see Khanh Hoa Fisheries Profile). Although main catching target species are high valued tuna, some vessels may shift targets by season, trip. Furthermore, some vessels engage in the longline fishery all year round, while others may switch to other fisheries (especially to fishing squid, and small tuna) in the sub season.

Off-shore longliners operate from December to August (or September). During September to November, almost all off-shore longliners stay in the shore for reparation and maintenance. Fishing ground of long line is very far and changes according to the monsoon. The first fishing season is the northeast monsoon. It lasts from December to April (March). Fishing activity takes place from the northeast of Hoang Sa and all the way to Philippine waters (13^0 – 19^0'N, 114^0 – 118^0'E). The time for a vessel from shore to fishing ground may be about 70 hours. The second is the southwest monsoon. The season ranges from May (April) to August (September). Longliners can fish from close to Truong Sa island all the way to Malaysian waters (5^0 – $13(15)^0$'N, 109^0 – 116^0'E). It may take around 50 hours to reach this fishing ground from Khanh Hoa.

Due to off-shore fishing, this fleet has high expenses, skippers and boat's owners are above 45 years old and have more than 25 years of experience (5-12 years in longline gear), each owner normally only owns one boat. Each long liner has around 9-10 crewmembers. This fleet is well equipped with such things as compass, fish finding devices, communication equipment, etc. Each trip may take 22-25(28) days (in which transport is about 5-8 days), 8-9 trips/year and break duration between trips is 5 days. The length of longline is about 35-50 km and 600-1000 hooks/longline (number of hooks could be changed upon each haul).The catch per trip may be around 1500 – 3000 kg, in which tuna (yellow fin tuna, big eye tuna) accounting for 60-70%, other fishes about 30 - 40% (sail fish, sharks, scads, etc.).

Currently, Vietnam's policy is to ease the pressure on coastal resources through a program to shift fishing activity from inshore to offshore by giving incentives, such as loan, tax, etc. Tuna is one of offshore target species which has been encouraged to exploit due to its high exported value. Giving some important economic performance indicators of Nha Trang's longline fleet and investigating which technical vessels characteristics are significantly important to annual vessel revenue and its productivity may shed some lights on possible changes in longline fishing strategies and regulations in the future.

DATA AND DIFFICULTIES IN DATA COLLECTION AND ANALYZE

Data for the study came from the first round of the survey about costs and earnings of fishing vessels in Khanh Hoa province conducted by University of Nha Trang in 2005 with donation of NORAD and assistance of Norwegian College of Fisheries Science. Of the total of about 200 off-shore long-line vessels, 32 were interviewed during July of 2005 about their costs and earnings in 2004. Each fishing household, represented by the fisherman and/or his wife, gave a face-to-face interview to two research team members in line with a project designed questionnaire form. The interviews were undertaken at home or onboard the vessel. Collected data were entered and stored into a database developed in Access software.

There are quite many difficulties in data collection and analysis. Firstly, since it is the first time staffs in our economics faculty at Fisheries University of Nha Trang have ever done an economic fieldwork survey of fishing vessels, we lack experience to interview fishermen with a limited educational level and very simple bookkeeping system. The second is that capital items are quite heterogeneous. One of important reasons is that a number of fishing vessels have moved into this fishery from others due to the increasing demand of high valued tuna for exported markets and also some long-line vessels may engage in other fisheries in the sub-season. This leads to difficulties not only for fishermen to remember but also for interviewers to collect information about their vessels. To overcome this problem, we try to design the questionnaire as detailed as possible and then compare and check items among vessels. However, like other economic surveys of fisheries estimates of economic values of fishing vessels are often subject to measurement errors and generally impractical to employ all inputs in fishing [3].

It is also important to note that at the beginning of 1990's, due to high inflation, gold is normally used for exchange instead of currency in Vietnam. Vessels with the same length may have different hull purchase prices due to differences in quality, year of building, year of purchase, wood prices or sometime just bargaining capacity and gold prices, etc. The situation is the same for the other capital items. Market prices also have important impact on capital item's purchase prices, and then on their depreciation, especially when the government started to implement the off-shore program in 1997-1998. Moreover, the estimated lifespan of capital items in the survey heavily depends on their owner's decision, knowledge and experience. Thus, estimates of capital costs and investments are accountancy based rather than economics based.

Although there existed some difficulties, collected data includes detailed information on various aspects of long-line fishery such as vessels characteristics, number of trips in the main and other season, crew size, fixed costs and variable costs, etc. Since variable inputs (fuel, bait, provision…) and revenue were collected as averages of all trips in the main and other seasons, it is quite easy to aggregate them to get individual annual revenue and variable costs. There are some observations with missing/unreliable data. Since the sample size is quite small, its average value is replaced for missing/unreliable information.[b] Hence, the data set is quite convenient for some analyses of various aspects of Nha Trang's longline fleet, especially the costs and earnings analysis.

ECONOMIC PERFORMANCE ASSESSMENT

Some important economic performance indicators

Definition of terms and calculation methods

Gross annual vessel revenue is the total year's vessel revenue at the landed price. It is the total of the average vessel trip revenue multiplies the number of trips in both the main and sub seasons in year 2004. Gross value added is the difference between gross annual vessel revenue and cost paid to other (supplying) industries. It is the sum of cost of labour, depreciation, interest and net profit. Gross cash flow is calculated as the gross annual vessel revenue less all expenses, except depreciation and interest.

Net profit is simply calculated as the gross annual vessel revenue less all expenses. This equals gross cash flow less depreciation and loan interest. The general approach is presented as follows [4]:

Gross annual vessel revenue
- Operating cost (fixed and variable), except labour cost

= Gross value added
- Labour cost

= Gross cash flow
- Depreciation
- Interest loan payment

= Net profit

The variable costs of a vessel are fuel, preservation, bait, minor repairs, etc. It is the total of the average vessel trip variable cost multiplies the number of trips in both the main and sub seasons in year 2004. The fixed cost and loan interest are real payment of the vessel's owner in the year.

Due to limitation of information in the data set, the study employs a linear depreciation plan. This method is to depreciate the vessel on the basis of acquisition value and apply a nominal rate of interest. The yearly vessel depreciation includes hull, engine, equipment and gear. Their nominal rates of interest are calculated based on their estimated life-spans which depend on their owner's decision, knowledge and experience.

Economic performance indicators

In 2004, there are almost 200 off-shore longliners in Khanh Hoa province which are mainly found in Nha Trang city. Table I presents preliminary economic performance for about 32 vessels in the Khanh Hoa province as follows.

Table I: Descriptive statistics of 32 longliners

Criteria	Mean	Standard deviation	Min	Max
- Length (m)	15.13	1.28	13.70	19.40
- Engine (HP)	121.88	81.21	45.00	365.00
- Age (years)	8.78	4.32	1.00	15.00
- Operating months	8.53	1.88	4.00	11.00
- Crew (persons)	9.16	0.68	8.00	10.00
-Yearly depreciation of important onboard equipment (1000 VND)	2832.20	695.03	1509.00	5220.70
- Annual vessel productivity (1000 VND/m)	37250	12321	10857	62500
-Yearly average income per fisherman (1000 VND)	**14474**	**7350.3**	**1755.6**	**34528**
Gross revenue (1000 VND)	**568250**	**206780**	**152000**	**1000000**
- Variable costs	310550	119030	102000	600700
- Labor cost	132310	67374	15800	310750
- Insurance, tax	5201.9	3885.3	0.000	17600
- Vessel and gear cost	26861	16999	5000	83000

Operating cost	474920	156910	147000	819650
Gross value added	**225640**	**139910**	**-41980**	**606000**
Gross cash flow	**93328**	**73646**	**-57780**	**295250**
- Depreciation	21068	6679	11802	46957
- Loan interest	3307.9	9833.8	0.000	51360
Total cost	499300	164100	147000	819650
Net profit	**68952**	**76337**	**-77381**	**273860**

In table I, the descriptive statistics of some important economic performance indicators such as gross revenue, annual vessel productivity, gross value added, gross cash flow, net profit and crew share, both per vessel and per man are presented. Interestingly, both most important economic performance indicators of an average longliner, gross cash flow and net profit, are positive. The average gross cash flow of the longline vessels was 93 328, with the range from -57 780 to 295 250 thousand VND.[c] Net profit of a longliner also varied from -77 381 to 273 860 thousand VND, with an average of 68 952 thousand VND. This means that the owner of an average longliner not only is capable paying for all expenses, but also has the reward for the operating year. Table I also shows that the average annual crew share is 14474 thousand VND. This corresponds to 93 percent of the average annual income of labour working in registered enterpries in the Khanh Hoa province [5]. However, since the average annual operating months of a longliner is 8.53, the average monthly crew share during the fishing season is 1697 thousand VND, which is about 30 percent more than that of registered enterprises in this Province. It is also important to note that the labour force working in registered enterpries only occupy 7.56% of Khanh Hoa population and most of them have high educational level and/or technical/vocational training [5].

In table II, a preliminary comparison of some important economic performance indicators among 3 longline groups which are categorized based on engine size is provided. The results show that an average vessel in the group with engine size ranging from 90 to 140 HP has best economic performance indicators with gross cash flow of 120 010 and net profit of 100 240 thousand VND. Moreover, while an average vessel in the group with engine size larger than 140 HP has highest gross annual revenue, its net profit is almost lowest.

The wide range of these indicators in table I and low net profit of the group with engine size larger 140 HP in Table II may firstly imply that the fishery was quite risky due to difficult weather and pelagic resource in the tropical sea area. The second reason may be that some vessels did not separate the cost of maintenance from that of improvement. Other explanation may be that some vessels gotten offshore project loan from government underestimated their revenues or overestimated their costs. Further analysis of two economic performance indicators such as gross annual vessel revenue and annual vessel productivity is implemented in the next section.

Table II: Economic performance indicators among vessel groups

	Off-shore Long liners		
Engine (HP)	HP π 90 (N=16)	90 ≤ HP ≤ 140 (N= 7)	HP φ 140 (N=9)
- Length (m)	14.431	15.000	16.467
- Age (years)	8.25	9.1429	9.444
- Operating month	8.5625	9.4286	7.778
- Crew	8.875	9.2857	9.556
- Yearly average income per crew man (1000 VND)	13022	17567	14648
Gross revenue	**476190**	**654290**	**665000**
- Variable costs	253710	339530	389050
- Labor cost	115460	163480	138020

- Insurance, tax	4518.5	2409.3	8588.9
- Vessel and gear cost	20923	28857	35867
Operating cost	394610	534280	571530
Gross value added	**197030**	**283490**	**231490**
Gross cash flow	**81575**	**120010**	**93468**
- Depreciation	18423	19765	26784
- Loan interest	2003.2	0	8200
Total cost	415040	554040	606520
Net profit	**61149**	**100240**	**58484**

Regression analysis of annual vessel gross revenue and productivity indicators

Variables and its descriptive statistics

The question of ‘do technical vessel characteristics have important impact on fishing vessel performance?’ is very important. At macro level, fisheries managers may use this information to design and implement policy instruments which are more compatible with the goal of economic efficiency by constraining or expanding some vessels characteristics. Fishermen, at micro level, may get some advice to maximize their benefit. Technical vessel characteristics include vessel attributes and onboard equipment attributes. Using regression analysis to investigate the impact of these characteristics on vessel annual gross revenue and productivity, we firstly need to choose good proxies to present for vessel attributes and onboard equipment attributes.

Physical measures such as hull length, horse power of engine and the age of hull are chosen as proxies of the vessel carrying capacity, moving speed and vessel age respectively to represent vessel attributes in the study. One advantage of the choice is that physical input measures are generally more robust in term of measurement. Next, the estimated lifespan of the vessel hull or engine is often long and depends on their owner’s decision, knowledge and experience. Their purchase prices mostly occupy the initial investment of longline operation, and as discussed above, also depend on many factors. This means that their yearly depreciation is heavily accountancy based. Hence, hull length, horse power of engine may represent the vessel fishing power better than their economic measures. Finally, the input control measures for fisheries management are more relevant with regard to physical vessel attributes [3].

Because of offshore fishing, most vessels are well equipped with such things as compass, fish finding devices, communication equipment, etc. For simplicity, onboard attributes are presented by the cost of onboard equipment which includes yearly depreciation of the most important onboard items for fishing. Because winch, GPS, compass, long and short range radio are mostly important for operating longline, the total depreciation per year of these items is calculated for the cost of onboard equipment of vessel operating longline only. While generator and lighting are very important for fishing squid, their yearly depreciation is also added into the cost of onboard equipment for vessels both operating longline and fishing squid. In this case, the use of the economic measure is convenient because we can easily aggregate different onboard items.

Due to time and sample size limitation, to keep our preliminary analysis as simple as possible, only two economic performance indicators, namely individual annual vessel gross revenue and its productivity are chosen for further analysis. They are the dependent variables in two regression equations.
Table I also shows that the selected vessels are quite heterogeneous in terms of technical vessel characteristics such as hull length, horse power, vessel age and the yearly depreciation of important

onboard equipment. Hull length for the sample longline fleet ranged from 13.7 to 19.4 meter, with an average length of 15.13 meter. Engine for the selected vessels varied from 45 to 365 HP, with a mean of about 121 horse power. The average age of the longline vessels was about 8.8 years, with the range from 1 to 15 years. Yearly depreciation of important onboard equipment of longliners also varied from 1509 to 5220.7 thousand VND, with an average of 2832.2 thousand VND.

Econometric specifications and the estimation method

Equations (1) and (2) represent equations to investigate whether the differences of technical vessel characteristics affect vessel annual gross revenue and its productivity in Nha Trang's off-shore longline fleet. [d]

$$R = \alpha_0 + \alpha_L L + \alpha_H H + \alpha_A A + \alpha_E E + \alpha_{LL} L^2 + \alpha_{HH} E^2 + \alpha_{AA} A^2 + \alpha_{EE} E^2 + \varepsilon_R \quad (1)$$

$$P = \alpha_0 + \alpha_L L + \alpha_H H + \alpha_A A + \alpha_E E + \alpha_{LL} L^2 + \alpha_{HH} E^2 + \alpha_{AA} A^2 + \alpha_{EE} E^2 + \varepsilon_P \quad (2)$$

Where R is vessel annual gross revenue (in 1000 VND); P is annual vessel productivity (in 1000 VND per meter of length); L is hull length (m); H is horse power of engine (HP); A is age of boat (years); and E (1000 VND) is the total depreciation per year of important onboard equipment. ε_R and ε_P are the random noise of equation (1) and (2), respectively. A second order linear approximation is also utilized when estimating equations. Simple ordinary least square econometric technique was employed to estimate functions.

A common problem with the model estimation is multi-collinearity since not only the simple correlation between hull length and engine is quite high but also one independent variable and its squared are highly correlated. The major consequence of severe multicollinearity is to increase the variance of the estimated regression coefficients and therefore decrease the calculated t-scores of those coefficients. Thus it may lead to misinterpretation. However, it causes no bias in the estimated coefficients, and it has little effect on the overall significance of the regression or on estimates of the coefficients of any non-multicollinarity explanatory variables.

Simpler models are preferred since they are easier to understand and interpret. In addition, simple models are less costly to put into practice in predicting and controlling the outcome in the future. The most important reason for this case is that simpler models may reduce the degree of multicollinarity and then may help us make interpretation better. Hence, the model-building technique of backward removal method is employed. The use of the technique begins with the specification of the design for a full model. Less comprehensive submodels are then tested to determine if they adequately account for the outcome under investigation. Finally, the simplest of the adequate is adopted as the best.

Since one independent variable and its squared are highly correlated and represent the same phenomenon, the squared of each independent variable is successively removed if it is highly statistically insignificant to get the best model.

Empirical results

The results of ordinary least square of six models of two equations from the full to the best functional form, designated M1 – M6, are presented in Table III and IV. White test for heterocedasticity, Jarque-bera test for non-normality of error term, Ramsey reset test for error specification were used to check important assumptions of linear regression model for each estimated model. Null hypotheses are rejected in all these tests.

According to the test statistics, R^2adjust and F value presented in Table 2 and 3, M2 and M5 have better performances than M1 and M4, respectively. By dropping the squared of engine, its effects on both gross revenue and productivity become statistically significant at the level of 5% while the effects of other variables almost remain the same. In the next step, the squared of vessel age is removed. The results of M3 and M6 seem a little bit better than M2 and M5, respectively since the estimated coefficients of other variables become statistically significant and almost unchanged, except the case of vessel age. Clearly, M3 and M6 tell us that vessel age do not statistically influence in both its annual revenue and productivity.

Table III: Results of Parameter Estimates, and Test Statistics of Equation (1)

	M1	M2	M3
α_L	1353400 **	1066700 **	1036200 **
α_{LL}	-42178 **	-33143 **	-32291 **
α_H	-105.96	1388.5 **	1463.3 **
α_{HH}	4.2835	0	0
α_A	22695	24841	2209.9
α_{AA}	-1232.1	-1350.1	0
α_E	434.31 *	467.78 **	506.13 **
α_{EE}	-0.047751	-0.052448	-0.058343 *
α_0	-11170000 **	-9069000 **	-8802000 **
R^2adjust	0.4981	0.5062	0.5098
F	57.80	66.024	75.881

Table IV: Results of Parameter Estimates, and Test Statistics of Equation (2)

	M4	M5	M6
α_L	85286 **	68769 **	66687 **
α_{LL}	-2733.8 **	-2213.2 **	-2155 **
α_H	4.9142	91.013 **	96.123 **
α_{HH}	0.24677	0	0
α_A	1636.6	1760.2	212.90
α_{AA}	-85.510	-92.310	0
α_E	30.727 **	32.655 **	35.277 **
α_{EE}	-0.0034764	-0.003747 *	-0.00415 **
α_0	-692560 **	-571500 **	-553250 **
R^2adjust	0.3976	0.4108	0.4130
F	57.118	65.635	75.164

Note: ** = statistically significant at the level of 5%.
* = statistically significant at the level of 10%.

The results in table III and IV show that for Nha Trang's longliners, the effects of technical vessel characteristics on the vessel revenue and productivity are statistically significant at the 10% or less, except the case of age of the boat in all models.

Regarding the hull length (proxy for vessel carrying capacity), the results in M3 and M6 show that the parameters associated with hull length are statistically significant at the level of 5%. The positive estimated coefficients of length and the negative coefficients of its squared in both model 3 and 6 suggest that the relationships between annual vessel revenue, productivity and its hull length are not linear. In particular, annual vessel revenue and productivity increase with its hull length but at a decreasing rate. Thus, if others keep constant, a vessel in Nha Trang's off-shore longline fleet could get its maximum annual revenue and productivity at hull length of 16,05 and 15,47 meter, respectively. This may make sense because of two reasons. Firstly, the relationship between hull length and its vessel carrying capacity is not often linear. Moreover, due to the seasonal effect, some big size longliners may not fish in some months if their trip revenue could not cover their trip variable cost while some small vessels may still operate longline since they have lower trip variable cost or simply change to fishing squid.

The engine power has positive and significant relationship with vessel revenue and productivity. Since the vessels use static gear, the propulsion power is not directly related to fishing capacity. A possible explaination for this is that due to very far from inshore to fishing grounds, larger HP, however, enable vessels to steam more safely, to fish in difficult weather, at higher speed the distances to (and between) the fishing grounds.

The parameters associated with onboard equipment are statistically at the 10% level in both M3 and M6. As expected, a vessel with the higher depreciation value of important onboard equipment for fishing could have better fishing performance. However, the negative estimated coefficients of its squared suggest that the annual vessel revenue and productivity increase with the yearly depreciation of important onboard equipment but at a decreasing rate. This is not surprising since there were a number of vessels that earn low income using some more onboard equipment items as lighting and generator for fishing squid in the sub-season.

The age of vessel does not statistically influence annual revenue and productivity, although its estimated coefficients are positive. In Pascoe [6, 7] the age of the boat was assumed to represent the design and construction materials employed and found to have negative impact on efficiency. Sharma and Lueng [8] also found the negative relationship between them although it is also not significant. The reason for the case may be that due to regular repairs and maintenance for offshore fishing, a vessel would not become worse as it aged. This is consistent with the argument of Pascoe [3], that while the vintage of the boat may result in differences in efficiency (i.e. due to new technologies incorporated into more recent vessel design and construction), there is generally no reason to presume that a boat would become less efficient as it aged provided it underwent regular maintenance. Moreover, since the number of years that the last owner owns the vessel hull was chosen as a proxy of vessel age, we may assume that a skipper with more fishing experience would own an older vessel. In Sharma and Lueng [8], skipper experience was found to have statistically significant positive effect on technical efficiency of Hawai's longliners. Hence this assumption may be a possible explanation of the case.

CONCLUSION

The paper preliminary gives some important economic performance indicators and starts further investigation of the impact of technical vessel characteristics on two economic performance indicators, namely gross annual vessel revenue and its productivity based on their 2004's cost and revenue data of a sample of 32 offshore longliners in Nha Trang. Even through the study is quite simple due to limitation of time and sample size, the results may give some implications for management of offshore longline vessels in Nha Trang. Firstly, the owner of an average longliner not only is capable paying for all expenses, but also has the reward for the operating year. Moreover, an average vessel in the group with engine size ranging from 90 to 140 HP has highest values of annual vessel gross cash flow and net profit. The annual average of crew shares is almost 2.7 times compared to that of average earnings of labour in Khanh Hoa province and about 2.5 times in the whole country.

Further analysis of gross annual vessel revenue and its productivity found that various technical vessel characteristics have statistically significant effects on these indicators. Specifically, vessels with longer hull and higher value of yearly depreciation of onboard equipment seem to have better revenue and productivity, but at a decreasing rate. Moreover, if all others remain unchanged, a vessel with hull length of 16.05 or 15.47 meter would get its maximum annual gross revenue or productivity, respectively. Even using static gears, HP still has its positive effects on vessel revenue and productivity. These should be carefully concerned when modelling and proposing management measures for Nha Trang's longline fleet.

Because of the use of the first round of data collection about costs and earnings of fishing vessels in Khanh Hoa province conducted by University of Nha Trang, the study just gives some preliminary findings for 32 observations. Moreover, the regression analysis of economic performance is rather limited since only gross vessel annual revenue and its productivity indicators are concerned. Therefore, further work is recommended to collect more data, regression analysis of gross cash flow, net profit and also may use Data Envelopment Analysis (DEA) or Stochastic Production Frontier (SPF) techniques for in depth analysis of economic performance.

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ENDNOTES

a. Information in this part is mostly based on the report of Fisheries Profile: Khanh Hoa province compiled by IEFP, RIMF, ALRMV II, 2005 [9].

b. There are 6 observations with missing data. Four of which lack data of sub gear cost. One misses value of estimated life span of engine used in 2004 since the vessel changes new engine in 2005, but we do not have information about the remaining value of its old engine. There is one observation lacking information of the costs of GPS and Short range radio since they are included in vessel hull value. For regression analysis, we use average values of depreciation (620 VND for GPS and 260 VND for Short radio) for these missing data to calculate the cost of important equipment. However, they are excluded when calculating total depreciation, cost and profit for this observation since they are already accounted in its hull value. Moreover, since capital items are quite heterogeneous and their estimated lifespan heavily depends on their owner's decision, knowledge and experience, some observations may have unreliable information of their lifespan. There are 6 observations with underestimated life span of some capital items which include battery (two observations), lighting for fishing squid (one), short range radio (one), and main line and brand line (two). Since this is the first round of data collection about costs and earnings of fishing vessels that their owners have a limited educational level and very simple bookkeeping system, missing and unreliable (overestimated/underestimated) data in some observations are unavoidable. Fortunately, since these adjustments only cause a slight change in total cost of adjusted vessel, using their average value to replace for these missing/unreliable information in the dataset is quite reasonable for the costs and earnings analysis of this fishing fleet.

c. VND: Vietnamese Dong, the unit of Vietnamese currency.

d. The normal functional form is chosen to present in the paper since the log functional form could not succeed in estimating the effects of technical vessel characteristics on simple vessel partial productivity. Flaaten [4] also used this functional form to test the difference in resource rent between two groups of fishing vessels.