A STUDY ON THE ECONOMIC PERFORMANCE AND EFFICIENCY OF OFFSHORE GILLNET VESSELS IN NHA TRANG, VIETNAM

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ABSTRACT

Vietnam's policy is to shift the fishing pressure from onshore to offshore water since the coastal resource has been overexploited, and a programme for investing in offshore vessels has thus been implemented since 1997. The question raised is whether the offshore fishing fleet is profitable and efficient or not? This study aims to evaluate the economic performance and efficiency of the offshore fleet in Vietnam – the case of the Nha Trang gillnet fishery in open access conditions, based on a costs and earnings survey carried out on the 58 offshore vessels. The empirical results indicate that an average gillnet vessel earns a gross margin profit of 17.3% and a profit margin of 3.8%, but makes an economic loss, even with the government fuel cost support. The average annual crew income is 74.5% more than the local average income per capita. An efficiency analysis of the vessels based on an application of the Salter-diagram shows that the large number of vessels with high relative standardized effort (above 1) is the most cost-efficient scenario for vessels from both a short- and long-term perspective. The majority of these vessels receive intra-marginal rents. The government fuel subsidies help to increase their gross cash flow by 17.5% and profit by 36% for an average vessel. The small-scale vessels receive the most benefit from these subsidies. The study also demonstrates that engine capacity, fishing gear and fishing day are the factors best reflecting the fishing effort of the vessels.

Key words: gillnet fishery, economic performance, economic efficiency, standardized effort, fishing subsidy.

INTRODUCTION

"*Vietnam has a coastline of about 3,260 km and its exclusive economic zone (EEZ) extends over more than one million square kilometers*" [1]. Vietnam's coastline has many bays and estuaries as well as diverse coastal and marine resources and the EEZ of Vietnam contains an abundant multi-species of fishery. In Vietnam's marine waters there are about 3.1 million tones of the entire standing stock of marine fish with more than 2000 fish species and around 1.4 million tones of the sustainable potential yield [2]. These have created good potential for the development of marine capture fisheries as well as marine aquaculture in Vietnam. Therefore, Vietnam's fisheries sector, including marine capture fisheries, has become an important sector in the national economy with its contribution towards the GDP (Gross Domestic Product) being 4% in 2006 [3]. However, Vietnam's marine fishing fisheries are referred to as small-scale and open access [4]. Marine fisheries production has continuously increased over time [5] and the number of fishing vessels has increased significantly and gone far beyond the control [1]. Coastal fishing capacity has exceeded the sustainable limit [1,2]. Coastal resources have thus been overexploited, and resources are decreasing.

Khanh Hoa is a coastal province in Southern Central Vietnam, and its sea area belongs to the Southern China Sea region. It is located along the coastal zone with a total land area of more than 5200 km^2 and a coastal line of 520 km. This coastline is made up of territorial waters and more than 200 islands [6,7,8]. Marine capture production of Khanh Hoa has fluctuated over time [9]. The number of vessels and engine capacity has increased in recent years, with an especially dramatic increase in 2008 and 2009 due to the 2008 fuel cost support[a]. Catch per vessel and catch per unit of engine power have almost been decreasing simultaneously [9,10,11,12]. Khanh Hoa's marine fisheries resources are considered to be declining remarkably [2].

Nha Trang is the central city of Khanh Hoa province. It occupies an area of 251 km^2. This city is not only an attractive tourist destination, but also a potential area for further development of fisheries [6]. The fisheries sector is the main driver of growth, responsible for 42% of the city's GDP [6]. The capture sector in Nha Trang city is highly representative of Khanh Hoa's capture sector [10]. For gillnet fishery, Nha Trang has 233 units with a total of 290 vessels whose engines have more than 50 HP (they account for more than 80%), and 178 vessels out of a total number of 208 vessels whose engines have more than 90 HP (they account for nearly 86%). Hence, it can be said that the offshore gillnet vessels of Khanh Hoa province are mostly located in Nha Trang's fishing community of which they are mostly found in Vinh Phuoc (145 units) and Xuong Huan wards (75 units) [10].

Since 1997 a program of investing in offshore fishing vessels has been implemented. However, the question raised here is whether the offshore fleet is profitable and efficient or not? The Vietnamese government, therefore, has emphasized the need to develop the offshore fleet but doing so with great caution to avoid the development of an economically unsustainable fleet [1]. In 2005, the Ministry of Fisheries[b] of Vietnam proposed two new major development goals of offshore fisheries management and development in Vietnam: (1) "*to ensure sustainable and efficient offshore fisheries, while maintaining both marine ecosystem functions and harmonious relationships with coastal fisheries and contributing to the protection of the sovereignty of the territorial waters and the national security of Viet Nam*"; (2) "*to enhance income, create new occupations and improve the living standards of fishing communities that depend on offshore fisheries*" [1]. In order to assess whether these two development goals are being achieved, monitoring and reporting the annual performance indicators were brought up at the Conference on the National strategy for marine fisheries management and development in Vietnam [1]. These indicators are referred to as measures to assist when drafting policies for marine resource management in Vietnam. Thus, Vietnamese policy-makers necessitate not only reliable assessments of offshore resources, but also an understanding of the economic realities of offshore fishing [1,8].

Based on the above considerations, *a study on economic performance and efficiency of the offshore fishing vessels* needs to be carried out, and some of the following questions should be raised: "What are the economic performance indicators of offshore fishing vessels?", "What is the income of crew members?", "Which vessels are more or less economically efficient than others?", And "How does a government support like the fuel cost subsidy affect annual earnings and costs of the fishing vessels?".

This study will address economic performance indicators and economic efficiency of Nha Trang's gillnetting vessels in the 2008 season through a costs and earnings survey. The offshore gillnet fleet is targeted to be chosen for this research. The reasons are that 1) gill net is one of the main Vietnamese gear types for offshore fisheries; 2) gill net is the type of gear that has high selectivity and less potential to do damage to the sea floor [13]. A possible result is that the overexploited marine resources can be recovered quickly. This study is being carried out only for the fleet in Nha Trang in a limited time frame and with a limited budget. Additionally, the majority of previous researches have already answered the first two questions. Therefore, the aim of this study is to explore the last two questions above - vessel efficiency and the effects of the fuel cost subsidy.

This study will address four main objectives. The first is to determine a set of economic performance indicators of the offshore gillnet vessels in Nha Trang, based on a costs and earnings survey for this fleet. The second is to find out which vessel group gets intra-marginal rents. The third is to find out which vessels are economically efficient. And the final objective is to determine how the government 2008 fuel cost support impacts the profitability of the offshore gillnet vessels in Nha Trang. In addition to the main objectives, this study's aim is to contribute to the development of methods of measuring standardized fishing efforts for the fishing vessels. This paper in the following sections presents theory and methodology, followed by results, with discussion and conclusion in separate sections.

THEORY AND METHODOLOGY

Costs and earnings definitions

Gross revenue is defined as landing value of the vessel in the year of fishing operations. It is the result of the average vessel trip revenue times the number of trips in the year 2008. In order to compare the effect of the 2008 fuel cost support to profitability of fishing vessels, gross revenue is calculated for two cases: one including and one excluding the fuel subsidies. The 2008 fuel cost support appears as quasi-lump-sum subsidies payable, and is given directly to fishers. Fishermen have to accept the market fuel price in their fishing operation. Since a subsidy is referred to as quasi-lump-sum subsidy payable to fishers, the profitability of fishing vessels with this type of subsidy may be the sum of the profitability without the subsidy and the quasi-lump-sum subsidy, regardless of adding this subsidy to revenue or subtracting it from cost. Additionally, although the 2008 fuel cost support seems like a fishing effort subsidy, in reality it was the income support of the government for fishermen; hence, this subsidy item should be added to gross revenue instead of subtracting it from the cost.

Income is the difference between gross revenue and variable costs. *Variable costs* are total expenses for all fishing trips in a particular year, excluding labour costs. They are the result of the average vessel variable cost per fishing trip times the number of fishing trips in the year 2008.

Gross value added is the result obtained from the annual gross revenue minus the total of annual variable costs and fixed costs, excluding labour costs. *Fixed cost* is the total sum of the annual repair and maintenance costs of hull, engine, gear and other equipment of the vessel, and insurance for vessels and all crew members.

Gross cash flow is referred to as a reward for capital employed in fisheries. It is calculated as gross revenue minus all expenses, excluding depreciation and interest. *Labour cost* is expenditure for whole crew members in the income share system. Crew members include vessel owner-operator's labour, owner's family-crew and other members.

Profit is the remaining value after deducting depreciation and interest payment on loans (except the calculated interest on owner's capital) from gross cash flow. It is considered as a reward for the owner in one year of fishing operations.

Net profit is referred to as the net economic profit to society of employing the owner's capital in the fishing activity after subtracting the opportunity cost of this capital from profit. It is calculated as gross revenue less all expenses. Thus, it is an actual net reward after all factors of production have received their compensation.

Depreciation is calculated based on the fixed capital value which is to be valued at current prices. This means that assets acquired in an earlier period (called historic prices) have to be revalued in order to convert the prices to the 2008 year. The annual average consumer price indices[c] are used. Depreciation is obtained by using a straight-line depreciation plan based on the owner's estimated lifespan of the fixed capital items.

The calculated interest on owners' capital in the year of the profitability analysis (2008) is calculated based on the level of the owner's capital held in 2008 and the 2008 base interest rate in Vietnamese dong which is about 9% per annum[d], which was chosen to reflect the opportunity cost of owner's capital.

In this study, indicators taken from interest are economic performance, not financial performance. The main indicator added for this analysis is gross cash flow. This indicator is referred to as a good short-term indicator in fisheries [14]. Positive gross cash flow means that the vessel owners are able to pay for all their operational costs and meeting at least part of their obligations to creditors. A reasonable hypothesis here is that the vessel owner has a positive gross cash flow in the fishing operation year (Hypothesis 1).

Hypothesis 1: The vessel owner has a positive gross cash flow from his fishing operation in 2008, including the fuel cost quasi-lump-sum subsidy**.**

Behaviour of heterogeneous fishing vessels in an open access fishery

First, it is assumed that price of fish is the same in all vessels. Second, it is assumed that fish stock is considered as constant from an individual vessel's point of view. Therefore, the vessel harvest function is a function of its effort, given period of time and the stock level. We assume that this function is the Schaefer harvest function, $h(e;X) = qeX$, where e is the effort of one individual fishing vessel, given the stock level of fish, X, and the catchability coefficient, q.

The profit of the vessel is $\pi(e; X) = pqeX - tc(e)$, where p is the market price of fish and $tc(e)$ is the total cost of effort. In the short term, $tc(e)$ is only the total variable costs of effort, $tvc(e)$, so this profit is the vessel operating profit. In the long term, $tc(e)$ consists of total variable costs of effort, $tvc(e)$, and fixed cost, f. Total revenue of a vessel is $pqeX$ as a function of vessel effort, given p, q and X.

The profit of one individual is maximized at the level of the effort where its marginal cost of effort equals its marginal revenue of effort, $mc(e) = pqX$. In the short term, the vessel will operate at a positive level of effort only if $pqX \geq tvc(e)/e = avc(e)$, where $avc(e)$ is the average variable cost of vessel effort. This means that the marginal revenue of effort has to be more than the minimum average variable cost of vessel effort. In the long term, the condition of the existence for fishing operations of the individuals is that the marginal revenue of effort has to be larger than the minimum average total cost of effort in order to cover the fixed capital cost. This means $pqX \geq tc(e)/e = [tvc(e) + f]/e = atc(e)$, where $atc(e)$ is the average total cost of vessel effort.

From the Schaefer harvest function $h = qeX$, we can calculate the catch per unit of effort (CPUE) = $h/e = qX$. A reasonable deduction is that the CPUE of each vessel has the same amount of qX since the fishing effort of heterogeneous vessels is standardized, and fish stock level is assumed as constant in the short term. Since fish price is considered the same for all vessels, the average revenue of the vessel effort is thus similar among the fishing vessels, and equals the average revenue of effort of the fishery.

Fishing effort standardization

The standardized fishing effort indicators for vessels will be estimated by effort function through the production function approach. With cross-sectional data for one year being used for the short term, an assumption of constant the variable of resource stock is reasonable. This assumption implies that the production function is separable. This separability allows aggregation of individual inputs into the aggregate variable fishing effort. And the effort function of each vessel can be presented in the form of Cobb-Douglas function:

$$EFFORT = g(x_1, x_2, ..., x_k) = Ax_1^{\alpha_1} x_2^{\alpha_2} ... x_k^{\alpha_k} \qquad \text{(Eq. 1)}$$

where *EFFORT* is the standardized fishing effort; $x_1, x_2, ..., x_k$ are a set of inputs of the vessel, and A is a constant. The Cobb-Douglas function was used validly in many studies of the fisheries fishing sector, such as the researches of Hannesson (1983), Campbell (1991) and Padilla and Trinidad (1995) [15,16,17].

A log-linear effort model for vessel *i* can be written as follows:

$$\ln EFFORT_i = \alpha_0 + \alpha_1 \ln x_{1i} + \alpha_2 \ln x_{2i} + ... + \alpha_k \ln x_{ki} + u_r \quad \text{(Eq. 2)}$$

where α_0, α_1, α_2,…, α_k are coefficients, A = exp(α_0), u_r is a random error term, and subscript *i* shows vessel *i*.

The amount of fish caught per unit of time is often used as a measure of effective fishing effort. However, since it is assumed that fixed prices of fish are the same for all vessels and months within one year, the annual gross revenue is considered as a proxy for annual quantity of fish. The 2008 gross revenue, therefore, is chosen as a proxy of a vessel's effective fishing effort due to lack of catch volume data for each vessel.

Adapting the definition of relative fishing power by Beverton and Holt (1957) [18], the relative standardized fishing effort of vessel *i* can be determined by the following formula:

$$e_i = EFFORT_i / \overline{EFFORT} \quad \text{(Eq. 3)}$$

where e_i is the relative standardized fishing effort of vessel *i;* $\overline{EFFORT}$ is determined in terms of unit of standardized effort which is an average standardized effort of all vessels.

The relative standardized effort of vessel *i*, e_i, is used for analysing economic efficiency of the vessels. By nature, using the results of "standardized effort" estimated from Eq. 1 or "relative standardized effort" calculated from Eq. 3 will produce the same conclusions. The notion of the "relative standardized effort" is applied for this study. Calculating "relative standardized effort" gives new indices of relative fishing power (RFP). These indices can be expressed as the relative fishing power efficiency of the vessels.

In this study, economic efficiency of the vessel is considered as the cost efficiency of the vessel since the average revenue per unit of the relative standardized effort of the individual vessels is regarded as identical. The ratio of costs to relative standardized effort reflects the cost efficiency of the vessel. The relationship between the cost efficiency and the relative standardized effort of each vessel will be graphed by Salter-diagram software. It will be presented in three perspectives. The short-term perspective includes variable, fixed and labour costs. There will be two long-term perspectives. The first long-term perspective comprises all costs excluding the opportunity cost of the owner's capital. The second long-term perspective is analysed with all cost items, including the opportunity cost of owner's capital. The intra-marginal rent is generated by those vessels that are the most cost-effective making above-normal profit which is more than zero profit of the marginal vessel in the open access fishery with heterogeneous vessels.

DATA

The 2008 data was obtained by a survey of costs and earnings of offshore gillnet vessels in Nha Trang, Vietnam. The data was collected through direct interviews with fishing households. The data consists of detailed information on various aspects of gillnet fishery such as vessel technical and operational characteristics, cost and landing value information and other information. From a population of 225 registered offshore gillnet vessels in Nha Trang, a sample of 58 gillnet vessels was selected for investigation. The number of gillnet vessels investigated comprises about 25.8% of the population.

RESULTS

Economic performance indicator results

The subsidies case

In this case, key economic performance indicators for an average gillnet vessel are given in Table I. The annual gross revenue from fishing operations varied from 480 to 1,550 million VND[e], with an average of 1044.6 million VND. Because all 58 surveyed gillnet vessels received the 2008 fuel subsidies, the average gross revenue with the subsidies increased to 1073.7 million VND. The results show that income, gross value added, gross cash flow and profit is positive for an average vessel, whereas net profit is negative (see Table I). For fishermen's income, 17.1 million VND was the income level of the average annual crew share. As a result, the average monthly crew share during the fishing season is 1.65 million VND, with the average annual total operating months of a gillnet vessel being 10.31.

For relative performance indicators, gross profit margin is estimated by dividing gross cash flow by gross revenue with the subsidies. Profit margin, return on capital value and return on owner's capital are estimated by dividing profit by gross revenue with the subsidies, net capital value and net owner's capital respectively. These indicators are represented including the standard deviation to determine differences in the vessels (see Table I).

Test hypothesis 1:

The average vessel's gross cash flow was 195.8 million VND with a large range from –35.8 to 440.2 million VND (Table I). By investigation, there were two vessels (vessel numbers 25 and 40) where gross revenue with the 2008 subsidies did not offset their variable, fixed and labour costs. Thus, the null hypothesis 1 is rejected in the case of these two vessels. However, this hypothesis is not clearly rejected since the average vessel gross cash flow was positive and far from zero. Hence, the null hypothesis rejection would not be statistically significant for all 58 vessels.

Table I: Economic performance indicators, including the 2008 fuel subsidies

Criteria	Minimum	Maximum	Mean	Std. Deviation
Gross revenue from fishing	**480.0**	**1550.0**	**1044.6**	**341.2**
Subsidy	26.0	30.0	29.2	1.6
Gross revenue with subsidies	**506.0**	**1580.0**	**1073.7**	**342.3**
Variable costs	280.0	880.0	604.4	174.5
Income	**140.0**	**810.0**	**469.3**	**193.8**
Fixed costs	30.0	150.9	89.4	30.1
Gross value added	**84.2**	**702.2**	**379.9**	**172.3**
Labour costs	57.8	396.0	184.1	78.4
Gross cash flow	**-35.8**	**440.2**	**195.8**	**121.2**
Depreciation	60.5	215.4	136.4	45.8
Interest payment on loans	.0	42.0	8.9	13.9
Profit	**-152.5**	**249.3**	**50.5**	**93.1**
Calculated interest on owner's capital	15.4	159.4	68.9	39.2
Net profit	**-211.0**	**157.1**	**-18.4**	**84.4**
Net capital value	171.5	1954.0	862.8	454.7
Net owner's capital	171.5	1771.5	766.1	435.3
Gross profit margin	-.045	.315	**.173**	.083
Profit margin	-.166	.186	**.038**	.085
Return on capital value	-.285	.329	**.053**	.127
Return on owner's capital	-.298	.329	**.061**	.139
Average income per fisherman	**7.2**	**33.0**	**17.1**	**5.8**

Notes: all economic values are in million VND per vessel per year, 1 USD = 16,948 VND. Source: own data

Table II: Economic performance indicators among vessel groups, including the 2008 fuel subsidies

Criteria	Range of engine power							
	50<=HP<90 (N=12)		90<=HP<250 (N=16)		250<=HP<400 (N=19)		HP >= 400 (N=11)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Gross revenue from fishing	**594.2**	*75.6*	**848.1**	*168.3*	**1249.7**	*125.1*	**1467.3**	*70.9*
Subsidy	26.0	*.0*	30.0	*.0*	30.0	*.0*	30.0	*.0*
Gross revenue with subsidies	**620.2**	*75.6*	**878.1**	*168.3*	**1279.7**	*125.1*	**1497.3**	*70.9*
Variable costs	366.3	*50.5*	531.3	*101.8*	714.7	*97.7*	780.0	*67.0*
Income	**253.8**	*50.8*	**346.8**	*137.0*	**565.1**	*81.6*	**717.3**	*79.9*
Fixed costs	58.1	*10.3*	71.9	*23.6*	110.6	*20.9*	112.4	*17.9*
Gross value added	**195.7**	*49.7*	**274.9**	*125.6*	**454.5**	*78.8*	**604.9**	*83.7*
Labour costs	105.7	*41.9*	141.4	*40.2*	216.7	*57.2*	275.4	*57.6*
Gross cash flow	**90.0**	*59.7*	**133.5**	*110.1*	**237.7**	*88.0*	**329.5**	*71.2*
Depreciation	75.7	*12.0*	111.8	*22.0*	162.9	*19.6*	192.3	*14.8*
Interest payment on loans	4.4	*5.4*	5.3	*10.2*	8.6	*13.7*	19.8	*19.8*
Profit	**9.9**	*62.6*	**16.4**	*100.9*	**66.2**	*92.8*	**117.4**	*71.2*
Calculated interest on owner's capital	27.8	*7.3*	48.4	*18.8*	84.4	*29.4*	117.1	*29.7*
Net profit	**-17.9**	*65.1*	**-32.0**	*97.6*	**-18.2**	*94.8*	**.3**	*69.3*
Net capital value	344.5	*108.1*	633.0	*185.7*	1024.6	*274.1*	1483.1	*314.2*
Net owner's capital	308.5	*81.6*	537.5	*209.1*	937.7	*326.5*	1301.3	*330.4*
Gross profit margin	**.145**	*.088*	**.145**	*.101*	**.187**	*.069*	**.219**	*.043*
Profit margin	**.015**	*.095*	**.011**	*.103*	**.053**	*.072*	**.078**	*.046*
Return on capital value	**.046**	*.178*	**.021**	*.152*	**.068**	*.096*	**.081**	*.052*
Return on owner's capital	**.046**	*.185*	**.031**	*.169*	**.077**	*.113*	**.093**	*.063*
Average income per fisherman	**12.2**	*4.2*	**14.2**	*3.7*	**19.2**	*4.8*	**23.1**	*4.6*

A breakdown of the sample by engine size of the vessels is given in Table II. The results show most annual performance indicators increased on average with engine sizes. These indicators comprise gross revenue with and without the subsidies, income, gross value added, gross cash flow and profit. Crew remuneration on average also increased with vessel engine sizes. Costs followed the same trend as gross revenue and vessel engine sizes. An average gillnet vessel of each group covered the cash cost as well as depreciation. Two vessel groups with higher engine power had economic performance indicators far better than those of two vessel groups with smaller engines in 2008. However, while vessels with more than 400 HP barely covered all expenses including the opportunity cost of owner's capital and got only a very small surplus with a net profit of 0.3 million VND on average for 2008, other vessels got negative net profits (see Table II).

The non-subsidies case

For the case excluding fuel subsidies, annual economic performance indicators (income, gross value added, gross cash flow, profit and net profit) on average were less than those of the case with the subsidy by 29.2 million VND: an average quasi-lump-sum subsidy of the surveyed vessels (see Table III). As obtained from the survey, there would have been 3 vessels with a negative gross cash flow (an increase of 1 vessel in comparison with the subsidy case), 23 vessels (which accounted for 40% of the total) with negative profit (an increase of 7 vessels) and 42 vessels (which accounted for more than 72% of the total) uncovered their opportunity cost of owner's capital (an increase of 9 vessels). Consequently, an average gillnet vessel was earning a negative economic profit (–47.6 million VND) from its actual fishing operation. Vessels with less than 250 HP on average were not able to cover depreciation and interest payment on loans from their gross fishing revenue; whereas vessels with more than 250 HP averaged a positive profit annually (see Table IV).

Table III: Key economic performance indicators, excluding the 2008 subsidies

Criteria	Minimum	Maximum	Mean	Std. Deviation
Gross revenue from fishing	**480.0**	**1550.0**	**1044.6**	**341.2**
Income	**110.0**	**780.0**	**440.2**	**192.9**
Gross value added	**54.2**	**672.2**	**350.7**	**171.4**
Gross cash flow	**-65.8**	**410.2**	**166.6**	**120.5**
Profit	**-182.5**	**219.3**	**21.4**	**92.7**
Net profit	**-241.0**	**127.1**	**-47.6**	**84.4**
Gross profit margin	-.085	.299	**.147**	.089
Profit margin	-.211	.166	**.008**	.092
Return on capital value	-.359	.250	**.007**	.128
Return on owner's capital	-.359	.250	**.007**	.142

Table IV: Key economic performance indicators among vessel groups, excluding the 2008 subsidies

Criteria	Range of engine power							
	50<=HP<90 (N=12)		90<=HP<250 (N=16)		250<=HP<400 (N=19)		HP >= 400 (N=11)	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Gross revenue from fishing	**594.2**	*75.6*	**848.1**	*168.3*	**1249.7**	*125.1*	**1467.3**	*70.9*
Income	**227.8**	*50.8*	**316.8**	*137.0*	**535.1**	*81.6*	**687.3**	*79.9*
Gross value added	**169.7**	*49.7*	**244.9**	*125.6*	**424.5**	*78.8*	**574.9**	*83.7*
Gross cash flow	**64.0**	*59.7*	**103.5**	*110.1*	**207.7**	*88.0*	**299.5**	*71.2*
Profit	-16.1	*62.6*	-13.6	*100.9*	36.2	*92.8*	87.4	*71.2*
Net profit	**-43.9**	*65.1*	**-62.0**	*97.6*	**-48.2**	*94.8*	**-29.7**	*69.3*
Gross profit margin	**.107**	*.092*	**.114**	*.107*	**.167**	*.070*	**.203**	*.044*
Profit margin	**-.029**	*.099*	**-.025**	*.109*	**.030**	*.073*	**.059**	*.047*
Return on capital value	**-.036**	*.170*	**-.033**	*.150*	**.037**	*.095*	**.060**	*.050*
Return on owner's capital	**-.044**	*.179*	**-.036**	*.165*	**.040**	*.111*	**.068**	*.062*

Econometric results and estimates of standardized fishing effort

Initially, many factors were considered as an input bundle to generate fishing effort. However, some of them were excluded in the final model because neither individual nor joint tests produced any evidence to support their significant effects on the fishing effort of the vessel. Consequently, engine capacity, fishing gear (as proxies for capital inputs) and fishing days in a year (as the proxy for variable inputs) are identified as factors affecting the fishing effort of the vessel. And the econometric result is

$$lnEFFORT_i = -0.045 + 0.251\ lnHP_i + 0.542\ ln\ GEAR_i + 0.478\ ln\ DAY_i \qquad \text{(Eq. 4)}$$

(P-value) (0.873) (0.000) (0.000) (0.000)

The effort equation is used to derive standardized measures of fishing effort for each vessel as follows:

$$EFFORT_i = \exp(-0.045) * HP_i^{0.251} GEAR_i^{0.542} DAY_i^{0.478} \quad \text{(Eq. 5)}$$

where *HP* is horsepower, *GEAR* is the number of pieces of gill nets, *DAY* is the number of fishing days in 2008.

The results indicate the effect of independent variables in explaining variations in fishing effort is significant for the sample vessels with an R^2 of 98.7%. F-statistic of 1394.4 specifically provides that the estimated relationship is significant. All coefficients estimated of the explanatory variables are significantly different from zero at 1% level or better based on the OLS estimation with White's procedure for correcting for heteroskedasticity.

In this study, the actual engine power, number of pieces of gill net and number of fishing days in the 2008 fishing season for each vessel are used to estimate the standardized fishing effort (Eq. 5). Estimated results for each of the sample vessels in 2008 are presented in Figure 1. The average standardized fishing effort is 1043.18 (units of effort). Vessel number 35 has the minimum standardized effort of 478.53 (units of effort), whereas the maximum standardized effort of 1514.77 is the amount of fishing efforts of vessel number 30.

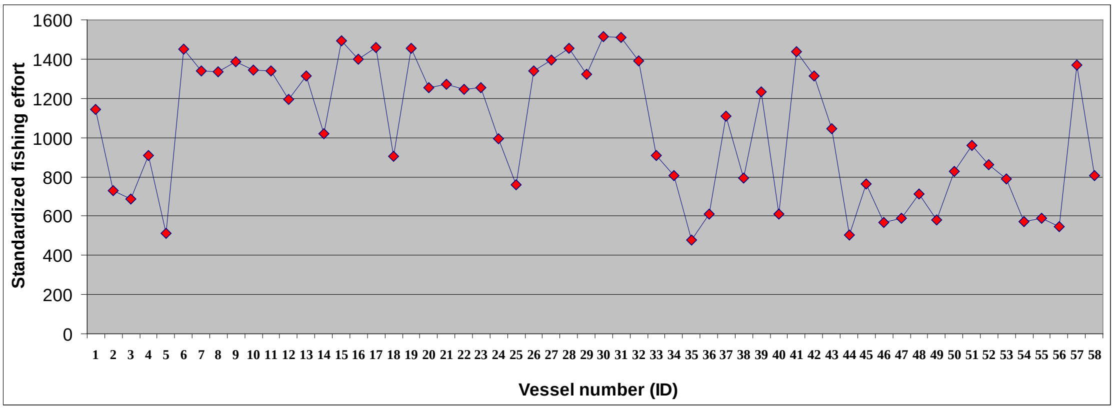

Figure 1: The standardized fishing effort of the 58 gillnet vessels. Source: own data

Relative standardized effort

Relative standardized effort is computed for each vessel. The minimum and maximum results of the relative standardized effort are 0.46 and 1.45, with corresponding vessel numbers 35 and 30, respectively (see Figure 2). There were 28 vessels with a relative standardized effort of less than 1, whereas 30 vessels had a relative standardized effort greater than 1. The majority of vessels with relative standardized effort indices above 1 had engines with more than 250 HP and 300 pieces of gill net or more.

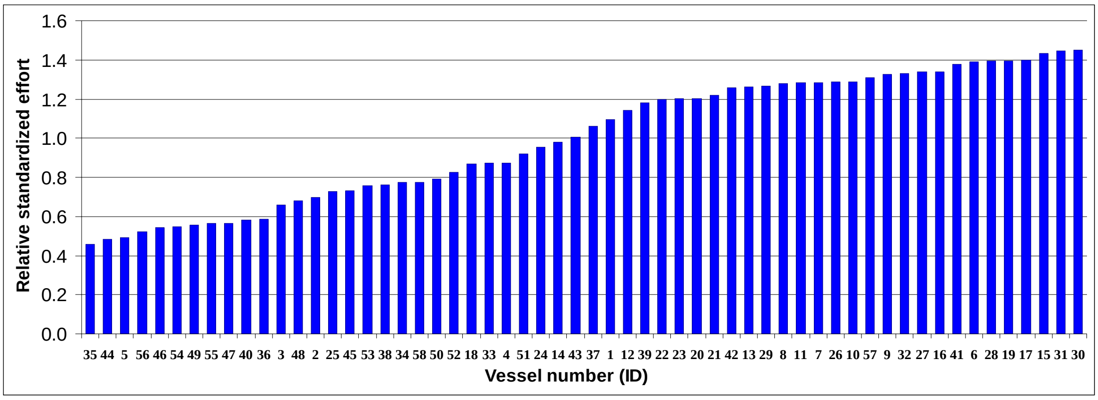

Figure 2: Relative standardized fishing effort of the 58 gillnet vessels. Source: own data

Economic efficiency of the vessel

Economic efficiency of the vessels in the short term

Figure 3 shows the relative cost efficiency of the 58 gillnet vessels in the short term, of which the relative standardized effort of each vessel *i* is measured by the width of the bar; the height of the bar measures the average total variable, fixed and labour costs per unit of relative standardized effort[f], avc_i, of each vessel *i*. All avc_i is sorted in order from the most (left) to the least (right) efficient vessel. The figures within the bars show the vessel numbers. The lower horizontal line is the average revenue per unit of the relative standardized effort of a fishery assumed to have 58 vessels, excluding subsidies[g] ($AR_{os}(E)$ = 1044.6 mi. VND), whereas the higher horizontal line is the average revenue per unit of the relative standardized effort of the fishery, including subsidies[h] ($AR_{ws}(E)$ = 1073.7 million VND). In general, the majority of the most cost-efficient vessels in the short term were those with large relative standardized efforts (above 1), while there were many vessels with smaller relative standardized efforts (below 1) belonging with the group of the lower cost-efficient vessels.

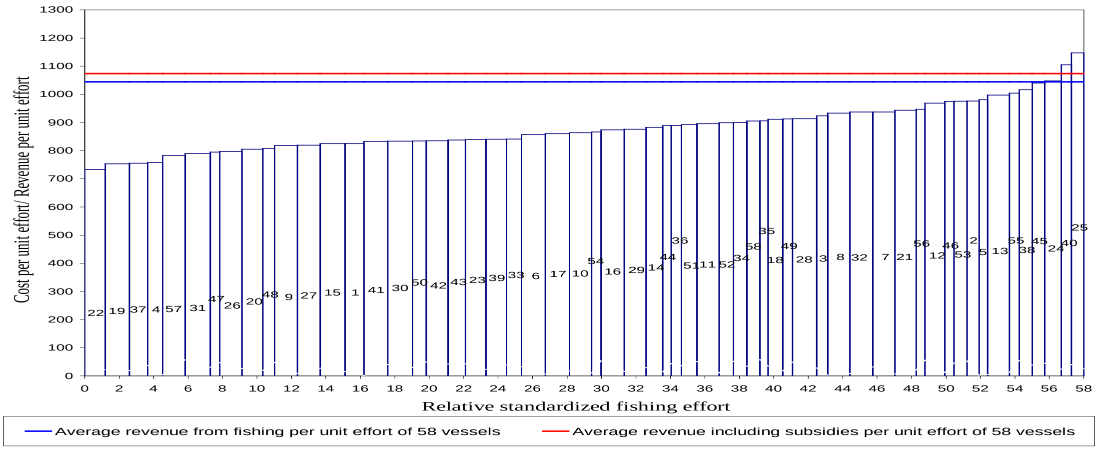

Figure 3: The cost efficiency of relative standardized effort in the short term among the 58 gillnet vessels. Unit: million VND per vessel per year. Source: own data.

Economic efficiency of the vessels in the long term

Figure 4 presents each vessel's individual efficiency in the long term excluding the opportunity cost of the owner's capital. The height of the bars on Figure 4 measures the average total cost[i] (excluding the calculated interest on owner's capital) per unit of relative standardized effort of each vessel *i*, atc_i. All atc_i are also sorted in order from the most (left) to least (right) efficient vessel. Figure 4 shows 22 out of the 30 vessels with relative standardized effort above 1 were among the 33 most cost-efficient vessels (their atc_i less than $AR_{os}(E)$). When including subsidies, 24 of 30 vessels with relative standardized effort above 1 were among the 40 most cost-efficient vessels (their atc_i less than $AR_{ws}(E)$). However, more than 70% of the additional 7 vessels had relative standardized effort below 1.

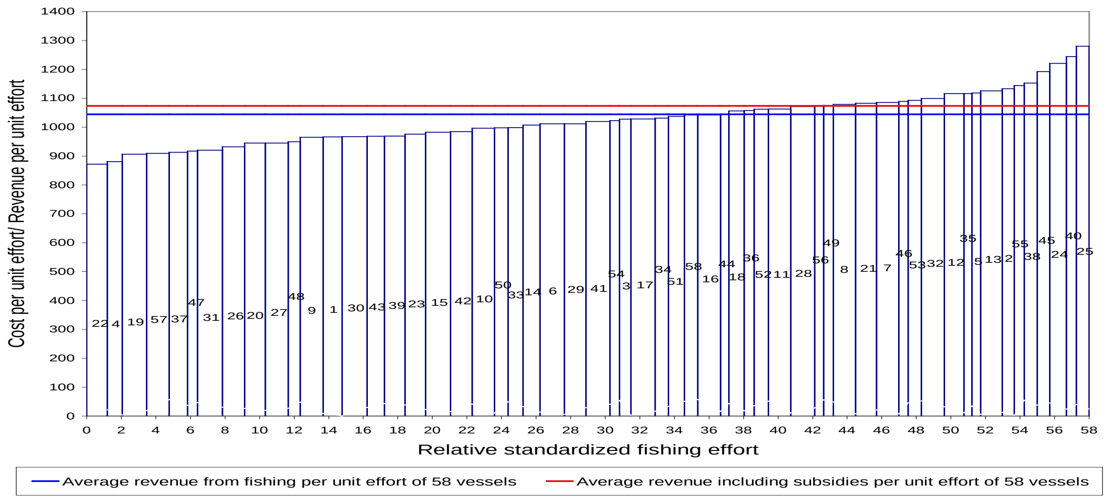

Figure 4: The cost efficiency among 58 vessels in the long term, excluding opportunity cost of owner's capital.

Similarly, Figure 5 shows vessel cost efficiencies including opportunity cost of owner's capital. The height of the bars on Figure 5 is the average total cost[j] (including opportunity cost of owner's capital) per unit of relative standardized effort of each vessel *i*, ac_i. The graphic results indicate that the majority of the vessels with high relative standardized efforts (above 1) belonged to the most cost-efficient vessel group. 75% of the most cost-efficient vessels (their ac_i lower than $AR_{os}(E)$) had relative standardized efforts above 1. Meanwhile, a high percentage of the vessels with low relative standardized efforts (under 1) comprised the medium or least cost-efficient vessels.

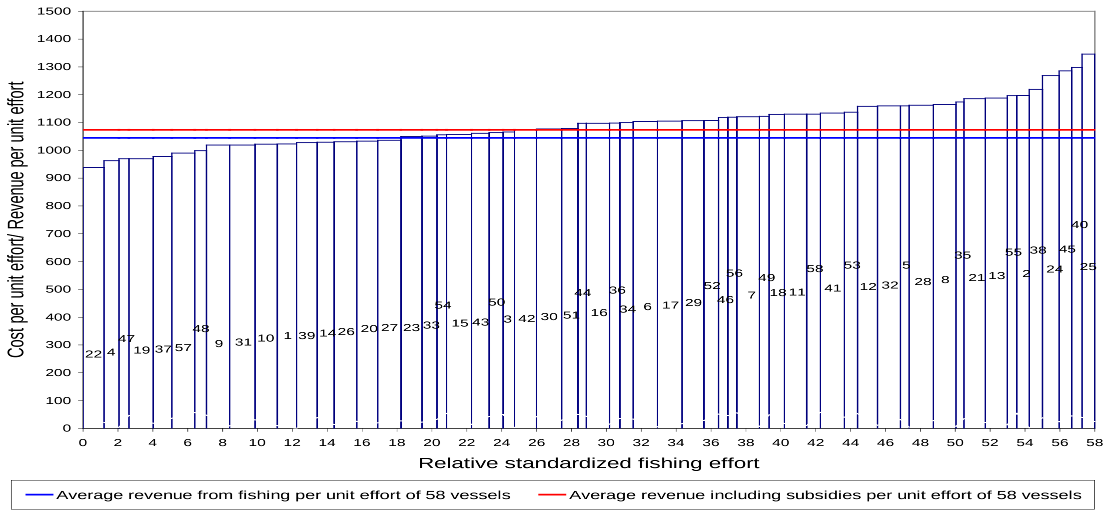

Figure 5: The cost efficiency among 58 vessels in the long term, including opportunity cost of owner's capital.

DISCUSSION

Key economic performances

The study carried out in 2008, based on a survey of costs and earnings data of a sample of 58 offshore gillnet vessels in Nha Trang, Vietnam, shows that the 58 vessels, on average, had positive income, gross value added, gross cash flow and profit both including and excluding the 2008 government fuel subsidies. On average, the vessels earned a gross profit margin of 17.3% and a profit margin of 3.8% including the subsidies. Excluding the subsidies, these percentages dropped to 14.7% and 0.08% respectively. This implies that the owner of an average gillnet vessel was not only capable of covering the variable, fixed, labour, depreciation and loan interest payment costs, but also turned a profit for the operating year (notwithstanding the opportunity cost of owner's capital) even excluding fuel subsidies.

The results above may highlight the advantages of fisheries under open access conditions versus the offshore gillnet fishery, which is exposed to high risks. The offshore fishery's capital investment and operational expenses are great, while capital rationing is actually limited in an imperfect capital market. Risks of damaging and losing fishing gear, which often represents half of capital invested, are quite large for this fishery due to high density of various types of vessel activities in fishing grounds. Moreover, difficult weather conditions and the remoteness of the fishing grounds cause obstacles for operations. Additionally, the 2008 world economic crisis's effects on the economy resulted in high expenses for fishing operations in 2008.

However, there were still two gillnet vessels unable to cover their total of variable, fixed and labour costs despite receiving the 2008 fuel subsidies, resulting in negative gross cash flows (one with a 55 HP engine, the other a 90 HP engine). These vessels may continue operations in next the few years without contradicting the economic theory of fishing vessels because the loss may be perceived as arising from bad luck or a poor year. If this loss persists beyond the next the few years, these vessel owners will eventually be forced out from the fishery.

Of the vessels surveyed, 27.6% (16 out of 58 vessels) operated at a loss (profit before the opportunity cost of owner's capital) even after receiving the 2008 fuel subsidies. These vessels may again operate as long as the loss is not expected to persist over a number of years; the loss may be attributed to bad luck or a poor year resulting in a low catch. Additionally, for fishermen in Nha Trang, the vessel and fishing gear are considered to be great assets that create opportunities for employment and income for most family members. When all costs are considered, including the opportunity cost of owner's capital and subsidies, 33 out of 58 vessels (57%) were found to be making economic losses. Excluding subsidies, 42 out of 58 vessels (72%) made economic losses. Thus, the net profit indicator, on average, was negative for both cases. This implies that, from society's perspective, higher returns could have been earned if owner's capital had been invested in the next best alternative activity.

The analysis demonstrates that in 2008, the average larger engine vessels had better annual economic performance indicators (including income, gross value added, gross cash flow and profit) than smaller engine vessels. Some explanations for these include: first, the larger engine vessels catch a greater fish volume, therefore achieving a larger amount of gross revenue; second, the large engine vessels are considered more cost-efficient than other vessel groups.

For remuneration, the average annual crew member's share was about 17.1 million VND. This figure was about 74.5% more than the 2008 average income per capita in Khanh Hoa province (9.8 million VND per capita per year of 2008 [19]), and 43.2% higher than the 2008 national average income per capita (monthly average income per capita at current 2008 prices was 995 thousand VND for the whole country – corresponding to 11.94 million VND per capita per year for 2008 [20]). This demonstrates that crew members may have earned an opportunity cost of labour or above in the fishing season of 2008.

The average annual income per fisherman increased with engine sizes. The two groups of larger than 400 HP and 250-400 HP were paid the highest annual incomes for crew members. This may not be unexpected since these large engine vessels spent a greater amount of time fishing than small engine vessels. From a societal perspective, fishing activities that provide lower income levels might not be preferable to those that provide larger incomes, given other things constant. For Nha Trang's 58 offshore gillnet vessels, the owner-operators and the owner's family-crew members received their explicit crew-share. Thus, the owner-operator derived income from both the crew-share as a crew member, and the profit (residual profit) as the vessel owner. Since the average annual profit indicator and crew income increased with engine sizes, there may be incentives for owner-operators to adopt technologies in order to provide them with the highest income.

Economic efficiency and intra-marginal rent of the vessel

In this study, economic efficiency analysis is based on results estimated from the fishing effort standardization. Econometric results indicated that the combination of parameters including horsepower, fishing gear and fishing days was reasonable for measuring vessels' standardized fishing effort. The relative fishing power indices were different between the vessels. Vessels equipped with high engine power, number of pieces of gill nets, and a large number of fishing days would have large relative standardized effort. Even though this does not come as a surprise, it is useful for the economic analysis to calculate the fishing power of each vessel and to compare them. The results proved that the 58 gillnet vessels were heterogeneous in the fishing effort and that they thus differed in efficiency of relative standardized effort.

The 58 gillnet vessels' cost efficiency of relative standardized effort had few differences between the short and long term. A large number of vessels with high relative standardized effort (more than 1) were the most cost-effective in both perspectives. For the short-term perspective, most vessels with relative standardized effort of more than 1 earned large gross cash flows compared with those with lower relative standardized effort of less than 1. In other words, the large numbers of intra-marginal rents in the short term were generated by mostly vessels with high relative standardized effort (above 1). For long-term perspectives, most intra-marginal rents were also generated by this vessel group. When all costs are considered, the least cost-efficient vessels accounted for a large amount of vessels with low relative standardized efforts (under 1).

The results above indicate that private investors may still find this fishery attractive in the near future. Either improvements or investments in engine capacity and fishing gear or an additional increase in fishing time may continue to grow. This will result in diminishing catch for individuals as fish stocks decrease over time, resulting in potentially forcing currently profitable vessels to become unprofitable. This seems to somewhat reflect the situation of Khanh Hoa's fishery since total engine power of the fishing fleet increased in 2009 [10].

As mentioned above, a great number of the least cost-efficient vessels (their ac_i more than $AR_{ws}(E)$) had a low relative standardized effort (under 1). Thus, the number of losing vessels was higher than intra-marginal vessels in the long run, including opportunity cost of owner's capital, resulting in economic losses on average for the 58 vessels. Additionally, since the average vessel return on owner's capital of 6.1% was less than the opportunity cost of owner's capital, an average gillnet vessel was making economic losses in 2008 even after including the subsidies. This implies that there were also a larger number of vessels making economic losses, whereas a smaller number of vessels were earning intra-marginal rents. However, profits increased with engine sizes, and average returns on owner's capital were highest for the two groups with largest engines. This means that most intra-marginal rents generated came from the vessels with large engine capacity.

The results above may not contradict each other because engine power is one of factors affecting vessel's standardized fishing effort. Vessel cost efficiency analyses provide information on which vessels earned an intra-marginal rent or extra-marginal rent. The majority of vessels with high relative standardized effort belonged to the two groups with greatest horsepower. Thus, a large amount of vessels with low relative standardized effort (under 1) and/or small engine power were extra-marginal vessels in the long term. An average gillnet vessel's economic loss may not contradict the open access fisheries theory with heterogeneous vessels when the results are analysed with only a single year's data. Moreover, the effects of the world economic crisis on the national economy combined with 2008's peak demand resulted in substantial input price index increases. Nevertheless, if vessels' losses in this study persist over many years, they may eventually be forced out from the fishery. There was also no positive economic profit for the fishery. This is probative that this fishery was overcapitalized from an economic perspective, and that the 2008 fuel subsidies may have led to an increase in fishing efforts.

The effect of the subsidies on profitability of the vessel

Thanks to the 2008 subsidies, gross cash flow and profit of an average gillnet vessel increased about 17.5% and 36% respectively. There were only 2 vessels that failed to cover their total variable, fixed and labour costs. Without the subsidies, there are 3 cases in total. The number of vessels that failed to cover all costs (excluding the opportunity cost of owner's capital) reduced by 30%. With the 2008 fuel cost support, two vessel groups of 50-90 HP and 90-250 HP were able to cover their depreciation and loan interest payment to earn a profit, inversely a negative profit. When all costs are considered, 33 vessels suffered economic losses, instead of 42 vessels in the non-subsidies case –down by 21.4%. Small-scale vessels (either low engine capacity or low relative standardized effort) may have received the most significant benefits from the 2008 fuel subsidies.

However, the 2008 fuel cost support is considered to be an unfavourable subsidy as it triggers potential impacts on growth of fishing effort, leading to fishing overcapacity and therefore putting fish stocks at threat of rapid depletion [21]. This problem will not ensure a sustainable income for fishermen in the long run. Thus, a question for Vietnamese policy-makers is whether it is necessary to maintain direct subsidies.

CONCLUSION

Results of economic analyses on the offshore gillnet vessels in Nha Trang, Vietnam demonstrated that an average gillnetter was able to cover all costs exclusive of opportunity cost of owner's capital, and earned a gross profit margin of 17.3% and a profit margin of 3.8%, including the 2008 fuel subsidies, but made an economic loss. The average crew income was 74.5% more than the average income per capita in Khanh Hoa province. The most economically efficient vessels are mostly owned by individuals with high relative standardized effort. These vessels earned the great number of intra-marginal rents generated. The 2008 fuel subsidies brought more benefits for small-scale vessels. In addition, the study shows that engine power, fishing gear and fishing days were the factors best reflecting the fishing effort of the gillnet vessels.

Through this study, some implications should be addressed. *First*, good subsidies such as fisheries management, monitoring and enforcement programs should be implemented in order to enhance the growth of fish stocks. Supports such as forecasting weather, training fishermen, providing information of fish stock and rescue and life-saving activities at sea may also be favourable subsidies that do not expand fishing effort and capacity. *Second*, registration for the gillnet fishery should be limited. This may lessen fishing overcapacity. *Third*, gillnet vessels that were the least cost-efficient persistently making economic losses or even negative profits for many years should be removed from fishing activities. The government should plan to have vocational guidance or training made available for them as well as their family members to ensure a stable income and life. *Fourth*, engine capacity, fishing gear and fishing time may be major factors in creating fishing efforts of the gillnet fishery. Regulations for fisheries management should be also considered based on these inputs.

Nevertheless, some studies should be performed in the future. Choosing a reasonable capital valuation is vital for measuring and interpreting long-term economic performance indicators. Social-economic information about fishermen should be considered in measuring standardized fishing effort. Additionally, time-series data should be gathered not only for the gillnet fishery but also for other fisheries in Nha Trang, Khanh Hoa.

ACKNOWLEGEMENT

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ENDNOTES

[a] See Decision 289/QD-TTg on 18 march 2008 and Decision 965/QD-TTg on 21 july 2008 by Prime Minister of Vietnam.

[b] Now it is Ministry of Agriculture and Rural Development.

[c] Information from IMF–International Monetary Fund, 2009. In Word Economic Outlook Database, October 2009.

[d] Information from website of State bank of Vietnam: http://www.sbv.gov.vn/vn/CdeCSTT-TD/tracuu.jsp.

[e] 1 USD = 16,948 VND, source: http://www.mof.gov.vn/Default.aspx?tabid=4431&ItemID=61365.

[f] The average total variable, fixed and labour costs per unit of relative standardized fishing effort of vessel *i* in 2008 is

$$avc_i = [\textit{Total variable, fixed, labour costs of vessel } i] / e_i$$

[g] The average revenue per unit of relative standardized effort of the fishery assumed including all surveyed vessels, without the 2008 fuel cost subsidy, is $AR_{os}(E) = [\sum_{i=1}^{58} \textit{Total revenue of vessel i, without subsidy}] / \sum_{i=1}^{58} e_i$

[h] The average revenue per unit of relative standardized effort of the fishery assumed with all surveyed vessels for the case of the 2008 fuel subsidy is $AR_{ws}(E) = [\sum_{i=1}^{58} \textit{Total revenue of vessel i, with subsidy}] / \sum_{i=1}^{58} e_i$

[i] Total costs consist of variable cost, fixed, labour costs, depreciation and interest payment on loans, except the calculated interest on vessel owner's capital. The average total costs (excluding the calculated interest on owner's capital) per unit of relative standardized fishing effort of vessel *i* in 2008 is

$$atc_i = [\textit{Total costs of vessel i, excluding the calculated interest}] / e_i$$

[j] Total costs consist of all costs (both cash expenses and non-cash expenses), including variable, fixed, labour costs, depreciation, interest payment on loans and the calculated interest on owner's capital. The average total costs (including the calculated interest on owner's capital) of relative standardized effort of vessel *i* in 2008 is

$$ac_i = [\textit{Total costs of vessel i, including the calculated interest}] / e_i$$