NOAA Fisheries Best Practices for Measuring Returns to Fishing Businesses

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U.S. Department of Commerce
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National Marine Fisheries Service

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1. Introduction

NOAA Fisheries and fishery management council economists are required to perform economic analyses in support of fishery management actions. They also perform analyses for research purposes. Fisheries economic analyses often include the estimation of financial and economic *returns*[1] to fishing businesses. Current guidance on conducting economic analyses[2] of regulatory actions leaves a large degree of latitude to economists on how to estimate returns. Because there can be regional differences in the characteristics of fishing businesses and in availability of cost, revenue, and other data, it is best to not be overly prescriptive. However, this has led to some inconsistencies in terms and methods among regional programs and among individual analysts.

To address these inconsistencies, a working group of NOAA Fisheries economists was formed in March 2017 to review relevant fisheries economics literature, guidelines, and accounting standards to produce a set of recommended approaches for estimating returns. This report contains the resulting recommended best practices. In developing recommendations, the working group considered existing fishing business cost data collection programs as well as what could reasonably be collected in the foreseeable future. Thus, these best practice recommendations do not suggest approaches that require inordinate amounts of data. These recommendations are consistent with other NOAA Fisheries guidance and common practices.

The recommendations are, at times, highly detailed, but they also acknowledge that multiple approaches may be tailored to meet a specific research or management need. Where there is flexibility, the document highlights important aspects of alternative approaches, but does not specify step-by-step instructions.

Furthermore, the recommendations strike a balance between describing approaches that adhere to common accounting principles and economic theory, should detailed data exist, and describing approaches given the limited data sets that typically exist. While we do not presume that analysts would have access to complete financial records for fishing businesses, nor recommend that such data be collected, it is important to understand how financial and economic returns should be estimated with reasonably complete financial records. It is important for two reasons: 1) it helps with understanding the basis for recommended procedures when data are limited, and 2) it guides efforts to improve the collection of cost-earnings information from fishing businesses.

Throughout this document, we use the term *fishing business* to mean businesses that primarily engage in fishing operations. This includes harvest of fish for sale, for-hire (i.e., charter or party/headboat) activities, as well as operations that are primarily engaged in fishing but also process fish onboard. Businesses that primarily engage in onshore wholesaling, processing, distribution, and/or retailing are not included. In cases where a business owns both harvesting and other downstream operations, the focus is limited to the harvesting component of the business.

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[1] For purposes of this discussion, "returns" is a general term referring to some measure of profit or loss (very broadly, the difference between revenues and costs). Typically, a "return" reflects the amount of money made or lost from an investment (as in return on investment), but here we broaden it to include money made or lost from a business activity. The best practices recommendations described in this document will then further define specific financial and economic terminology to replace this broad notion of "returns".

[2] Current guidance on conducting economic analyses of regulatory actions can be found at the following link, but it is in the process of being revised to be consistent with changes to multiple legal mandates. https://www.fisheries.noaa.gov/national/laws-and-policies/guidance-conducting-economic-and-social-analyses-regulatory-actions

2. History/Background

2.1. Mandates for Economic Analyses

Many of the measures discussed in the following sections can be used to meet the analytical needs associated with one or more "legal" mandates[3] that drive the demand for these and other measures of economic performance. Economic analyses of federal regulatory actions in U.S. fisheries are primarily driven and shaped by the following mandates: Executive Order (E.O.) 12866, the Regulatory Flexibility Act (RFA), the National Environmental Policy Act (NEPA), the Endangered Species Act (ESA), and the Magnuson Stevens Fishery Conservation and Management Act (MSA), including several of the National Standards (NS) contained within that Act. Executive Order 12866, RFA, and NEPA apply to the vast majority of federal regulatory actions,[4] including but not limited to federal fisheries regulatory actions, while the MSA is specific to federal fisheries regulatory actions.

Of these mandates, E.O. 12866 is the most encompassing with respect to the breadth and depth of its economic analysis requirements, though NEPA is also broad with respect to its requirements. For example, E.O. 12866 and NEPA analyses typically include a description of the affected industry, all affected entities,[5] and the economic environment.[6] Conversely, in practice, the RFA analysis only describes entities directly regulated by a proposed regulatory action. For federal fisheries regulations, the MSA specifically requires a description, including an economic description, of the affected fishery(ies). Estimates of the variety of returns described would be suitable for such purposes, though the analyst will need to decide which of those measures are appropriate and necessary for a specific federal fisheries regulatory action. These estimates are important not only because they satisfy the requirement to describe the affected fishery and entities, but also because that information establishes the baseline from which regulatory alternatives, including the no action or status quo alternative, are assessed under the various types of analyses discussed below. Typically, these baseline descriptions cover at least a 3-5 year time period, and thus a time series of estimates is highly desirable.

The primary objective of E.O. 12866 is to ensure that federal regulatory actions maximize net benefits to the nation, which includes potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity. In other words, the benefits of a regulatory action should justify the costs of that action, consistent with applicable statutory requirements. Thus, E.O. 12866 requires an assessment of how a regulatory action is expected to affect net benefits to the Nation, including an assessment of the regulatory action's effects on net economic benefits (i.e., the difference between economic costs and benefits). This analysis of net benefits to the Nation is commonly referred to as a "benefit-cost analysis" (BCA). A comparable type of assessment is expected with respect to determining whether federal fisheries regulations are achieving Optimum Yield (OY) under NS1, where OY is the amount of fish harvested that will maximize overall (net) benefits to the Nation. Similarly, the guidelines for NS7 indicate that the benefits of a regulatory action should justify the costs, while the guidelines for NS9 indicate that management measures intended to minimize bycatch "to the extent

[3] "Legal" mandates includes Executive Orders as well as statutes in this case.

[4] Certain types of regulatory actions taken by NOAA Fisheries are not subject to one or more of these mandates, but they are relatively few in number.

[5] The reference to "affected entities" in E.O. 12866 and NEPA includes, but is not necessarily limited to, individuals, businesses, communities, and government jurisdictions, and thus is broader than the reference to "directly regulated entities" in the RFA. For example, recreational anglers are "entities" under E.O. 12866 and NEPA, but they are not entities under the RFA.

[6] E.O. 12866 also requires an analysis of effects on businesses of differing sizes, and other entities (including small communities and governmental entities), but this analysis is generally contained within the RFA analysis for NOAA Fisheries' regulatory actions.

practicable" must also take net benefits to the Nation into account. In addition, NS5 requires consideration of economic efficiency (i.e., maximization of net economic benefits) in the utilization of fishery resources. NS4 requires that Federal fisheries regulations avoid "excessive" concentrations of fishing privileges as such concentrations may lead to the exercise of market power and, in turn, a loss of economic efficiency (i.e., deadweight loss) and economic profits in the long run. Other provisions in the MSA suggest that an analysis of economic benefits and/or costs is necessary to satisfy the analytical requirements of the Act.[7] NEPA's analytical requirements are broader, but NOAA Fisheries' established practices for evaluating effects (e.g., changes in benefits and costs) on the human environment, including direct, indirect, and cumulative effects, are sufficient to meet NEPA's requirements.

Net economic benefits are conceptually measured as the sum of consumer surplus and producer surplus. For proposed regulatory actions, we are interested in the expected change in net economic benefits and thus the expected changes in consumer and producer surplus. Thus, estimates of producer surplus, and the revenue and cost variables necessary to generate those estimates, are critical with respect to meeting the economic analysis requirements of multiple mandates that apply to federal fisheries regulatory actions. Although measurement of consumer surplus is not addressed in this guidance, measurement of producer surplus is addressed in Section 5.

Executive Order 12866 also requires an assessment of the current distribution of economic costs and benefits between affected entities, and how that distribution is expected to change due to a regulatory action, relative to the no action alternative. Other mandates explicitly or at least implicitly require a similar assessment (e.g., NEPA, RFA, E.O. 13272, NS7, and NS1). Executive Order 12866 and other mandates (i.e., NS4 and sections 303(a)(14), 303(b)(6), and 303A(c)(5) of the MSA) additionally require an assessment of whether the current distribution and/or changes to that distribution due to a regulatory action are "fair" and/or "equitable."[8] The firm-level estimates discussed in Section 3 are important inputs into these analyses.

In addition, E.O. 12866 requires a determination of whether a regulatory action is expected to have an "economically significant" effect on the economy. The threshold for economic significance is an annual effect on the economy of $100 million, where "economic effect" in this case is measured by aggregating the absolute value of all annual costs, benefits, and transfers resulting from the action (i.e., it is not a measure of net benefits). Again, many of the estimates discussed in Sections 3.2 and 3.5 are important inputs into this determination.

An assessment of an industry's current economic impacts is required under 303(a)(13) of the MSA. Further, the expected economic impacts of a regulatory change should also be considered under NEPA, E.O. 12898, as well as NS8 and section 303(a)(9) of the MSA when the necessary data are available. "Economic impacts" in this case refers to changes in employment, income, sales, and value-added at the community, state, regional, and/or national level. Many of the estimates discussed in Section 3 can be used to help build economic impact models or modify "off the shelf" models (e.g., IMPLAN[9]). Further, estimates of ex-vessel revenue are an input into the models for the commercial sector, which in turn can be used to estimate the economic impacts of a fishery's commercial sector, while expected changes in ex-vessel revenue or costs can help analysts determine the economic impacts of regulatory actions on the commercial sector.

Some legal mandates involving economic analyses are primarily concerned with minimizing or reducing the costs or adverse effects associated with federal regulations. For example, for federal fisheries

[7] See MSA sections 303(a)(9), 303(a)(14), and 303(b)(6).

[8] The assessment of distributional changes is "positive" (objective and fact based) in nature, while the assessment of whether those changes are equitable is inherently "normative" (subjective and value based).

[9] http://www.implan.com/

regulatory actions, NS 7 requires that the costs of management be minimized, where practicable. The costs of management include compliance costs for those being regulated, such as capital outlays, operating and maintenance costs, and reporting costs.

Similarly, the RFA and E.O. 13272 are primarily concerned with minimizing the adverse effects of federal regulatory actions on directly regulated entities (e.g., commercial[10] and for-hire fishing firms), particularly "small" entities.[11] These mandates do not require NOAA Fisheries or other agencies to pick the regulatory alternative that minimizes the adverse effects on these entities; however, they do require agencies to consider that alternative and explain why it was not selected if another alternative was chosen. Specifically, the primary purpose of the RFA analysis is to determine if a proposed regulatory action is expected to have a "significant" economic effect on a "substantial" number of small entities, including whether the action is expected to have a disproportionate effect on small entities relative to large entities. Estimates of ex-vessel revenue at the firm level can be used to determine if a commercial or for-hire fishing firm is "small." Also, Section 610 of the RFA further requires NOAA Fisheries to conduct, within 10 years, a retrospective review of rules that were expected to have a significant economic effect on a substantial number of small entities. The primary purpose of the review is to determine if, based on updated economic and other information, the actual effects of the rule are the same or similar to those that were initially expected, and thus whether the objectives of the rule are still being met.

For NOAA Fisheries' regulatory actions, the "significance" of economic effects under the RFA is based on an analysis of the action's adverse and positive effects on the *profitability*[12] of directly regulated firms, particularly adverse effects (reductions) on the profitability of small entities (e.g., commercial or for-hire fishing firms) and whether those effects are disproportionate between small entities and large entities. Although no specific reduction in *profitability*, either in absolute or percentage terms, will necessarily trigger a determination that the adverse effects are "significant" (i.e., the determination is a judgment call by the analyst), a finding of disproportionate effects will trigger a determination that the economic effects are significant under the RFA (U.S. Small Business Administration, 2017).

Profitability can be reduced as a result of decreases in ex-vessel revenues or increases in costs. Thus, estimates of profit/returns for commercial and for-hire fishing at the firm and industry level, as well as the measures of revenues and variable/fixed costs needed to estimate returns, are critical with respect to meeting the analytical requirements of the mandates discussed above. Further, as a result of the RFA Section 610 review requirement that applies to many of NOAA Fisheries' rules, it is important to have estimates of these measures over time.

2.2. Other Uses of Returns Measures

In order to support economic analyses, significant agency resources are devoted to collecting information about revenue and operating costs from fishing businesses. A critical component of this effort is providing useful summaries of the information back to those who provide the data. This is important for maintaining good relationships with industry, which can lead to better response rates. Providing draft reports to the industry for review also provides a mechanism for quality control. This type of feedback is

[10] NOAA Fisheries has an agency-specific, single size standard at 50 C.F.R. § 200.2 for all businesses primarily engaged in the commercial fishing industry (NAICS 11411). This standard was established in 2015 and is currently $11 million in gross revenues, but is subject to review every five years.

[11] The term "entities" under both the RFA and E.O. 13272 includes businesses, organizations, and governmental jurisdictions such as cities. For businesses and organizations, the definition of a "small" entity varies by industry and type of organization.

[12] In general, *profitability* is the ratio of revenues to some measures of costs.

often done with the use of financial statements such as the income statement and balance sheet. Gaining consistency in the production of these types of statements can help to maintain clear communication of information and conduct cross regional and/or fishery comparisons of economic performance.

Beyond the mandates previously described that drive much of the work of NOAA Fisheries' economists, there are other reasons for estimating returns to fishing businesses. Fisheries economics research that is not directly linked to the evaluation of management alternatives is conducted to explore new approaches to fisheries management, to better understand economic behavior of fishermen, and to develop or improve tools used in fisheries economic analyses, among other topics.

2.3. NOAA Fisheries Fishing Vessel Cost Data Collections

Recognizing the importance of measuring returns, in 2001, NOAA Fisheries implemented a strategic initiative to improve the collection of economic data from fishing businesses. Previous cost data collections carried out or funded by NOAA Fisheries, or its precursor the U.S. Bureau of Commercial Fisheries, date back as early as 1961, but were temporally and geographically sporadic.[13]

The NOAA Fisheries' programmatic support led to systematic expansions of cost data collection programs. The programs differ by region because each have different functional relationships with their respective fisheries management councils, and some data collections were built around other existing data collection initiatives such as logbook and at-sea observer programs.

Cost data are collected using a variety of methods. Survey vehicles such as mail, telephone, in-person, web-based, and add-ons to existing logbook and observer programs are used. Some surveys are mandatory while others are voluntary. All fixed costs are collected at the annual level. Variable costs are collected at a trip level for some fisheries and at an annual level for others. For some fisheries, all trips are surveyed but most are sampled. Some trip-level collections are ongoing (logbook/observer programs) while annual surveys are conducted at a 1-7-year interval.

3. Definition of Terms and Measures

As described in Section 2, there is a need to monitor the well-being of fishing businesses with a common metric through time. We have chosen the term *returns* to convey their well-being. We then use specific financial and economic terminology to define *returns* to fishing businesses..[14] Returns within financial and economic perspectives all have common elements but treat certain costs differently. For example,

[13] A detailed history of commercial (i.e., exclusive of for-hire fishing businesses) cost data collection efforts and a snapshot of all commercial NOAA Fisheries collections programs as of 2014 can be found in Thunberg et al. (2015). Cost data for for-hire vessels are collected from separate recreational fisheries data collection programs conducted in each region.

[14] The primary differences between financial and economic measures are the inclusion of opportunity costs in the economic measure; the valuation of positive and negative economic externalities for missing and incomplete markets using economic (shadow/accounting) prices based upon willingness to pay, willingness to accept, or opportunity cost; and accounting for other types of distortions to market prices, notably quantity and price controls for inputs and outputs, again using economic prices. Opportunity costs are the foregone value of resources used in their best alternative use; a currently available alternative that is sacrificed (adapted from Terry et al., 1996).

while explicit costs[15] are used in both financial and economic returns, there are implicit costs,[16] such as the value of the time an owner spends as a captain, that are only used in estimating economic returns. Table 1 lists elements used to measure returns from a financial or economic standpoint.

From a financial accounting framework, revenues and costs used to estimate returns are typically organized in income statements. Other aspects of firm financial well-being are characterized in cash flow statements and balance sheets. Typically, studies that estimate economic returns do not characterize revenues and costs using the same tools. These differences will be explained more fully below.

Each cost category is designated as a variable cost, fixed cost, or a cost that could be one or the other depending on the particular circumstances or could have characteristics of both variable and fixed costs. Variable costs are costs that vary with the amount of production or effort. Fixed costs are costs that do not change with production or effort. An example of a cost that has variable and fixed characteristics is *vessel expenses* (repair/maintenance). Greater levels of fishing effort lead to more wear and tear on a fishing vessel and so repair/maintenance costs would be higher. However, there are other types of repairs/maintenance, such as painting the hull, that may not necessarily vary with the number of trips, time at sea, or fish caught. For economic analyses that require separate treatment of variable and fixed costs, analysts may need to further investigate the nature of the costs and/or break out the cost categories defined here into individual cost items.

[15] Explicit costs are costs for which a direct payment was made.

[16] Implicit costs reflect the use of internal resources. Because direct financial transactions are not observed, other methods for deriving implicit costs are used. Implicit costs, along with explicit costs, reflect opportunity costs, and are used in the measurement of economic returns.

Table 1. Definition of revenue and cost categories used in financial and economic measures.

Name	Definition (code next to cost category name: VC = variable cost, FC = fixed cost, MX = could be variable or fixed depending on circumstances or has characteristics of both)
Ex-vessel revenue	The revenue obtained from the sale of fish from the harvesting vessel to first level buyer (dealer, wholesaler, processor, or retailer).
For-hire/charter revenue	Revenue from passenger fees; tips; fish cleaning; sale of food, beverages, and souvenirs; charter fishing; research charters; eco-tours (e.g. whale/bird watching trips); sunset cruises; burials at sea, etc.[17]
Quota pound/access privilege revenue	Revenue obtained from the transfer of harvest quota or other permit-related fishing access privileges (e.g., days at sea) that expire at the end of a fishing year/season. For fishing quota this is limited to quota pounds.[18] Sale of long-term quota shares[19] are not considered here.
Non-operating revenue	Revenue from ancillary business-related activities (that is, excluding major activities considered part of the normal operations of the fishing business). Such amounts may include: (a) dividends, (b) interest on securities, (c) profits on securities (net of losses), (d) insurance payouts, and (e) miscellaneous other income items.
Gain on sale of capital asset	If proceeds from the sale of physical capital or intangible asset is greater than the long-term asset's book value, then enter as a gain.[20] Otherwise see *loss on sale of capital asset* below. Book value is original purchase price less accumulated depreciation/amortization.
Cash from sale of physical capital	Cash proceeds from the sale of physical capital.
Cash from sale of intangible asset	Cash proceeds from the sale of intangible asset.
Direct[21] subsidies	Direct cash payment from a subsidy program. Only include direct subsidies related to the fishing business, i.e., not personal subsidies.
Cash receipts from loans	Cash inflow from the procurement of business loans.

[17] Adapted from Steinback and Brinson (2013). Revenue may be in the form of individual passenger fees or from chartering the vessel. These examples mostly apply to recreational/tourism related activities but commercial vessels could have some of these revenues as well (e.g., research charters).

[18] Quota pounds are maximum amounts of fish, measured in pounds, which can be caught in a fishing year or season. The limits are placed on individual or groups of fishermen. For more information see Holland et.al. (2015_.

[19] Quota shares are percentages of an overall fishery or stock limit. These percentage shares are long-term privileges used to determine quota pounds within a particular fishing year or season.

[20] https://www.accountingcoach.com/cash-flow-statement/explanation/8

[21] In-kind subsidies (also known as indirect subsidies), such as fishing quota allocated gratis, are not typically accounted for in financial nor economic profit statements. Exemption from the highway tax on fuel is not considered a direct subsidy nor are tax exemptions on other inputs. The Capital Construction Fund is not considered a subsidy since there is no direct payment. Rather, pre-tax income is deferred from taxation for use in vessel (re)construction and later recaptured by reducing the depreciable cost of the vessel. Direct subsidies include disaster payments. A recent example of this is monies provided through the Coronavirus Aid, Relief, and Economic Security (CARES) Act. For a complete description of subsidies available to U.S. fishermen, see Sharp and Sumaila (2009).

Table 1 (continued)

Name	Definition (code next to cost category name: VC = variable cost, FC = fixed cost, MX = could be variable or fixed depending on circumstances or has characteristics of both)
Value of non-market outputs	Value of outputs not sold in a market and for which a benefit is derived. Therefore, no market price is observed. For a fishing business, this could be the value of fish bartered or used for personal consumption, for example. Information for estimating this value may not be available. This item is included, however, for completeness.
Hired crew and captain payment (VC)	Payments to crew and captain who are hired, including any other costs directly related to crew/hired captain labor such as benefits, bonuses, payroll taxes, etc. In most cases, payment is determined by a crew share formula but hourly rate pay or salaried crew would be included. Non-crew employee (such as office staff, etc.) pay is not considered here. Payment to a vessel owner who works as captain or crew is not included, nor is the value of a vessel owner's time as captain or crew.
Owner-operator payment (MX)	Payment to an owner for working on the vessel as captain or crew. In most cases, payment is determined by a crew share formula but hourly rate pay or a salary would be included here. Only cash payments are included, the value of a vessel owner's time is not included. This cost is used on the cash flow statement only.
Non-labor trip expense (VC)	Payments for non-labor trip related expenses. May include, but not limited to, fuel (net of any highway tax that may have been refunded), gear, bait, ice, water, salt, groceries, supplies, sales costs, and handling/offload costs. These expenses may or may not be included in the crew share formula for determining crew expense. Further, crew may pay for certain trip expenses, which should not be included here. That is, only include expenses paid for by the owner even if those expenses are "deducted" from the crew's share for the purpose of determining *hired crew and captain payment*. For for-hire/charter activities, additional expenses include cost of concessions (food, drink, souvenirs, etc.), tackle and supplies (soap, detergent, mops, brooms, bags, uniforms/clothes, trash bags, other plastic bags).[22]
Vessel expense (MX)	Payments for vessel and gear maintenance and repair, including drydock repairs. These are for maintenance and repairs that occurred due to fishing operations, not capital expenditures for new equipment (e.g. engine replacement, electronics upgrade). Equipment/vessel lease expense included here. Purchases of a new capital asset (including vessel, motor, or other major equipment) are recorded under capital expenditures in the year they occur and are then depreciated over either the economic or physical life of the asset.
Overhead (FC)	All other payments that are usually and regularly incurred by fishing businesses but not loan payments, income taxes, nor landings taxes. Other types of taxes and fees are included here. Also includes, but not limited to, fishing business related vehicle costs, professional fees, association fees, office space, storage space, insurance, mooring/docking, permit/license fees, monitoring costs, advertising, communications costs, travel, cost recovery fees, and non-crew labor/salaries. Owner withdrawals are not included.

[22] Adapted from Steinback and Brinson (2013).

Table 1 (continued)

Name	Definition (code next to cost category name: VC = variable cost, FC = fixed cost, MX = could be variable or fixed depending on circumstances or has characteristics of both)
Interest expense (FC)	Interest portion of loan payments.
Principal expense (FC)	Principal portion of loan payments.
Income taxes (MX)	Payment of local, state and federal income tax.
Quota pound/access privilege cost (VC)	Payment for the purchase/lease of harvest quota or other permit-related fishing access privileges that expire at the end of a fishing year/season. For quota, for example, this is limited to quota pounds. Purchase of long-term quota shares are not considered here.
Physical capital expenditures (FC)	Purchase of capital inputs (includes vessel, motor, and other equipment) recorded in the year they occur.
Intangible asset expenditures (FC)	Cost of acquiring fishing privileges. This includes fishing permits and fishing history (i.e., history that leads to the issuance of limited access permits) and quota share. These values are often bundled with the price of the vessel. Efforts should be made to separate these from the vessel price. This does not include quota or other access privileges that expire at the end of a fishing year/season. Also, this does not include annual permit/license fees associated with maintaining the fishing privilege.
Depreciation of physical assets (FC)	In financial statements (financial depreciation): allocation over time of the historical cost (or original cost), less salvage value, of a physical capital input having a limited useful life (i.e. vessels, engines, machinery, fishing gear, etc.) by a noncash expense periodically charged against income over the service, or useful life, of that capital.[23] See Section 4.1. Depreciation methods for tax purposes are not considered. However, if the information described above is not available, depreciation used in tax filings may be the only option. In the calculation of physical capital cost on economic profit statement (economic depreciation): the gradual decrease in the economic value of capital stock either through physical depreciation, obsolescence, or change in the demand for the services of the capital stock.
Amortization of intangible assets (FC)	For limited access permits, fishing history, and quota share that does not have a sunset date nor does it "wear out" as a physical asset would (i.e., its life is unlimited), the amortization cost is zero.
Non-operating expenses (FC)	Expenses for ancillary business-related activities (that is, excluding major activities considered part of the normal operations of the business). Such activities may include: (a) unusual costs, (b) loss on foreign exchange transactions, (c) losses on securities (net of profits), and (d) miscellaneous other expense items.
Loss on sale of capital asset	If proceeds from the sale of physical capital or intangible asset is less than the long-term asset's book value, then enter as a loss. Otherwise see *gain on sale of capital asset* above. Book value is original purchase price less accumulated depreciation/amortization.

[23] Adapted from Farm Financial Standards Council (2014). See page II-30 where they recommend book value approach.

Table 1 (continued)

Name	Definition (code next to cost category name: VC = variable cost, FC = fixed cost, MX = could be variable or fixed depending on circumstances or has characteristics of both)
Landings and other ad valorem taxes (VC)	Taxes paid that are based on the value or weight of inputs or outputs.
Value of owner time as captain (VC)	Value of owner's time as captain or crew (not as entrepreneur/owner).
Value of owner time as entrepreneur (MX)	Value of owner's time spent running the business outside of time spent on vessel as captain or crew.
Physical capital cost (FC)	User cost of capital multiplied by the quantity of capital. See Section 4.1.
Intangible asset cost (FC)	See Section 4.2.
Value of non-market inputs	Value of inputs used that are not obtained through a market and so no price is observed. This could include the value of an input obtained by barter or an internally produced input, such as self-caught bait or self-made net. Information for estimating this value may not be available. This item is included, however, for completeness.

3.1 Stylized Financial Statements

Financial statements are commonly used by businesses for a variety of purposes including tax preparation, internal management, and public and shareholder reporting. They are also used by fisheries economists to summarize cost-earnings data collections by reporting aggregate or representative financial profiles, and in analyses of regulatory actions to characterize aspects of financial/economic impacts. Standard accounting practices establish common methods within various industries. To the extent practicable, these approaches are used.

Financial statements at an individual business level are notoriously complex, individual case dependent, and are relegated to the fields of accounting, tax preparation, finance, business management, etc. Economists are generally interested in questions broader than the nuances surrounding individual business accounting. In particular, implicit costs are critical to economic analyses. However, there is overlap between financial and economic analysis in terms of data needs. The financial statements presented here are highly stylized and are not recommended for actual use by an individual fishing business. These stylized financial statements are presented at the individual fishing business level for use in economic or other analyses and to portray financial characteristics of the fishing industry.

Financial statements are typically prepared for an individual firm. There are three general types or categories of firms in the fishing industry: 1) firms that own vessels, 2) firms that own fishing privileges (e.g., quota shares, quota pounds, or permits), and 3) firms that own vessels and fishing privileges. Firms in the first category can be affiliated with firms in the second category, particularly in fisheries managed by catch shares (e.g., a firm that owns a vessel can have a contractual arrangement to lease fishing privileges from another firm). Economists are interested in evaluating the returns to each type of firm. However, to illustrate important aspects of costs associated with vessel owners vs. fishing privilege owners, the financial statements are shown for types 1 and 2 only. If desired by the analyst, types 1 and 2 can simply be combined to create financial statements for type 3.

Many fishing businesses own more than one vessel. The financial statements presented here assume that revenues and costs for all vessels within a firm are combined. Financial statements could be prepared for each vessel using the same methods, but non-vessel specific costs (such as business vehicle costs, for example) would need to be allocated to each vessel (see Section 3.5). The financial statements presented below are for a single fiscal or calendar year at the individual fishing business level, unless stated otherwise. To see example statements with actual revenue and cost values, see Appendix A.

3.1.1. Income Statement

An income statement is a financial accounting of revenues less explicit costs of various types. Typically, the first type of costs deducted from revenue is that most closely associated with the production of a business's core product or service. In the case of fishing businesses, the focus is on costs associated with fishing operations.

The result of deducting what we refer to as *fishing costs* (see Table 2 for a list of cost categories according to each business type) from revenues is *gross income*. Gross income indicates the degree to which the money generated from core fishing activities contributes to paying overhead and other costs that support those activities and, ultimately, to income. *Overhead* is then deducted from gross income resulting in *operating income*. Most financial analyses of fisheries will not go beyond the stage of calculating operating income. That is, in most analyses, *pre-tax income* and *income (after tax)* will not be calculated because operating income represents the return to all beneficiaries of the productive activity, such as the business owner, financiers, and taxing entities. If there is a need to focus on returns to the business owner only, then interest and tax expenditures[24] can be deducted. Further, if returns to business activities beyond primary operations are desired, non-operating revenue and expenses can be factored in. Table 2 describes these various types of deductions from revenues and the terms used at each stage.

In addition to the inclusion of *hired crew and captain payment* on the income statement, in certain circumstances, *owner-operator pay* could also be included as a fishing cost. This would account for a common practice among fishing businesses to pay the vessel owner a share of the hired crew and captain payment when serving as captain or crew. Including owner-operator pay might allow for a more accurate comparisons of income (gross, operating, pre-tax, or after tax income) between fishing businesses with hired captains versus owner-operated vessels. (Care should still be used in making these comparisons in the event there are systematic differences between shares given to hired captains and owner-captains.) This is in contrast to standard accounting practices, where cash payments to owner-operators or owner withdrawal of cash are excluded as expenses on the income statement. In standard accounting practices, they are returns to the vessel owner and are accounted for separately in a statement of owner equity. For this reason, we do not include owner-operator pay on the income statement. Depending on the type of analysis and the information desired, owner-operator pay could be included on the income statement. If included, it should be clearly stated that the true financial income to the owner is the sum of owner-operator pay and income.

3.1.1.1. Treatment of Quota Pounds (QP) and Quota Shares (QS)

A QP holder is a business that has been granted the right to harvest a maximum amount of fish within a fishing season; this quota is expressed in pounds of fish. There are a number of ways in which QP could be obtained, but all depend on an initial allocation of quota by government regulators. The initial allocation is in the form of QS (expressed in percentage terms of quota) associated with a fishing permit, vessel, or vessel owner applied to the applicable annual catch limit or quota and is converted to QP that

[24] Since *income taxes* are greatly influenced by differences in accounting methods and other factors not directly attributable to core fishing activities, they are not typically collected on NOAA Fisheries fishing vessel cost surveys.

can be harvested within that year or season.[25] The QP are then transferred from the QS/QP holder to a vessel owner. Often, they are the same entity. The QP can also be transferred from one business to another. There is usually an open market, some more formal than others, for the trading of QP. Quota Shares, once allocated by regulators, can also be traded -- sometimes in association with a fishing permit. The treatment of each of these circumstances in the income statement is discussed below.

Quota Share

When QS are initially allocated with no associated cost to the owner, there is no expenditure. If there is a cost associated with the initial allocation of QS[26] or if purchased from another QS holder in conjunction with a vessel and/or limited access permit purchase, an expenditure occurs. Sometimes one or more permits, QS, and the vessel are bundled into a single transaction. Efforts should be made, through data collection or other valuation methods, to record separate physical capital expenditures and intangible asset expenditures. For the sake of illustration, an assumption is made here that these values are known separately. These expenditures would be apparent in the cash flow statement and their value would be reflected in the balance sheet. In the income statement, however, physical capital assets are used up over time through a depreciation charge and intangible asset costs are amortized over time. For QS where the useful life is unlimited because there is no sunset provision,[27] the amortization charge is zero. Where a sunset provision exists, the values would be divided by the time remaining until the sunset date.[28]

Quota Pounds

As described above, fishing business can have one of three types of ownership arrangements (vessel owner, fishing privilege owner, or both). The income statement described here keeps the accounting for vessel owners and fishing privilege owners separate, regardless of the actual ownership arrangement. However, there may be advantages to preparing an income statement for a fishing business that holds QP and owns vessels. There are three possible scenarios (for purposes of illustration), each requires different treatments of QP in the income statement: 1) separate QP holder and vessel owner -- with separate accounting entities, 2) single fishing business that holds QP and owns vessels -- with separate accounting entities, and 3) single fishing business that holds QP and owns vessels -- with accounting entities combined.

Scenario 1[29] is straightforward in that the QP holder records revenue from selling QP to vessel owners or to other QP holders. Any QP purchased from other QP holders is recorded as a QP cost on the QP holder's income statement. Only cash transactions for buying/selling QP need to be recorded as QP revenue or QP cost on the QP holder's income statement. The QP of one species is sometimes traded for QP of another species. Under the assumption that the total value of each quantity of species traded is equal, the change to income is zero. Therefore, barter trades need not be explicitly accounted for on the

[25] Therefore an entity can be both a quota share and quota pound holder simultaneously. Quota pounds are merely the expression of quota share in a given year.

[26] To date, no U.S. catch share programs have required payment for an initial allocation of quota share.

[27] Quota shares issued under Limited Access Program are limited to 10 years but with provisions for renewal.

[28] This assumes straight-line depreciation is used.

[29] In practice, scenario 1 is a rare occurrence since, in order to meet this definition, all of the QP purchased would have to be fished. If there were an excess of QP then the vessel owner becomes by default a QP holder (scenario 2). Also, barter trades under this scenario are not possible by definition since the vessel owner holds no QP to trade.

income statement. Vessel owners record the QP purchased, and fished,[30] from QP holders as a QP cost on their income statement.

For scenario 2, when QP is fished, the value of the QP fished is treated as an expense and subtracted from revenues in calculating the vessel owner's income. Since there is no market transaction, an appropriate price needs to be determined in order to calculate the cost of QP fished. Most likely, the most relevant and available information to determine this value will be the prices realized in any cash transactions the QP holder side of this business type has engaged in. If there are no transactions, then other information about the QP market will need to be used. Methods for estimating QP price are described in section 4.2. As with scenario 1, for the QP holder side of this particular type of business, only cash transactions for buying/selling QP need to be recorded as QP revenue or QP cost.

For scenario 3, the entries of cash revenue from the transfer of QP and the cash cost of QP purchased are the only entries required on the income statement. As in scenarios 1 and 2, any barter trades would net out and so are not required. There is also no need to record the value of QP fished as an expense since that is internal to this type of business and when the vessel owner and QP holder sides of this business are combined, the QP cost on the vessel side would net out with the QP revenue on the QP holder side.

[30] Recording quota pound/access privilege cost for the vessel owner appears to violate the convention that vessel owners do not "hold" QP. Since the QP is fished and therefore used in a relatively short time-frame, we ignore this minor technicality.

Table 2. Income statement for a fishing business.

INCOME STATEMENT	Vessel Owner	Fishing Privilege Holder
Revenues:		
Ex-vessel revenue	+	
For-hire/charter revenue	+	
Quota pound/access privilege revenue		+
Direct subsidies	+	+
Fishing costs:		
Hired crew and captain payment	-	
Non-labor trip expense	-	
Vessel expense	-	
Quota pound/access privilege cost	-	-
Depreciation of physical capital	-	
Amortization of intangible assets		-
Landings/ad valorem taxes	-	
Gross Income	=	=
Overhead	-	-
Operating Income	=	=
Non-operating revenue and expenses:		
Non-operating revenue	+	+
Gain/loss on sale of capital asset	+/-	+/-
Interest expense	-	-
Non-operating expenses	-	-
Pre-tax Income	=	=
Income taxes	-	-
Income (after tax)	=	=

3.1.2. Balance Sheet

A balance sheet shows a business's equity, or net worth, by comparing its assets to its liabilities at a single point in time (Table 3). Assets typically include current assets (cash and cash equivalents, accounts receivable, and inventory) and non-current assets (tangible assets such as machinery, buildings, and land; and intangible assets such as licenses/permits, goodwill, patents, or copyright). Liabilities typically include both current liabilities, such as debts to be paid within a year and accounts payable, and long-term liabilities, such as debts and other financial obligations due later than a year.

Given that the data collection burden would be very high to obtain all assets and liabilities, it is recommended that assets be limited to those most closely associated with fishing: vessels, gear, QP (i.e., the value of the pounds of quota that expire within a fishing season), limited access permits/histories (i.e., the value of permits/histories, usually associated with a fishing vessel or owner, that can be sold) and QS (i.e., the value of the QS that become QP in future fishing seasons). In terms of liabilities, it is recommended to only include loan balances, and not highly detailed information such as accounts payable or other financial obligations.

Table 3. Balance sheet for a fishing business.

BALANCE SHEET – VESSEL OWNER	
ASSETS (current market value)	**LIABILITIES**
Vessels	Loan Balance
Gear	
	EQUITY (+/-)

BALANCE SHEET – FISHING PRIVILEGE HOLDER	
ASSETS (current market value)	**LIABILITIES**
Limited Access Permits/Histories	Loan Balance
Quota Share	
	EQUITY (+/-)

3.1.3. Cash Flow Statement

Cash flow statements are used to show a business's ability to meet its financial obligations using cash inflows from business operations (see Table 4). Cash flow is affected by the timing of income and expenditures. Cash flow statements are used to assess the need to adjust accounts payable and receivable schedules and to adjust cash reserves through loans or other means. The inclusion of the principal portion of loan payments, i.e. *principal expense*, is important to the cash flow statement to highlight the impact of debt service.

Cash flow statements are less important for understanding the financial viability of a business than are income statements and balance sheets. That is, even though a business could experience cash flow problems in the short term, its income could be adequate and assets could well exceed liabilities. Conversely, positive cash flows could mask imbalances in assets/liabilities or inadequate net income. For example, depreciation is not included in a cash flow statement because it is not a cash transaction. While the purchase price of the asset would be on the cash flow statement in the period it was purchased (recorded as a *physical capital expenditure*), the *depreciation expense* in future years would only be recorded in the income statement. Therefore, cash flow might be favorable during the years an asset is depreciated but that depreciation expense could be a drain on net income as shown in the income statement. Cash flow statements are most useful for long-range planning of the operation, investment, and financing components of a business. That is, while the cash flow statement is for a single year, they are often prepared for multiple years (with projections used for future years) to assess changes in flow over longer time frames. This type of information can be useful to economists for assessing the economic/financial well-being of a fleet that may be seeing changes in net cash flow due to changing stock, regulatory, and/or market conditions. The cash flow statement is the least complex to prepare and can point to emerging conditions, the nature of which are possibly revealed in the income and economic profit statements.

For fishing businesses that hold QP and own vessels, there is no need to record the vessel owner's cost of using of QP obtained from the QP holder side of the business because an exchange did not occur.

Owner-operator pay is included on the cash flow statement to highlight the impact to cash flow from the common practice in some fisheries to pay owners a share of the revenue while working as captain or crew.

The term "cash flow" in this context should not be confused with "cash accounting" or its alternative, "accrual accounting." All the financial statements and the economic profit statement could be prepared with either accrual accounting or cash accounting. In accrual accounting, transactions are recorded when they occur, not when cash is received or paid. It is merely a distinction about which year to assign the transaction (i.e., an item could be purchased at the end of a year but paid for in the following year). The cash flow statement concerns itself only with transactions for which cash is exchanged (regardless of whether recorded according to accrual or cash accounting). Excluding the non-cash *depreciation expense* is the primary example of this. In addition, these terms should not be confused with accrual and cash flow accounting in benefit-cost analysis.

Table 4. Cash flow statement for a fishing business.

CASH FLOW STATEMENT (cash inflows = "+" cash outflows = "-")	Vessel Owner	Fishing Privilege Holder
Ex-vessel revenue	+	
For-hire/charter revenue	+	
Quota pound/access privilege revenue		+
Non-operating revenue	+	+
Direct subsidies	+	+
Cash receipts from loans	+	+
Cash from sale of physical capital	+	
Cash from sale of intangible asset		+
Hired crew and captain payment	-	
Owner-operator pay	-	
Non-labor trip expense	-	
Vessel expense	-	
Overhead	-	-
Interest expense	-	-
Principal expense	-	-
Physical capital expenditures	-	
Intangible asset expenditures		-
Income taxes	-	-
Quota pound/access privilege cost	-	-
Non-operating expenses	-	-
Landings/ad valorem taxes	-	
Net Cash Flow	=	=

3.2. Economic Profit

Economic profit differs from accounting income (gross, operating, pre-tax, or after tax income as defined in our financial statement) in that implicit costs are considered in addition to explicit costs. The implicit costs considered here are the economic values of the owner's time, physical capital costs, the value of non-market inputs and outputs, and intangible asset costs.

Fisheries economists often need to go beyond financial implications of fisheries regulations and evaluate how different options play out in terms of changes in economic welfare. Research around different regulatory approaches often involves the development of models in order to predict how an approach might affect fishermen's behavior. Measures of economic profit and its components are used to evaluate the economic effect of the changes in behavior.

Table 5 shows the components of economic profit from the perspective of a fishing business in a single-year analysis. Table 5 also shows the components of economic profit from the two ownership perspectives: 1) vessel owners, and 2) fishing privilege holders.

The value of a fishing business owner's labor time is divided into two components. The first component is time spent as a captain or crew. The owner could have used that time earning income as a hired captain on another boat or in a different occupation (the owner's opportunity cost). Such data are often difficult to obtain, and so a wage rate comparable to a fishing captain is often applied. Methods are described in Section 4.3.

The value of a fishing business owner's time running the business as an entrepreneur is listed separately because it requires a different wage rate than that of a fishing captain. Information about time spent running the business is more difficult to collect. Methods for measuring this component of owner's time are also described in Section 4.3.

On the income statement, the cost of using physical capital devoted to a fishing business is captured in a depreciation charge and the cost of financing the purchase of capital is captured in an *interest expense*. For the economic profit measure, both the depreciation and interest expenses are replaced with a broader measure, the *physical capital cost*. This measure addresses opportunity costs. Physical capital costs are described in Section 4.1.

In catch share fisheries, each QS holder has the option of: 1) fishing the QP that result from the QS in a given fishing season, 2) leasing the QP to someone else, or 3) selling the underlying QS that yield QP. Options 1 and 2 have an associated opportunity cost of not choosing option 3. In the economic profit statement (Table 5) we define *intangible asset costs* and measure the opportunity cost of holding limited access permits, QS, and QP. Methods are described in Section 4.3.

Inputs or outputs, even when they are not bought or sold in a market and thus receive a market price, are given an economic value. As input examples, bait that is caught and used by the same vessel or nets that are made and/or maintained and repaired by the crew would be assigned an economic value. Market prices (net of taxes) had the input been purchased may be used to value the non-market input, assuming the input was made available through increased supply, rather than being taken from another use. For the bait example, the value would be the price for bait obtained in the market but excluding any taxes. When the input is displaced from an alternative use, in principle the demand price inclusive of tax from that input's displaced use should be used. For example, bait may be drawn from usage elsewhere, in which case its economic price is that from the market price in its alternative use. When the input is partly sourced from increased availability and partly sourced from displacement with another previous use, the proper economic price is a weighted average of both prices (where the weights are the cost shares from each source). An output example might be seafood that is caught and consumed in kind by the fisherman and/or the fisherman's family; this non-market output also needs to be assigned an economic value. Prices (excluding taxes) for what would have been paid in a market may be used as an estimate of value, under the assumption that the seafood was from increased availability and the supply was perfectly or highly elastic.

Table 5. Economic profit statement for a fishing business.

ECONOMIC PROFIT	Vessel Owner	Fishing Privilege Holder
Revenues:		
Ex-vessel revenue	+	
For-hire/charter revenue	+	
Quota pound/access privilege revenue		+
Non-operating revenue	+	+
Gain on sale of capital asset	+	+
Direct subsidies	+	+
Value of non-market outputs	+	+
Explicit Costs:		
Hired crew and captain payment	-	
Non-labor trip expense	-	
Vessel expense	-	
Quota pound/access privilege costs	-	-
Landings/ad valorem taxes	-	
Overhead	-	-
Non-operating expenses	-	-
Loss on sale of capital asset	-	-
Implicit Costs:		
Value of owner time as captain	-	
Value of owner time as entrepreneur	-	-
Physical capital cost	-	
Intangible asset cost		-
Value of non-market inputs	-	-
Economic Profit	=	=

3.3. Comparison of Income, Cash Flow, and Economic Profit Statements

In order to compare how the revenue and cost components are used in the income statement, the cash flow statement, and the economic profit statement, all three statements are shown side-by-side in Table 6 from the vessel owner perspective only (therefore, *intangible asset cost* is not shown since that applies to the fishing privilege holder only).

Table 6. Comparison of income, cash flow, and economic profit statements from vessel owner perspective only.

INCOME STATEMENT	CASH FLOW STATEMENT	ECONOMIC PROFIT
(+) Revenues:	**(+) Additions to cash:**	**(+) Revenues:**
Ex-vessel revenue	Ex-vessel revenue	Ex-vessel revenue
For-hire/charter revenue	For-hire/charter revenue	For-hire/charter revenue
Direct subsidies	Direct subsidies	Direct subsidies
	Non-operating revenue	Non-operating revenue
		Gain on sale of capital asset
	Cash receipts from loans	
	Cash from sale of physical capital	
		Value of non-market outputs
(-) Fishing costs:	**(-) Subtractions from cash:**	**(-) Explicit Costs:**
Hired crew and captain payment	Hired crew and captain payment	Hired crew and captain payment
	Owner-operator pay	
Non-labor trip expense	Non-labor trip expense	Non-labor trip expense
Vessel expense	Vessel expense	Vessel expense
Quota pound/access privilege cost	Quota pound/access privilege cost	Quota pound/access privilege costs
Depreciation of physical capital		
Landings/ad valorem taxes	Landings/ad valorem taxes	Landings/ad valorem taxes
(=) Gross Income		
(-) Overhead	Overhead	Overhead
(=) Operating Income		
(+/-) Non-operating revenue and expenses:		
(+) Non-operating revenue		
(-) Interest expense	Interest expense	
(-) Non-operating expenses	Non-operating expenses	Non-operating expenses
(+/-) Gain/loss on sale of capital asset		Loss on sale of capital asset
(=) Pre-tax Income		
(-) Income taxes	Income taxes	
	Principal expense	
	Physical capital expenditures	**(-) Implicit Costs:**
		Value of owner time as captain
		Value of owner time as entrepreneur
		Physical capital cost
		Value of non-market inputs
(=) Income (after tax)	**(=) Net Cash Flow**	**(=) Economic Profit**

3.4. Aggregation to Fishery Level

The financial and economic statements presented thus far have been at the individual fishing business level, a primary purpose of which was to illustrate all the revenue and cost categories, and associated data elements needed for various measures of returns. There is often a need to perform analyses at an aggregate[31] level.

Aggregation across business types and across firms in a fishery can be done with income statements, cash flow statements (see Table 7), balance sheets (see Table 8), and the economic profit statement (see Table 7). In aggregating across both vessel owning firms and access privilege holding firms, fishing *QP/access privilege revenue* and *QP/access privilege cost* cancel out so these two components do not appear in Table 7.

[31] There are two aspects of aggregation: 1) summation across owner types in the fishery of interest, and 2) summation across all firms in the fishery of interest.

Table 7. Financial and economic statements at the aggregate fishery level (all business types).

INCOME STATEMENT	CASH FLOW STATEMENT	ECONOMIC PROFIT
(+) Revenues:	**(+) Additions to cash:**	**(+) Revenues:**
Ex-vessel revenue	Ex-vessel revenue	Ex-vessel revenue
For-hire/charter revenue	For-hire/charter revenue	For-hire/charter revenue
Direct subsidies	Direct subsidies	Direct subsidies
	Non-operating revenue	Non-operating revenue
		Gain on sale of capital asset
	Cash receipts from loans	
	Cash from sale of physical capital	
	Cash from sale of intangible asset	
		Value of non-market outputs
(-) Fishing costs:	**(-) Subtractions from cash:**	**(-) Explicit Costs:**
Hired crew and captain payment	Hired crew and captain payment	Hired crew and captain payment
	Owner-operator pay	
Non-labor trip expense	Non-labor trip expense	Non-labor trip expense
Vessel expense	Vessel expense	Vessel expense
Depreciation of physical capital		
Amortization of intangible assets		
Landings/ad valorem taxes	Landings/ad valorem taxes	Landings/ad valorem taxes
(=) Gross Income		
(-) Overhead	Overhead	Overhead
(=) Operating Income		
(+/-) Non-operating revenue and expenses:		
(+) Non-operating revenue		
(-) Interest expense	Interest expense	
(-) Non-operating expenses	Non-operating expenses	Non-operating expenses
(+/-) Gain/loss on sale of capital asset		Loss on sale of capital asset
(=) Pre-tax Income		
(-) Income taxes	Income taxes	
	Principal expense	
	Physical capital expenditures	
	Intangible asset expenditures	**(-) Implicit Costs:**
		Value of owner time as captain
		Value of owner time as entrepreneur
		Physical capital cost
		Intangible asset cost
		Value of non-market inputs
(=) Income (after tax)	**(=) Net Cash Flow**	**(=) Economic Profit**

Table 8. Balance sheet at the aggregate fishery level (all business types).

BALANCE SHEET	
ASSETS (current market value)	**LIABILITIES**
Vessels	Loan Balance
Gear	
Limited Access Permits/Histories	
Quota Share	
	EQUITY (+/-)

3.5. Cost Allocation

Most policy and management actions pertain to singular fisheries and assume each entity (vessel) is a separate firm. However, vessels fish in multiple fisheries and therefore incur joint/common costs, firms own multiple vessels, and even non-joint/common costs are often collected on an annual basis. To conduct analyses of management alternatives, it is necessary to implement methods for allocating costs.

Terry et al. (1996) states that for equitable and efficient allocation the following criteria for choosing cost allocation methods must be met: 1) costs allocated need to sum to the total costs incurred, and 2) cost allocated to an output cannot exceed cost of producing that output. They propose two methods: 1) Separable Costs-Remaining Benefits Method (SCRB Method), and 2) Use of Facilities Method. But they ultimately choose the Use of Facilities Method because of the potentially arbitrary assumptions associated with attempts to calculate stand-alone costs for purposes other than the original intended purpose, as required by the SCRB method.

Within the Use of Facilities Method, Terry et al. (1996) recommend allocating costs by time, production value, or production volume. We recommend using either of these three approaches based on availability and reliability of available data.

3.6. Returns to Crew

At times, economists and other social scientists have reason to evaluate returns to crew in addition to returns to the vessel owner and the fishing privilege holder as described above. From a financial accounting point of view, this can be done by using components of the income statement for vessel owners and modifying it for the crew perspective (however, examples of financial statements are not provided here). That is, *hired crew and captain payment* from the vessel owner's perspective becomes earnings for a crew member. Deducted from that, and from any other cash inflows crew may receive, are any trip expenses paid directly by the crew resulting in a measure of gross income for crew. If there are any other occupation-related expenses incurred by crew (e.g., gear or clothing not provided by the fishing business owner[32]) then those would be deducted as well.

In terms of economic remuneration for crew, physical capital nor intangible assets are not typically employed. Therefore, physical capital cost and intangible asset cost would not apply. There is however,

[32] It is unlikely, however, that this information would be collected.

the value of crew time that should be accounted for (similar to values of the captain's time). Crew have an opportunity cost to their time working on a fishing vessel. This opportunity cost of crew time includes time spent in leisure or working in alternative employment that receives a wage or payment in kind, or self-employment. A wage rate for occupations comparable to fishing crew can be used to measure the cost. Details are provided in Section 4.3.

Financial returns to other business components may also be calculated. These include returns to investment, assets, equity, and capital. Detailed descriptions of these types of measures are beyond the scope of this document.

4. Recommended Methods

For many of the cost categories listed in the financial and economic profit statements, cost data collected through surveys would be used directly. For example, the actual cost of fuel would be used to calculate *non-labor trip expense paid by vessel owner* as defined in Table 1. No additional data manipulation or estimation is required. For other cost categories, however, estimation and analysis of survey-collected data are needed to arrive at a cost. For example, to calculate a depreciation charge, the one-time expenditure for a piece of equipment must be spread over its useful life so that an annual amount can be derived for use on an income statement. This requires that certain assumptions and/or conventions be used. The following sections provide recommended methods for deriving physical capital costs, intangible asset costs, and labor costs. In addition, methods are recommended for allocating costs across multiple fisheries and vessels.

4.1. Depreciation

Financial depreciation is defined (Table 1) as the allocation over time of the historical cost (or original cost), less salvage value, of a physical capital input having a limited useful life (i.e. vessels, engines, machinery, fishing gear, etc.) by a noncash expense periodically charged against income over the service, or useful life, of that capital. It is further noted that depreciation methods for tax purposes are not considered unless there is no other information available.

Economic depreciation (Table 1) is defined as the gradual decrease in the economic value of capital stock either through physical depreciation, obsolescence, or change in the demand for the services of the capital stock.

Costs associated with physical capital are treated differently on the income and economic profit statements. Depreciation underlies each of these approaches where financial depreciation is used in the income statement and economic depreciation is used in the economic profit statement. For the income statement, the annual financial depreciation charge is entered directly as a fishing cost in the calculation of gross income. For the economic profit statement, economic depreciation is incorporated into the calculation of physical capital cost; see Section 4.2 – Physical Capital Costs (Economic Profit Statement).

The choice of financial depreciation method depends on the purpose of the analysis. However, values chosen by others can help the analyst make a decision about the best way to proceed. For example, a report undertaken jointly by several European fishery agencies (Malvarosa et al., 2006) recommended straight-line depreciation for assets if conducting the analysis at the firm level. In order to take this conventional approach, purchase price or current market value information and a reasonable estimate of the service life (or remaining service life if using current market value) of the vessel or other piece of capital equipment is required. They also recommend an alternative approach using depreciation rates of 2.5% for the hull, 10% for the engine, 20% for electronics, and 16% for other equipment. A Food and

Agriculture Organization study of financial performance of North and South American fishing fleets used a combined depreciation rate for the entire vessel of 4% for vessels less than 25 years of age and 2% for vessels age 25 years and older (Kitts et al., 2020).

An OECD manual on measuring capital (OECD, 2001) discusses three depreciation methods: 1) straight-line, 2) sum-of-the-digits, and 3) geometric depreciation. See page 70 of the manual for a description of the implications of using any of those three methods.

4.2. Physical Capital Costs (Economic Profit Statement)

For a fishing firm, physical capital includes the vessel(s) and their fixed capital components such as engines, electronics, and other equipment. If there are shore-side tangible assets owned by the firm, such as buildings, cars, and other equipment, they are also considered physical capital. The common feature for all types of physical capital are that they are durable and used over multiple time periods. Intangible assets, which would include items such as QS, licenses, and permits are not included in this section, but are covered in Section 4.3.

The contribution of physical capital to cost is not as easily measured as other inputs like labor. Usually the producer owns these, and when they convey services in a production process, no market transactions are observed. If physical capital is leased or rented, measuring its cost is straightforward since the quantity and the price would be readily apparent. Alternatively, if the value of physical capital was known at the beginning and end of a time period, physical capital cost would simply be the difference between the beginning and end of the time period value. However, since neither of these situations typically exist, physical capital cost must usually be inferred. Some past studies have referred to this inferred cost of physical capital usage as its "rental price," though the more common term used now is "user cost of capital" (Christensen and Jorgenson, 1969; Hulten, 1991; Balk, 2011). The user cost of capital is the per unit price for using the services from a physical capital good during a particular period of time. In order to infer the cost of physical capital used during a particular time period, both the "price" (i.e. user cost of capital) and a quantity of physical capital needs to be derived.

Most of the cost surveys administered by NOAA Fisheries provide estimates of vessel value, reported either by the vessel owner or from a marine surveyor. Detailed data on the purchase price of the vessel and subsequent investments in the vessel are usually not available. The same is true of components of the vessel such as engines, fishing gear, electronics, etc. Moreover, rarely do market values for these components exist in survey data. Another complication is that these values change over time so using historical book value from, perhaps, five or ten years past is not relevant in an economic (as opposed to a financial) analysis. These data limitations complicate the estimation of the user cost of capital. Methods for determining the appropriate quantity of physical capital, which rely on fishing vessel productivity data usually available from non-cost survey data, are presented below (see the Quantity of Physical Capital).

Given the nature of information available to the analyst, it is likely that the physical capital cost calculations will be based on the vessel (embodying the hull, engine, gear, and equipment) as opposed to individual components of the vessel, and the quantity of vessels consist of units of one. To simplify the discussion, the determination of the user cost of capital is presented at the vessel level in whole units. Furthermore, a process for determining the user cost of capital given both periodic vessel value estimates and investment data is described. This is for completeness and to aid with the subsequent description of procedures for estimating user cost of capital when investment data is unavailable.

User Cost of Capital

At the beginning of time period *t*, a capital asset of type *i* has value, denoted as V_i^t. In subsequent sections, methods to estimate *V* (i.e., capital value) will be discussed. For now, assume that the value exists and is known. The calculation of the user cost for a unit of asset type *i*, of vintage *j*, during time period *t* is defined by Balk (2011) as:[33]

$$\mu_{ij}^t \equiv r^t V_{ij}^t + (V_{ij}^t - V_{ij}^{t+1}) + \tau_i^t V_{ij}^t \qquad (1)$$

The first term on the right-hand side of equation 1 is the "price" of holding the capital for another time period. The term r^t is the opportunity cost of capital rate during period *t* which the owner desires to earn on his/her investment during the time period, and represents what would be earned if the asset was sold and the proceeds were placed in an alternative investment vehicle (i.e., its opportunity cost). Past studies in fisheries have assumed an opportunity cost of capital that is equal to the rate of return on a BAA rated bond, which are considered somewhat "risky" bonds (Squires, 1992). The second term (shown in parentheses) is the revaluation of the capital stock between the beginning and end of time period *t* (beginning of period *t+1*). This could be due to economic depreciation, but also includes the possibility that the asset increases in value. Balk (2011) splits this second component into a term for economic depreciation, and a term for "unanticipated revaluation." Fisheries studies typically assume there is no "unanticipated revaluation" of physical capital. However, "unanticipated revaluation" could apply to an asset like an ITQ share (see Section 4.3 Intangible Assets). The third component is a tax rate which is levied on capital value. For example, excise taxes imposed on vehicles would be one example of the tax component. Note that μ_{ij}^t is a unit user cost for each type of capital asset.

An equivalent way of expressing the above relation is:

$$\mu_{ij}^t = V_{ij}^t (r_i^t + \delta_{ij}^t - \varphi_{ij}^t + \tau_{ij}^t) \qquad (2)$$

Here, *r* is the opportunity cost of capital rate during time period *t*, δ is economic depreciation rate during time *t*, φ is the revaluation rate during time period *t*, and τ is the tax rate levied on the capital asset value. As mentioned, if data are available, user cost can be calculated for each piece of physical capital (vessels, engines, fishing gears, etc.) owned by the firm. Aggregation over all asset types and ages during a time period yields the capital services cost in time period *t* as:[34]

$$C_k^t \equiv \sum_{i=1}^{I} \sum_{j=1}^{J_I} \mu_{ij}^t K_{ij}^t \qquad (3)$$

[33] This user cost implicitly assumes an infinite service life.

[34] The rental-rate estimates are used as proxies for the relative marginal products of the different classes of capital. If the rental rates do indeed reflect the relative marginal products, they will be the appropriate weights to use when calculating the aggregate index of capital services.

Since K_{ij}^{t} is the quantity of each asset type i of age j, the final C_{k}^{t} value is an aggregate value which incorporates all the different capital assets of each age held by the firm (the inclusion of age will become apparent in the Quantity of Physical Capital section but can be ignored for now). For a single fishing vessel, the calculation of physical capital cost is simply the value of the vessel times an appropriate interest rate (e.g., BAA rated bond rate), plus the economic depreciation cost, minus any increase in value of the vessels, plus any taxes paid on the vessel value. Usually, vessels do not increase in value over time, so typically there is no revaluation term. The term for taxes can also be ignored if taxes, such as property or excise taxes, are not assessed on the vessel.

A choice must be made whether to apply a common or separate interest rate to each capital asset type. Furthermore, a choice must be made between using a constant or variable interest rate. Following standard practice, we recommend using a common interest rate reflecting the owner's opportunity cost of capital for all capital asset types. Regarding the choice of a constant or variable interest rate, we recommend using an appropriate rate for each time period rather than a fixed rate for all time periods.

Physical Capital Value

Since user cost is based on the value of capital at a point in time, capital value needs to be estimated. Methods used to calculate capital value include: 1) book/historical value, 2) hedonic models, 3) market value surveys, 4) insured market value surveys, 5) insured replacement value surveys, 6) estimated present value (PV) based on cash flow, and (7) perpetual inventory method. Ideally, capital value would first be established through a benchmarking exercise and then recalculated in subsequent time periods. This would be accomplished through an investment survey or a recalculation of the benchmark values.

Book value is the purchase price for an asset, plus additional capital investment, minus depreciation. The book value of a vessel is the sum of the book values for each piece of capital equipment on the vessel and the vessel itself, should that information be available. In some instances, equipment may have a book value of zero as they have already been fully depreciated. More likely, book values would be calculated for the vessel as a whole. Once a benchmark book value is established for each vessel, it needs to be adjusted in each subsequent time period to account for depreciation and purchase of new equipment, or replacement of obsolete equipment.

Often, regular investment data needed to estimate book value for a fleet of vessels is unavailable. An alternative method which could be used to establish a benchmark value and to regularly update capital value is to use a statistical model based on the hedonic method. With this approach, a statistical model is constructed which generates values for individual attributes of the capital stock. For example, the value of a fishing vessel is determined by the size of the hull and engine, the types of electronics, gear, crew berths and amenities, and the quantity and types of permits. Given information on the sale price of individual vessels, along with information on their characteristics and a sufficiently large sample size, values for each attribute can be estimated separately. Kirkley and Squires (1988) applied this approach to determine the value of otter trawl and scallop dredge vessels in New England. Other examples include Erkiaga and Ikazuriaga (2013) and Guyader et al. (2003). A more recent article used a similar method based on distance functions to estimate capital values for all vessels in federally permitted fisheries in the northeast United States (Färe et al., 2017). The distance functions were estimated with linear programming methods and the shadow values generated by the models were used to estimate capital values for 2016. They were also used to construct a capital stock index for the squid, mackerel, and butterfish fishery between 1996 and 2015.

Practical Consideration in Calculating User Cost of Capital

In practice, it is likely that the only information available is periodic estimates of vessel values from a survey or from the results of a hedonic model. Vessel values from surveys may be intermittent, with gaps of a number of years between surveys. It is unlikely that regular investment data would be available. If it were, however, a book value-type approach would consist of starting with a beginning value from a survey (as a proxy for the purchase price) and then adjusting that value each year by subtracting depreciation and adding any investments (this approach is the perpetual inventory method). User cost of capital is then the sum of depreciation, the opportunity cost of capital (vessel value times the interest rate), and any taxes levied on the vessel; all based on the starting value for the year. As new vessel value information became available from a survey, book values could be adjusted by the change in value apart from the amount invested in vessel improvements. We recommend not including this type of value change in the calculation of user cost of capital, but it would be appropriate to adjust the book value to account for the most recent value assessment upon which user cost of capital is based.

As mentioned, the most likely scenario is that the only information available is periodic vessel valuations from a survey or hedonic model and no investment information. In this case, as above, the user cost of capital is based on a beginning vessel value. In subsequent years without new vessel value information or estimates, the quasi-book value is reduced by economic depreciation. When new vessel value information becomes available, it will not be clear whether the new value reflects changes in the market, investment in improvements, or both. In this case, the new vessel value simply becomes a new starting point. While both the investment and market adjustment factors contained in the new vessel value estimate are explicitly ignored, they are accounted for, in a sense, in the calculation of user cost of capital since depreciation, opportunity cost, and any taxes are based on the new value estimate; it's just the influence of each is unknown.

Quantity of Physical Capital

The following discussion of the quantity of physical capital applies to situations where adjustments for the declining productivity of physical capital, either at the firm level (multiple vessels or multiple components of the vessel) or at the fishery level, is appropriate.[35] Capital (K) is a stock variable measured at a point in time. Conversely, the quantity of capital used, sometimes called capital services, is a flow variable measured over a period of time. Therefore, the stock of capital needs to be converted into a flow measure, i.e. into capital services. First, we begin with a single capital good at the start of period 1. The quantity (i.e., stock) of capital good Kt is the number of units of capital good i added to the capital stock in all prior time periods. At first glance, this may seem like a trivial exercise as an analyst may have data showing how many units of capital good i have been added each year. For example, in the case of a multi-vessel fleet, the analyst may have information on the number of fishing vessels added to the fleet each year.[36] However, the analyst faces a problem if additional information on how many vessels have been retired or the difference in productivity between a newer and older vessel is unavailable. If there are differences in productivity between vessels of different age (called vintage effects), units of capital from different time periods will not be comparable, and aggregating units of capital with different ages would not yield a consistent measure of the capital stock. The question for the analyst is whether there is a way to estimate an aggregate measure of K for each fishing firm given all past investments without knowing

[35] Even though the focus of this document is the firm, and fishery level financial and economic profit statements are produced by summing firm level statements, we include this discussion in the event that a fishery level analysis of physical capital cost is desired.

[36] We are ignoring the fact that a fishing vessel is made up of several different capital goods.

information about obsolescence of prior investments or productivity divergence between different cohorts of the same capital good.

The perpetual inventory method (PIM) is one method that has been adopted worldwide to solve the capital aggregation problem outlined above. Using this approach, all past surviving cohorts of capital from year *v* at time *t* are weighted by a value $Ø_{t-v}$ which is between zero and one and allows for older capital to be less productive than newer capital (i.e. capturing vintage effects). The weighted series are then added up to form an aggregate measure of *K* (Hulten, 1991). The measure of capital *K* at time t is as shown by Hulten (1991) is:

$$K_t = \phi_0 I_t + \phi_1 I_{t-1} + ... + \phi_T I_{t-T} \qquad (1)$$

Here, $Ø_0$ equals one, *I* is the quantity of new capital added in year *t*, and *t-T* is equal to *v*, the oldest surviving vintage. Equation one results in a measure of capital stock (*K*) which yields the quantity of new capital investment needed in time period *t* to equal the productivity of past investments. Since the *Ø* symbol in equation 1 is a weight which allows for differences in productivity between different cohorts of capital, Hulten (1991) states that *K* is defined in terms of "efficiency units." In other words, *K* at time *t* is an aggregate measure of capital based on the efficiency of past units of capital investment. A recent empirical application includes Pokki et al. (2018).

In theory, measuring K_t as defined in equation 1 is quite easy if information on past investments is available. However, because an efficiency sequence (*Ø*) is rarely observed and usually needs to be inferred, the calculation of *K* is more complicated than it appears. Fortunately, several methods have been developed to calculate *Ø*. Three that will be discussed briefly here are the "one-hoss shay," straight-line efficiency, and geometric decay. A fuller discussion of these methods, along with their relative advantages, can be found in Hulten (1991).

Under the "one-hoss shay" profile method, all vintages of a capital stock have the same productivity until they are obsolete. In other words, productivity is constant until the asset reaches the end of its useful life. Hulten (1991) observes that the one-hoss shay efficiency profile could also be called "light-bulb" efficiency, because light bulbs of different ages produce the same light until they burn out and are discarded. In equation 1, all *Ø* terms take the value 1, and determining the efficiency sequence becomes a problem of estimating the useful lifespan *T* of the capital good.

Straight-line decay means that productivity declines in equal increments in each year. This differs from the one-hoss shay approach as a two-year-old light bulb would produce less light than a one-year-old bulb. Equation 1 is modified as follows:

$$K_t = I_t + (1 - \frac{1}{T}) I_{t-1} + (1 - \frac{2}{T}) I_{t-2} + ... + (1 - \frac{T-1}{T}) I_{t-T} \qquad (2)$$

In equation 2, productivity in year *t* equals one, and then it declines in subsequent years by an equal increment. For example, an asset with a useful life of 10 years would be 50% as productive in year 5. This approach is borrowed from the straight-line method used to depreciate capital[37] in accounting and reflects

[37] It is important to distinguish here that the decline in efficiency of capital, used to determine the appropriate quantity of capital, is distinct from "depreciation" as defined for determining the user cost of capital (i.e., the price). While the methods described are similar and it may appear that "decay" (reduction in efficiency) and

the rule that assets should be amortized in equal increments over a set time period (Hulten, 1991). However, determining what the appropriate time period should be in the absence of pre-established accounting rules is non-trivial.

The third method that we mention here is geometric decay, where productivity decays at a constant rate. Assuming a rate of decay δ, equation 1 would be modified as follows:

$$K_t = I_t + (1-\delta)I_{t-1} + (1-\delta)^2 I_{t-2} + ... + (1-\delta)^T I_{t-T} \qquad (3)$$

This approach has been widely used in empirical studies. However, it is viewed skeptically by some (Hulten, 1991) because the cumulative loss in productivity over time could be considered too great depending on the rate chosen. For example, a 5% rate of decay leads to a 19% loss in productivity after four years, while a 10% rate leads to a 34% reduction. Depending on the capital good in question, a 34% reduction may be too great. Perhaps just as importantly, a geometric rate of decline leads to an improbable outcome in that no asset is ever retired, as the productive capacity never reaches zero. Nevertheless, for some capital goods, a geometric rate of decline may be the best choice.

The methods above allow us to form an aggregate capital measure based on a single capital asset which is comprised of various vintages of the same asset. However, in most applied problems, there is usually more than one type of capital good used in a production process. For example, a fishing vessel is made up of a hull, engine, electronics, fishing gear, and other equipment. Each capital component of the fishing vessel needs to be tracked separately in order to calculate capital service flows, requiring a decay schedule for each piece of the capital stock (see above).

4.3. Intangible Assets

4.3.1. Overview

Intangible assets in fishing businesses are primarily composed of fishing permits, QS, QP, and other licenses/permissions that allow for access to fish resources and any associated quantities of fish. While there may be other intangible assets commonly associated with any type of business that should be accounted for in a similar fashion, we focus on methods for accounting for intangible assets that allow for access to fish resources.

A distinction is made between the annual fees paid to a regulatory agency for a fishing permit or license and the inherent value of the permit or quota that could be traded. Annual processing fees paid to a regulatory agency are an overhead expense. The cost of acquiring, for example, the fishing history that leads to the issuance of a limited access fishing permit that has associated levels of access (an amount of quota or allowable fishing time, perhaps) is treated in distinct ways appropriate for each of the financial and economic profit statements, similar to the treatment of physical capital.

Only intangible assets that are limited and are tradable are considered. That is, open access fishing permits are not considered since they can be obtained by anyone. They have no inherent value, they

"depreciation" (reduction in value of a single unit of capital) are accounting for the same thing, resulting in double counting, they are, in fact, distinct components of total physical capital cost. That is, a shiny new machine that produces a certain number of goods will fetch a lower price years later even though it produces the same number of goods per unit of time (the price reflects depreciation). Should the machine then produce a fewer number of goods per unit of time, the decay in efficiency is reflected in the quantity (something less than one machine).

typically are not tradable, and they may be obtained by paying the associated annual fee to the issuing agency. Limited intangible assets, such as a limited access permit, may have been granted based on historic participation in a fishery and so, while there may not have been a recording of an expenditure, if the asset can be traded then there is an opportunity cost for holding/using it and a cost is calculated.

The treatment of intangible assets is described in two parts. In the first part, the expenditures and values are assumed to be fully known and so the focus is on proper placement on the financial and economic profit statements. The second part discusses data needs and how to estimate expenditures and values given typical data limitations. Within each of the two parts, the treatment of both intangible assets that expire annually (QP for example) and those that span multiple years (QS for example) are described. Intangible assets that expire annually are referred to as single-year intangible assets and those that span multiple years are referred to as multi-year intangible assets.

4.3.2. Intangible Assets (IA) on Financial and Economic Profit Statements

Single-Year Intangible Assets

Record proceeds from the sale of single-year IA, QP for example, on the income statement, cash flow statement, and economic profit statement as *QP/access privilege revenue* for the fishing privilege holder. These entries are not made for the vessel owner since, according to our accounting convention for keeping these two business types separate, a vessel owner does not hold QP or other access privileges.[38]

For the purchase of single-year IAs, record the cost as *QP/access privilege cost* on the income statement, cash flow statement, and economic profit statement for either the vessel owner or the fishing privilege holder, depending on which business type made the purchase.

Since there is no year-end value to a single-year IA, there is no entry on the asset side of the balance sheet. However, if money was borrowed to purchase the single-year IA and there is an outstanding loan balance at the end of the year, list the balance as a liability. Additionally, there is no *amortization of intangible assets* charge on the income statement nor is an *intangible asset cost* calculated for the economic profit statement.

Multi-Year Intangible Assets

The treatment of sale and purchase of multi-year IA only applies to the fishing privilege holder; no entries are made on the vessel owner financial and economic profit statements. Record the proceeds from the sale of multi-year IA, QS for example, as *Cash from sale of intangible asset* on the cash flow statement. However, the sale of a long-term capital asset, such as a multi-year IA, must be handled differently on the income and economic profit statements. Here, determine if the sale resulted in a gain or a loss. This requires information about the original purchase price and accumulated amortization to determine the book value of the multi-year IA. Book value is the original purchase price less accumulated amortization. If the multi-year IA was sold at a price greater than its book value, the difference is entered as a *gain on sale of capital asset* on the income and economic profit statements. If the multi-year IA was sold at a price less than its book value, the difference is entered as a *loss on sale of capital asset* on the income and economic profit statements.

[38] If statements are being prepared which combine the vessel owner with the fishing privilege holder (scenario 3 as described in Section 3.1.1.1), then record *QP/access privilege revenue.*

Record the purchase of a multi-year IA as an *intangible asset expenditure* on the cash flow statement. For the income statement, the cost of the multi-year IA must be amortized over time, similar to depreciation of *physical capital*. If there is an expiration date to the multi-year IA, then divide the purchase price of the multi-year IA by the life of the asset (straight-line method) and record as *amortization of intangible assets*. If the nature of the multi-year IA is one in which portions are "used up" at different rates at different points of its useful life, then consider different amortization schedules. In most cases, the straight-line method will be most appropriate. If there is no expiration date, then there is no amortization expense because multi-year IA does not get used up over time; i.e., the value of the multi-year IA remains the same. For the economic profit statement, calculate the *intangible asset cost* according to the methods described below.

Record the market value of the multi-year IA as an asset on the balance sheet. List any outstanding loan amounts used for the purchase of the multi-year IA under liabilities. The market value for multi-year IAs are likely to fluctuate based on the supply and demand for them and based on conditions within the fishery. If there is an expiration date for the multi-year IA, that would be reflected in the year-to-year market values. If there is no expiration date, then values would fluctuate based on market/fishery conditions only.

Table 9 provides a summary of how the various transactions of single-year IA and multi-year IA sales/purchases are made on the financial and economic profit statements.

Table 9. Intangible assets on financial and economic profit statements.

	Single-year Intangible Asset		Multi-year Intangible Asset
	Vessel Owner	Fishing Privilege Holder	Fishing Privilege Holder (no vessel owner entries)
Income Statement	**Purchase:** *QP/AP cost*	**Sale:** *QP/AP revenue* **Purchase:** *QP/AP cost*	**Sale:** -- If gain, record as *gain on sale of capital asset* -- If loss, record as *loss on sale of capital asset* **Purchase:** *Amortization of intangible assets*. Equal to zero if no expiration date.
Cash Flow Statement	**Purchase:** *QP/AP cost*	**Sale:** *QP/AP revenue* **Purchase:** *QP/AP cost*	**Sale:** *Cash from sale of intangible asset* **Purchase:** *Intangible asset expenditure*
Economic Profit Statement	**Purchase:** *QP/AP cost*	**Sale:** *QP/AP revenue* **Purchase:** *QP/AP cost*	**Sale:** -- If gain, record as *gain on sale of capital asset* -- If loss, record as *loss on sale of capital asset* **Purchase:** Calculate *intangible asset cost*.
Balance Sheet	**Assets:** No entry recorded since single-year IAs expire at the end of the year resulting in no year-end value. **Liabilities:** Record any outstanding loan balances from single-year IA purchases.		**Assets:** Record market values of multi-year IAs **Liabilities:** Record any outstanding loan balances from multi-year IA purchases.

Calculation of Intangible Asset Cost

The calculation of intangible asset cost follows from the calculation of physical capital cost as described in Section 4.2, Physical Capital Costs (Economic Profit Statement). For intangible assets, each tradeable limited access permit or bundle of QS is treated as a single unit and its value, or price (i.e., the user cost of intangible assets), is known or estimated. Therefore μ^t is designated as the user cost of a multi-year IA in time period *t*. At the beginning of time period *t*, a multi-year IA has a value of V^t:

$$\mu^t = r^t V^t + (V^t - V^{t+1}) + \tau^t V^t \qquad (1)$$

Where:

- r^t is the opportunity cost rate of holding the multi-year IA in period *t*
- $(V^t - V^{t+1})$ is the revaluation of the value of the multi-year IA over the time period. For multi-year IAs with an expiration date, this would include amortization. Values could also change due to market conditions.
- τ^t is the tax rate applied to the value of the multi-year IA, if any.

As with physical capital, equation 1 can be rewritten as:

$$\mu^t = V^t(r^t + \delta^t - \phi^t + \tau^t) \qquad (2)$$

Where the value change over the period is broken out into two rate terms: δ^t is the amortization rate during time t and ϕ^t is market valuation rate (could be positive or negative) during time t. The *intangible asset cost* then becomes the sum of all user costs (μ) for particular multi-year IAs a fishing business may hold.

4.3.3. Intangible Assets Values -- Data Needs and Estimation

Single-Year Intangible Assets

Access privileges in the denomination of the annual allocation (often called QP) show up in the income statement as costs to the vessel and/or QS/QP/Permit holder and as revenue to the QS/QP/Permit holder. As Section 3.1.1.1 explains, there are three possible scenarios or ownership arrangements, each requiring different treatments of QP in the income statement: 1) separate QP holder and vessel owner – with separate accounting entities, 2) single fishing business that holds QP and owns vessels – with separate accounting entities, and 3) single fishing business that holds QP and owns vessels – with accounting entities combined.

For scenarios 1 and 3, **only cash transactions for buying/selling QP need to be recorded as QP revenue or QP cost on the QP holder's income statement**. However, as Section 3.1.1.1 explains, scenario 1 is unrealistic because if not all QP is fished, the vessel owner becomes by default a QP holder (making it scenario 2). Scenario 3 does realistically occur, especially early in an ITQ program. However, as the program matures, the actively fishing sector is expected to consolidate while the QS may be retained by the original owners or purchased by non-fishing entities. This would result in more and more transitions from scenario 3 to scenario 2 over time.

Scenario 2 **requires that the value of all QP fished be treated as an expense and subtracted from revenues in calculating the vessel owner's income**. There may be cash transactions for all or a portion of the quota fished, but there may not be. Data on cash transactions can be used directly, and can also be used to estimate an appropriate price to value quota fished for which no market transaction took place. Quota transactions without a market transaction can occur for a variety of reasons, including within risk pool or cooperative trades, a company transferring the quota to their vessel at no cost, or barter trades.

Data Collection Considerations for Scenarios 1 and 3

For scenarios 1 and 3, cash transactions for buying/selling QP need to be recorded as QP revenue or QP cost on the QP holder's income statement. Data can be collected from vessels through an annual census or by aggregating records of quota transactions.

Data collection through annual cost census or survey

The most explicit way to obtain the costs of quota purchases is to collect the net quota expenses through an annual census questionnaire. If vessels are able to track and report expenses on quota purchases, they can be deducted from annual earnings as directed by Table 6. There are several potential complications to this approach. Surveys may be designed to allow a vessel to designate their own fiscal year such that

revenues and expenses more closely match their fiscal-year accounting books. This presents a problem if the fiscal year differs from the "fishing year" or fishing season determined by management, since there is no way to determine how much of the fiscal year's quota expense to allocate to each fishing year.

Data collection through quota transactions records

As an alternative to a census or survey of quota expenses, it may be possible to calculate expenses on quota using records of quota transactions (Holland and Norman, 2015). Generally, quota transactions must be reported to an agency to move QP from the seller's account to the buyer's account, and a price is recorded for some transfers.[39] This may not be the case if the fleet is structured as a cooperative.

Expenses on quota purchases can be calculated directly if the value at the time of the trade is explicit and reported. The best possible case is if a quota transactions database is designed to collect accurate price information, the buyer's account, the seller's account (whether it is a QS owner account or a vessel account), the quantity traded, the relevant characteristics of the QP traded (e.g., species, class, or any other identifying characteristic), and the quota transfer database does not allow for barter or in-kind transactions. "Self-trades" – the transfer of quota from a quota holder to a vessel account that is the same business type for accounting purposes (scenario 3) – should be identified, as the price is likely to be zero or unrepresentative of the true value. Self-trades should be removed prior to estimating the value of cash transactions. If these conditions are met, then using the quota transactions database to calculate net quota purchases for a vessel is straightforward. However, this simplicity is unlikely to be present in most ITQ programs.

Complication: Inaccurate price information

If the price of the quota traded is recorded at the time of the transaction, it may be inaccurate. Often, a trade is agreed upon with a price to be determined upon delivery (as a share of revenue when fish is delivered, for example), or a price adjustment or bonus is awarded upon delivery. Mechanisms to allow participants to edit the quota transaction price information should be in place, as well as post-transaction reminders to confirm or update the price information upon delivery of the catch. As a mechanism for promoting compliance, price information should also be regularly verified and participants contacted about inaccurate reporting.

Complication: Self-trades that are not explicitly identified

Self-trades describe a situation where a trade is made between two related business types so no cash transaction occurs. These trades may occur to make quota available for specific vessels or they also might occur to "store" quota until a fishing vessel is chosen/needs the quota. In some programs, annual distributions of quota are made to quota accounts, but must be fished out of vessel accounts. This means that every quota pound must be transferred at least once, but the transfer could be between two related entities (quota and vessel accounts owned by the same company) or two unrelated accounts. It is recommended that this initial quota transfer be identified as the initial transfer, with the option to either record a transaction price or to record the transfer as a self-trade.

Complication: "Other" trades

[39] Throughout the U.S., it is voluntary to report the price/value of the transaction.

Trades may not be explicitly labeled as cash trades, and may be identified as "other" if none of the choices precisely describe the transaction. Barter trades, ex-post corrections, and transfers between harvesters and risk pools, cooperatives, or other groups often fall into this category.

Barter trades describe a situation where QP are exchanged for a different set of QP. It is reasonable to assume that the total value of the bundle of species traded is equal since the exchange occurred. Under this assumption, the change to income is zero. Therefore, barter trades need not be explicitly accounted for on the income statement in scenarios 1 and 3.

If the catch share program is set up as a cooperative, or if individual members are members of risk pools in which a third entity completely controls the distribution of quota, then active vessels may fit the definition of scenario 1 if vessels purchase quota from the cooperative or risk pool entity. In this case, however, it is unlikely that the transaction prices would be available to researchers, and cost information would have to be obtained through a census.

Data collection for scenario 2:

Scenario 2 necessitates the valuation of all quota fished, not just that which is traded in cash transactions. For single species fisheries or fisheries where trades occur species-by-species, observations of cash transactions can be used to value untraded caught quota. Means or medians are generally appropriate, with inspection of standard deviation, skewness, and/or percentiles of the observed prices. It is important to acknowledge that quota transactions databases may have a variety of the complications discussed above that may require the use of more complicated empirical methods, even for single species fisheries or single species transactions.

More difficult complications arise, however, in a multispecies fishery where multispecies trades are common. Here hedonic price models can be used to estimate lease values for each individual species (Holland, 2013; Murphy et al., 2015). Hedonic price models are also useful when groups (cooperatives, sectors, or other groups) can trade quota across groups and must report prices and quantities, but the individual trades within the group are unknown (e.g., Northeast Multispecies Groundfish and Alaska crab). These trades between groups are often large, multispecies trades.

A hedonic framework for valuing the implicit species-level prices that a traded as a bundle or package is:

$$TV = P_a X_a + P_b X_b + \ldots P_n X_n + e_t,$$

Where TV is the total value of the trade, and is regressed on the quantities of each quota stock or species included in the trade X_n, and P_n is the estimated coefficient and the average implicit price for each stock or species (Holland, 2013).

The estimated prices from the model can be used to value quota traded within each group, although they may be biased by the structure of the lease market (Murphy et al., 2015). Murphy et al. (2015) suggest that the prices estimated using only the between-sector lease prices might be biased upward if within-sector markets clear at lower prices due to the involvement of permit banks, privately funded leasing organizations, and the concentration of liquidity within sectors. When prices are estimated using between-sector trades, it is often difficult to know how representative they are of the overall quota market.

Multi-Year Intangible Assets

If the initial values for a multi-year IA are known, such as the purchase price, that information can be used for calculating *amortization of intangible assets* on the income statement and the starting conditions for calculating the *intangible asset cost* on the economic profit statement. If the value is not known then it must be estimated.

The American Institute of CPAs wrote a useful summary of three methods for valuing intangible assets[40] – the market, income, and cost approaches. The market approach, which uses observable market data, may be the most tractable of the three even though obtaining reliable data may be difficult. The income approach uses information about the income or cash flow that an intangible asset produces. Obtaining data that can be directly traceable to a particular multi-year IA may be particularly difficult for fishing businesses that are active in multiple fisheries. The cost approach estimates value by evaluating the cost of replacing an intangible asset. This approach is used for intangible assets that are developed by a business, such as internally developed software or engineering designs, etc., which is beyond the scope of the practices being recommended here. Nevertheless, while we recommend using the market approach, the income and cost approaches could be considered in certain cases.

Beyond using agency collected data of multi-year IA transactions or a survey of fishing businesses that is targeted at multi-year IA values separate from vessel sales, a hedonic model approach could be used if there are data on vessel purchases that include the multi-year IA. These data could be obtained by surveys of fishing businesses or vessel brokers or by using advertised listing prices. A model that incorporates both vessel characteristics and the characteristics of the fishing permit or QS would allow for the values of each to be estimated separately.

4.4. Measuring Labor Costs

For financial statements, the explicit payments to crew and owner-operators obtained from survey data are recorded as *Hired crew and captain payment* or *owner-operator pay*. Should this information be unavailable, knowledge of typical crew share systems along with revenue and *non-labor trip expense* may be used to estimate these labor costs. If none of this information is available but there is some information about the amount of time spent working, publicly available average wage rates for workers in similar occupations could be used. An example of such information, using construction and extraction occupations, can be found at the U.S. Bureau of Labor Statistics website.[41]

Beyond these direct methods for obtaining actual (or estimates of) *Hired crew and captain payment* or *owner-operator pay,* for purposes of the economic profit statement, an economic price of labor is required. For returns to fishing businesses, this means finding appropriate measures of the *value of owner time as captain* and the *value of owner time as entrepreneur*. A measure of the value of crew time is needed for determining economic profit to crew (as described in Section 3.6).

The economic price for labor, called the shadow wage rate, measures the economic value to society from the last unit of labor employed in the fisheries sector plus any disutility of worker effort, both measured in economic prices to account for distortions elsewhere in the economy. This shadow wage rate is based on

[40] American Institute of Certified Public Accountants, Inc. 2012. CGMA Tools: Three approaches to valuing intangible assets. 7 p. Available at https://www.cgma.org/content/dam/cgma/resources/tools/downloadabledocuments/valuing-intangible-assets.pdf

[41] U.S. Bureau of Labor Statistics. Occupational Employment and Labor Statistics. Available at https://www.bls.gov/oes/current/oes470000.htm

the economic benefits given up when people work, such as the value of forgone leisure, the value of employment that is not directly paid a wage but contributes to the economy, and the value of unemployment benefits.

The shadow wage rate also accounts for any government-induced distortions in labor markets, including minimum wage laws, unemployment insurance, income taxes, and legal impediments to labor mobility. Market-induced distortions include union market power over wages or restricted entry into a particular market.

Labor always has an opportunity cost. People do not work for free even if there is high unemployment and idle labor, and there is always a forgone output of leisure that forms the reservation wage plus disutility of effort. Not only might seemingly unemployed labor be employed in the informal economy or be self-employed and/or receive payments in kind, but unemployed labor has a reservation wage – the minimum amount a worker would accept and the minimum cost of hiring an unemployed person (Ray, 1984).

In practice, an opportunity cost based approach to the shadow wage rate generally uses hourly wage rates published by the Bureau of Labor Statistics and by state agencies. These hourly wage rates correspond to different labor categories. Since fishing is largely a "blue collar" industry, hourly wage rates for different corresponding labor categories can be averaged together to allow for uncertainty over what the foregone labor category would be. These labor categories should correspond to the urban or rural areas closest to the home port of the vessel, on the reasonable assumption that most labor lives in proximity to their "place of work".[42] To account for the presumed managerial ability of the captain, the captain can be given an hourly wage rate that is higher than that given to a crewmember. An hourly wage rate that is 25% higher has been used in the past (Squires, 1987); another alternative would be to use the crew share differential between crew member and captain, if available, to set the captain's hourly wage rate. The total number of hours worked in a year must also be assigned based on survey information. Thus, the opportunity cost of labor is the alternative hourly wage rate (potentially averaged over multiple labor categories and including taxes since this is a demand price gross of tax) multiplied by the number of hours worked in a year. Similar considerations apply for a vessel mechanic or other crew with specialized skill.[43]

To account for *value of owner time as captain,* the rate used for a hired captain for the time the owner spends at sea can be used. For the *value of owner time as entrepreneur*, a similar approach whereby an estimate of the time spent "running the business" (which could be a part-time or full-time endeavor) at a comparable wage rate can be used.

[42] If the crew size is sufficiently large to suggest some specialization and division of labor, then one crew category can be mechanic, which has its own separate hourly wage rates.

[43] If we assume that vessel labor is drawn from the pool of unemployed labor, the opportunity cost of a laborer is their hourly wage rate less unemployment benefits. Because society no longer has to pay these unemployment benefits, these represent a benefit to society and become a transfer payment. Thus, the opportunity cost of crewmembers is a weighted average of the alternative hourly wage rate (averaged over multiple labor categories and including taxes) multiplied by the number of hours worked in a year for those crewmembers that are drawn from current employment and the alternative hourly wage rate multiplied by the number of hours worked in a year for those crewmembers that are drawn from current unemployment less their previous unemployment benefits (if this information is available). The weights for each category are the relative share of labor costs for the previously employed and unemployed in the total labor category costs.

5. Fishing Business Returns and Measures of Welfare

Central to much of the work in fisheries economics is the investigation of how various approaches to fisheries management, and the resulting policy changes, affect society's welfare. Welfare is measured from the point of view of both consumers and producers. While the vast array of theory and methods of welfare economics are not the subject of this paper, the measurement of returns to fishing businesses and the terminology and approaches therein are important inputs into analyses of welfare as it relates to fisheries. Therefore, it is important to introduce some of the prominent aspects of welfare economics. These concepts are briefly introduced here because the measures of returns described in this document relate to them in various ways. Because this is simply a review of welfare concepts, we make no recommendations on methodology.

Setting aside consumer welfare for the moment, the notion of producers' welfare is commonly associated with *profit*. *Profit* is defined as total revenue less total variable costs[44] and total fixed costs.[45] For now, the types of costs included in variable or fixed costs are not specified. While measures of profit are often appropriately used in regulatory analyses, there are conditions in which other measures of producer welfare are more appropriate.

A commonly used measure of welfare to the producer is *producer surplus*. *Producer surplus* is "the difference between what a firm is willing to sell the output for, and what is actually received for a good (the market price) for all units of output produced." This is measured by "the area above the short-run supply curve and below price" (Just et al., 2004). A distinction of this firm level definition is that the lower bound of the area is determined by the price at which average variable cost is equal to *marginal cost.*[46] At prices below this point, the firm would choose to shut down. Mathematically, a firm's producer surplus is its total revenue less its total variable costs. This is the distinguishing aspect between using producer surplus over profit for welfare measurement. For situations where shutdown points must be considered, profit would underestimate welfare (Just et al., 2004).

Just et al. (2004) equate the term *quasi-rent* with *producer surplus*. Before discussing quasi-rent, the concept of *rent* is introduced. There are different types of rent. The two broadest types are *economic rent* and *Ricardian rent*. Two other types of rent, more narrowly focused on natural resources, are *resource rent* and *scarcity rent*.

Bromley (2009) defines *economic rent* as "the net revenue to a firm that is in *excess* of what would be necessary to keep the firm engaged in its current activity. Economic rent is extra-competitive (excess) profit. Industries with blocked entry, or with some other means to prevent competitive pressure, earn economic profit." Just et al. (2004, p. 183-184), in more narrowly focusing on owners of factors of production, equates economic rent to producer surplus and, further, state that "the owners of factors of production, such as labor and land, derive 'economic rent' from the services provided by these factors for which there is a positive market demand."

Using agricultural land as an example, Bromley (2009) defines *Ricardian rent* as "the differential income earned by the most productive fixed asset (land) in comparison to all other parcels of lesser quality in the same local market." The term *infra-marginal rent* is then used for what all the other parcels of land earn except for the least productive parcel which has zero *Ricardian rent*. Van Kooten and Bulte (2000) define *Ricardian rent* as "the excess of the market value of supramarginal (non-marginal) units of in situ resources over current scarcity rents." They also refer to *Ricardian rent* as *differential rent*.

[44] Costs that change with the level of production.

[45] Costs that remain unchanged regardless of the level of production.

[46] The additional cost of producing one more unit.

Because Van Kooten and Bulte (2000) define *resource rent* as the sum of *scarcity rent* and *Ricardian rent*, Van Kooten and Bulte's (2000) definition for *scarcity rent* is the "difference between marginal revenue and marginal production costs that can only come about as a result of the natural or policy-induced scarcity of a resource."

Bromley (2009) refers to *resource rent* as simply payment for raw material used as a factor of production. Coglan and Pascoe (1999) define *resource rent* as the "return to the owner of the resource" and "in fisheries, *resource rent* is the return to the owner of the fishery resource, and represents the value of the input generated by the fish stock in the production process." Edwards (2005) defines *resource rent* as the product of the quantity of total landings and the resource price, where the resource price is the ratio of the resource value (value of the natural resource and associated fishing capital less the capitalized value of fishing capital) to the exploitable biomass. He states that this average, rather than the marginal valuation, is a *scarcity rent* but does not further define that term. He does, however cite Coglan and Pascoe (1999) but not in the context of *resource rent* nor *scarcity rent*.

With an understanding of various notions of rent, *quasi-rent*, which Just et al. (2004) equate to *producer surplus,* can be further clarified. Just et al. (2004) state that *quasi-rent* is the "excess of gross receipts which a producer receives for any commodities produced over their prime cost – that is, over the extra cost that the firm incurs in order to produce those things which it could have escaped if it had not produced them." Also, "it is a rent on fixed factors employed by the firm but, unlike factor rent, may not persist over a long period of time." The temporary nature of *quasi-rent* is an important distinguishing feature. Again using agricultural land as an example, *quasi-rent* is the above normal earnings that farmers – those that pay rent for the land they use – might obtain due to improved techniques or entrepreneurship. These temporary *quasi-rents* convert to *economic rent* (Just et al., 2004, seem to have *economic rent* in mind when they use the term *factor rent*) as landowners, in turn, raise rental rates. Van Kooten and Bulte (2000) stress that "the term quasi-rent refers to any payment made to a (human-created) capital asset that is in fixed supply for the time being; any return to the "sunk" component of capital represents quasi-rent" and that "these quasi-rents are returns that accrue to firms from past investments and innovative practices and are not attributable to the natural capital stock."

The concept of rent, in its various forms, and producer surplus have to do with welfare accruing to the producer. Consumer welfare, on the other hand, is commonly measured with *consumer surplus*. The concept is similar to producer surplus and is defined by Just et al. (2004) as "the area under the demand curve and above the price line." Conceptually, this area represents the value consumers obtain from buying a good at a market price that is lower than what they were willing to pay.

Producer surplus and consumer surplus are approximations of two other monetary-based welfare measures: *compensating variation* and *equivalent variation*. These welfare measures are thought to be conceptually more accurate but more difficult to measure directly. See Just et al. (2004) for an in-depth discussion on compensating variation and equivalent variation.

Jensen et al. (2019), after reviewing various welfare measures and their fisheries applications, conclude that total economic welfare is defined as the sum of total resource rents, producer surplus, and consumer surplus. They observe that considering all economic surpluses corresponds to a utilitarian social welfare function. They further observe that if fishing effort is completely homogeneous, economic welfare only includes the resource rent and consumer surplus, whereas the resource rent and producer surplus constitute economic welfare when the output price is constant (to which can be added under a perfectly elastic demand curve even with price changes). Economic welfare is captured by the resource rent if fishing effort is completely homogeneous and the output price is constant. They further observe that under open access in the harvest sector, consumer and producer surplus could be positive even though economic rent is absent. Finally, they observe that economic welfare in the value chain contributes to overall fishery economic welfare.

Rents, producer surplus, consumer surpluses, and, to a limited degree, profits are all important aspects of investigations into measures of welfare. As can be seen from the discussion above, there are a variety of methods that can be used for estimating them. We do not provide specific recommended approaches beyond the brief review of these concepts. Rather, we focus on the terminology and methods used to characterize measures of returns from accounting and economic perspectives which would, in turn, be useful for evaluating welfare in fisheries.

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Appendix A. West Coast Groundfish Trawl Catch Share Fishery Case Study

As described in the main text, each region and fishery has its own specific data limitations and management design that affects how net returns are calculated. This case study includes all vessels that participated in the West Coast groundfish trawl catch share fishery (that did not target whiting) in 2018. In addition to catch share participation, all other commercial fishing activity is included, primarily Dungeness crab and shrimp.

This fishery operates off the coast of Washington, Oregon, and California with about 70 active vessels. About one-third of the fleet is owner-operated at least part of the time. The fishery utilizes individual fishing quotas where permit owners are allocated quota for 30 species, or categories of species, based on historical participation. Each year the quota shares are converted to quota pounds and permit owners can transfer quota pounds from permits to vessels and between vessels. Individuals often own both quota and vessels, but the ownership is often separated into distinct limited liability corporations. Both quota earnings and quota costs are requested on the annual vessel surveys and so for the purposes of this analysis, both quota costs and revenues are included in the measures of net returns for the fishing operations. Each vessel is treated as a separate fishing business, despite common practice for one person or company to own multiple vessels.

The NWFSC Economic Data Collection Program (EDC) only collects information about revenue and costs directly associated with operating a vessel. It does, however, collect revenues from leasing or selling quota. Therefore, the following categories of information listed in Table A1 are not collected for this fishery: *non-operating revenue, gain/loss on sale of capital asset, interest expense, non-operating expenses,* and *income taxes*. *Non-operating revenues* are not collected because they can't be easily allocated among multi-vessel operations nor provide information about the performance of the fishing vessel portion of a diversified business. *Non-operating expenses* are not collected because they are heterogeneous across the fishing companies where some vessels have office and storage space as part of a larger fishing operation and others are operated out of personal homes. In both cases, it would be unreasonable to ask a participant to estimate the share of the total office costs or house mortgage that is associated with the vessel operations.

Ideally, capitalized investments would be reported separately from expenses for repair and maintenance of equipment and gear. Survey participants, most commonly vessel owners or skippers, indicated that they did not have the financial background to assess whether an individual outlay should be categorized as a capitalized investment or an expense. They did indicate that it would be relatively simple to report the tax depreciation, but unfortunately the treatment of capital expenses for tax purposes is different from the methods proposed here. Therefore, the EDC Program did not request that participants separate these two types of expenses.

For this case study, repair and maintenance costs are combined with capitalized expenditures. The implication for the income statement is that vessel expense contains relatively larger expenditures that would normally be spread over the useful life of the capital equipment. In turn, depreciation will be lower but the overall effect is that gross income will be lower since the capital expenditures are wholly attributed to the year of purchase. Future *gross income* calculations will be higher than normal since future depreciation charges will be lower. There is a similar impact to the economic profit statement in that vessel expenses are inflated while *physical capital cost* is deflated since there is no way to distinguish a capital expense from repair/maintenance. There is no impact on *net cash flow* from the cash flow statement. However, *vessel expense* is inflated while *physical capital expenditure* is deflated on the cash flow statement.

For the purposes of this analysis, the vessels within the fleet are treated as firms that own both vessels and fishing privileges. Of the 70 vessels included in sample, 17 recorded both quota earnings and costs, and 42 recorded only quota costs. Table A1 provides notes about each of the categories of information used in the case study.

Below are income, cash flow, and economic profit statements (Tables A2, A3, and A4, respectively) for the West Coast trawl groundfish catch share fishery for 2018. A balance sheet was not prepared because the EDC program does not collect information on liabilities.

The statements reflect the average, or representative, vessel and show totals for the fleet as a whole. To avoid combining disparate business types into one measure, firms that do not own vessels but do own fishing privileges are excluded.

For the income statement (Table A2), available data are sufficient to calculate *operating income* only. The lack of information about *non-operating revenue and expenses* and *income taxes* does not allow for the calculation of *pre-tax income* nor *income (after tax)*.

Note that at the fleet level, *quota pound/access privilege costs* exceed *quota pound/access privilege revenue*. Had all firms owning quota been included, these two items would have been of equal value since all buyer costs would have matched all seller revenues.

In the cash flow statement (Table A3), *net cash flow* was calculated. However, data was not available for many of the items in the statement. The most significant of these missing items, that typically affect net cash flow, are *interest expense, principal expense,* and *income taxes*. Other items, such as *cash from loans or sale of capital assets*, while important, may be intermittent and only affect *net cash flow* in particular years.

Cash flow is useful for seeing the ebbs and flows of additions and subtractions from cash over multiple years. Firms use cash flow to plan for financing needs as they consider purchase and sale of capital assets and the resulting ability of revenues to cover expenses. Figure A1 shows cash flow trends of median values for 2011 through 2018 in real terms. Expenses increased somewhat from 2014 and later. Revenues also increased from 2013 and later, resulting in relatively stable net cash flow. This type of information can be useful to economists for assessing the economic/financial well-being of a fleet that may be seeing changes in net cash flow due to changing stock, regulatory, and/or market conditions. The cash flow statement is the least complex to prepare and can point to emerging conditions, the nature of which might be further revealed in the income and economic profit statements.

In the economic profit statement (Table A4), the *value of the owner's time as a captain* and an *entrepreneur* was estimated using the median hourly wage rate of $19.69 per hour for construction laborers in nonmetropolitan areas of the Oregon coast.[47] This rate is increased by 25% to account for the additional skills required to captain a fishing vessel and run a fishing business. For time as captain, total days at sea for the vessel was multiplied by the proportion of time the owner operated the vessel as indicated on the EDC survey. The remaining working time in the year, assuming a standard 40-hour work week, is used for time as an entrepreneur.

Physical capital cost was calculated according to the methods described in Section 4.2 for a single vessel; that is, the sum of the opportunity cost of the vessel and depreciation. We assumed no change in vessel value and ignored taxes. Opportunity cost is vessel value times a BAA bond rate of 3.8% for 2018. Depreciation was calculated at 4% of vessel value.

[47] SOC code 472061, area 4100006. See https://www.bls.gov/oes/current/oes472061.htm

Intangible asset cost cannot be calculated because there is limited data on quota share or permit values. Intangible asset expenditures are collected and are shown on the cash flow statement. Since there are no sunset provisions on the quota share and permits held by these vessels, the *amortization of intangible assets* is set to zero, as shown on the income statement.

Based on the data available for this fishery, the revenue figures on the income statement are identical to those on the cash flow statement. It also turns out for this case study that expenses deducted from revenues are similar, resulting in *operating income* on the income statement being nearly equal to *net cash flow* on the cash flow statement. With full data, the bottom line results on these two statements would be different given the differences in their structures (i.e., depreciation and amortization charges only appear on the income statement, and *principal expense, physical capital expenditures,* and *intangible asset expenditures* only appear on the cash flow statement). Therefore, comparisons between the income and cash flow statements in this case do not yield any additional insights.

Total revenues on the economic profit statement are slightly higher than on the income statement due to the inclusion of value of non-market outputs. With the inclusion of the *implicit costs* on the economic profit statement, *economic profit* is substantially lower than *operating income* on the income statement. This is expected and illustrates the purpose for preparing economic profit statements. That is, the *implicit costs*, which are true costs but not as readably observable as *explicit costs*, can be substantial and better reveal the underlying economic conditions of fishing businesses.

Table A1. Notes on revenue and cost categories.

Revenue/Cost Category	Notes
Ex-vessel revenue	Shore-based revenue from fish tickets and at-sea revenue from EDC forms.
For-hire/charter revenue	Most vessel do not have this category of earnings, when this is applicable to a vessel's operation, the most common revenue is from participating in NMFS-run research projects.
Quota pound/access privilege revenue	If this revenue is recorded on a vessel form, it is considered income to the fishing vessel firm.
Non-operating revenue	Not collected.
Gain on sale of capital asset	Not collected.
Cash from sale of physical capital	This information is requested on the EDC form, but because it involves transfer of asset, the actual transaction often occurs outside of the EDC survey period.
Cash from sale of intangible asset	This information is requested on the EDC form, but because it involves transfer of asset, the actual transaction often occurs outside of the EDC survey period.
Direct subsidies	Direct subsidies are rare in this fishery. There was a period where the electronic monitoring exempted fishing permit participation was subsidized, but no comprehensive information is available for this subsidy.
Cash receipts from loans	Not collected.
Value of non-market outputs	Total delivery weight designated as personal use multiplied by the average ex-vessel price for that species based on all deliveries designation as "human food."
Hired crew and captain payment	Hired captain and crew wages, bonuses, benefits, payroll taxes, and unemployment insurance.
Owner/operator payment	Calculated as annual skipper wages multiplied by the percentage of trips the vessel was operated by the owner.
Non-labor trip expense	Includes fuel, observer, trucking, bait, ice, other supplies, food, offload fees, freight, crew travel paid by boat, and communication costs.
Vessel expense	Includes capitalized expenditures and repair and maintenance expenses on gear and equipment.
Overhead	Includes insurance, moorage, fishing association fees, licensing fees, observer costs, cost recovery fees, on-vessel communication fees. Information on fishing business related vehicle costs, professional fee, office space, storage space, advertising, communications costs, and non-crew labor/salaries is not collected.

Table A1 (continued)

Revenue/Cost Category	Notes
Interest expense	Not collected.
Principal expense	Not collected.
Income taxes	Not collected.
Quota pound/access privilege cost	Includes lease of quota shares and lease/purchase of quota pounds. Does not include purchase of quota shares.
Physical capital expenditures	This information is requested on the EDC form, but because it involves transfer of asset, the actual transaction often occurs outside of the EDC survey period.
Intangible asset expenditures	This information is requested on the EDC form, but because it involves transfer of asset, the actual transaction often occurs outside of the EDC survey period. Includes lease and purchase cost of limited entry permits as well as license/permit renewal fees.
Depreciation of physical capital	Depreciation on the EDC form is depreciation reported on the business's tax return. Vessel valuation, which includes the value of the hull, engine, and equipment, is reported on the EDC form. So rather than use the depreciation for tax purposes, a rate of 4% of the vessel is used.
Amortization of intangible assets	There is no sunset date for any intangible assets in this program and so amortization costs are zero.
Non-operating expenses	Not collected.
Gain/loss on sale of capital asset	Not collected.
Landings/ad valorem taxes	Includes buyback fee (4.5% on all IFQ landings) (see Holland et al., 2017) and Washington fish tax (1% tax split evenly between vessels and processors).
Value of owner time as captain	Total days at sea for vessel multiplied by the proportion of time the owner operated the vessel. The resulting days are multiplied by eight (typical work day) to get total owner-operated hours. Hours are multiplied by 125% of the Oregon construction median hourly wage ($19.69/hr) in order to convert a crew wage rate to a captain wage rate.
Value of owner time as entrepreneur	Hours worked as entrepreneur are calculated as the difference between a 2,080 hour work year and the hours worked on the vessel. The hourly wage rate is the same as above ($19.69*125%).

Table A1 (continued)

Revenue/Cost Category	Notes
Physical capital cost	Sum of the opportunity cost of the vessel and depreciation. Assume no change in vessel value and no taxes. Opportunity cost is vessel value times a BAA bond rate of 3.8% for 2018. Depreciation was calculated at 4% of vessel value.
Intangible asset cost	Not calculated because intangible asset values are not collected.
Value of non-market inputs	There may be some cases of vessels using bait they caught or acquired from non-market sources, but there is not enough information to estimate the value of those inputs.

Table A2. Income statement: for fishing firms owning both vessels and fishing privileges.

INCOME STATEMENT	Vessel Mean	Vessel Median	Fleet Total (70 vessels)
Revenues:			
Ex-vessel revenue	806,724	768,892	56,470,664
For-hire/charter revenue	11,584	0	810,865
Quota pound/access privilege revenue	8,371	0	585,962
Direct subsidies	NA		
Total Revenues	826,678	786,338	57,867,491
Fishing Costs:			
Hired crew and captain payment	277,952	255,884	19,456,641
Non-labor trip expense	101,616	85,950	7,113,144
Vessel expense	76,107	49,459	5,327,483
Quota pound/access privilege cost	62,944	26,853	4,406,112
Depreciation of physical capital	32,947	24,773	2,273,312
Amortization of intangible assets	0	0	0
Landings/ad valorem taxes	19,921	16,490	1,394,503
Total Fishing Costs	571,488	524,695	40,004,142
Gross Income	255,191	263,814	17,863,349
Overhead	81,464	73,703	5,702,480
Operating Income	173,727	158,490	12,160,869
Non-operating Revenue and Expenses:			
Non-operating revenue	Not collected		
Gain/loss on sale of capital asset	Not collected		
Interest expense	Not collected		
Non-operating expenses	Not collected		
Total non-operating revenue and expenses:	N/A		
Pre-tax Income	N/A		
Income taxes	Not collected		
Income (after tax)	N/A		

Table A3. Cash flow statement: for fishing firms owning both vessels and fishing privileges.

CASH FLOW STATEMENT	Vessel Mean	Vessel Median	Fleet Total (70 vessels)
Additions to cash:			
Ex-vessel revenue	806,724	768,338	56,470,664
For-hire/charter revenue	11,584	0	810,865
Quota pound/access privilege revenue	8,371	0	585,962
Non-operating revenue	Not collected		
Direct subsidies	NA		
Cash receipts from loans	Not collected		
Cash from sale of physical capital	Incomplete data		
Cash from sale of intangible asset	Incomplete data		
Total additions	826,678	768,338	57,867,491
Subtractions from cash:			
Hired crew and captain payment	277,952	255,884	19,456,641
Owner-operator pay	21,154	0	1,480,797
Non-labor trip expense	101,616	85,950	7,113,144
Vessel expense	76,107	49,459	5,327,483
Overhead	81,464	73,703	5,702,480
Interest expense	Not collected		
Principal expense	Not collected		
Physical capital expenditures	Not collected		
Intangible asset expenditures	4,405	0	308,320
Income taxes	Not collected		
Quota pound/access privilege cost	62,944	26,853	4,406,112
Non-operating expenses	Not collected		
Landings/ad valorem taxes	19,921	16,490	1,394,503
Total subtractions	645,564	588,877	45,189,480
Net Cash Flow	181,114	191,950	12,678,011

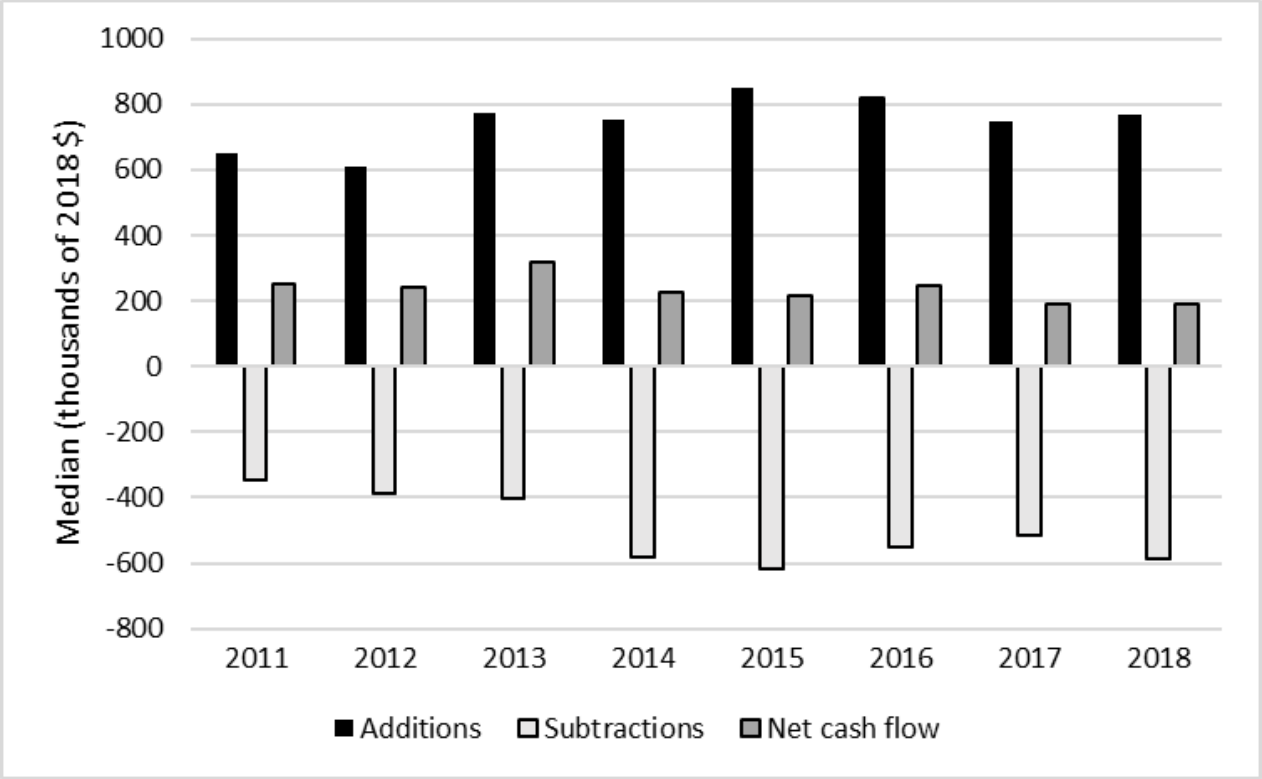

Figure A1. Multi-year cash flow.

Table A4. Economic profit statement: for fishing firms owning both vessels and fishing privileges.

ECONOMIC PROFIT STATEMENT	Vessel Mean	Vessel Median	Fleet Total (70 vessels)
Revenues:			
Ex-vessel revenue	806,724	768,892	56,470,664
For-hire/charter revenue	11,584	0	810,865
Quota pound/access privilege revenue	8,371	0	585,962
Non-operating revenue	Not collected		
Gain on sale of capital asset	Not collected		
Direct subsidies	NA		
Value of non-market outputs	343	0	24,033
Total Revenues	827,022	786,338	57,891,524
Explicit Costs:			
Hired crew and captain payment	277,952	255,884	19,456,641
Non-labor trip expense	101,616	85,950	7,113,144
Vessel expense	76,107	49,459	5,327,483
Quota pound/access privilege costs	62,944	26,853	4,406,112
Landings/ad valorem taxes	19,921	16,490	1,394,503
Overhead	81,464	73,703	5,702,480
Non-operating expenses	Not collected		
Loss on sale of capital asset	Not collected		
Total Explicit Costs	620,005	581,024	43,400,363
Implicit Costs:			
Value of owner time as captain	5,511	0	385,794
Value of owner time as entrepreneur	45,683	51,194	3,197,786
Physical capital cost	64,246	48,665	4,497,205
Intangible asset cost	Not calculated		
Value of non-market inputs	Incomplete data		
Total Implicit Costs	115,440	99,859	8,080,785
Economic Profit	91,577	78,008	6,410,376