Economic Data Collection Program:

First Receiver and Shorebased Processor

Cost Disaggregation

Draft - Do Not Cite

Marie Guldin, Erin Steiner, Jerry Leonard

NOAA Fisheries

Northwest Fisheries Science Center

May 25, 2016

1 Introduction

It is important to conduct economic analyses of specific fisheries. In order to perform analysis at the fishery level, costs must be broken out by fishery. The Northwest Fisheries Science Center's Economic Data Collection (EDC) Program is currently conducting research to determine the "best" method of allocating annual aggregated costs to specific fisheries for the shorebased processing sector. This document describes the process of determining that method and results of a sensitivity analysis comparing this method to other potential methods. The document layout is as follows: Section 2 introduces the EDC Program and data collection and Section 3 illustrates the need for cost disaggregation, and the method used for the catcher vessel sector. Section 3.1 outlines the different methods examined, and Section 3.2 reports the results of the sensitivity analysis.

2 Economic Data Collection Program

In January 2011, the West Coast Limited Entry Groundfish Trawl fishery transitioned to the West Coast Groundfish Trawl Catch Share Program. The catch share program consists of cooperatives for the at-sea mothership (including catcher vessels and motherships) and catcher-processor fleets, and an individual fishing quota (IFQ) program for the shorebased trawl fleet. The Economic Data Collection (EDC) Program[1] is a mandatory component of the West Coast Groundfish Trawl Catch Share Program, collecting information annually from all catch share participants: catcher-processors, catcher vessels, motherships, first receivers, and shorebased processors. Baseline, pre-catch share, data were submitted in 2011 for the 2009 and 2010 operating years. Data for the first year the fishery operated under the catch share program (2011) were submitted in 2012, and likewise, subsequent data are submitted one year after the year of fishery participation. The EDC information is used to monitor the economic effects of the catch share program by collecting information on operating costs, revenues, and vessel and processing facility characteristics.

3 Cost Disaggregation

It is important to conduct economic analyses of specific fisheries. Many vessels and processors that participate in the catch share program also participate in other fisheries. In order to perform analysis at the fishery level, costs must be broken out by fishery. However, EDC participants incur several types of costs that are aggregated across all fisheries. These are called "joint" costs in the economics and accounting literature and include fixed costs (e.g., new processing equipment), or variable costs (e.g., labor). The former are joined by the nature of the costs themselves, while the latter are often joined due to observational limitations. It is difficult to assign fixed costs to a particular fishery because the level of the cost does not vary with business activity (at least over the short run). Many variable costs can

---

[1] Additional information on the EDC Program can be found at `www.nwfsc.noaa.gov/edc`.

theoretically be tracked by fishery, but it would be difficult or costly to do so. For example, although an EDC participant could theoretically set up a system to track expenditures on supplies by fishery or species, doing so may be prohibitively costly.

In June 2013, the EDC Program presented research to the PFMC SSC (Agenda Item F.2.b[2]) regarding the selection of a method for cost disaggregation for catcher vessels relative to various criteria, and a .[3] This document presents similar research for the first receiver and shorebased processor sector. Because this sector is quite different in many respects from the catcher vessel sector, there are some differences regarding approaches to cost disaggregation. Much of the information on the EDC form for shorebased processors is collected at the species level (e.g. fish production information), not the fishery level like the catcher vessels. Therefore, we allocate costs to species groups rather than fisheries. This means that analysis of catch share species includes all processing of that species, not just fish caught within the catch share program. This applies primarily to sablefish, which are caught in several other fisheries, but also to rockfish and other groundfish species. From 2009-2014, an average of 93% of groundfish pounds received by EDC processors was caught with a trawl permit, which accounted for 80% of total fish purchase costs. While it would be ideal to isolate costs associated with the production of catch share groundfish only, there is not enough information to do so.

The first receiver and shorebased processor sector includes a wide variety of entities that range from independent catcher vessel owners who unload and truck their own fish to large multi-facility processing companies with a wide range of product offerings. Some respondents who provide information do not own a physical processing facility and thus do not incur many of the costs on the EDC form. Here we focus only on those companies that process fish.

3.1   Cost Disaggregation Methods

We allocate aggregated annual costs to three species groups: 1) Shoreside Pacific whiting; 2) Non-whiting groundfish; and 3) Other. Non-whiting groundfish include flatfish (e.g., petrale sole and dover sole), roundfish (e.g., sablefish and lingcod), and rockfish. The third category "other" includes all other species reported on the EDC form.[4]

We analyze four methods of cost disaggregation: 1) disaggregation by input pounds; 2) disaggregation by output pounds; 3) disaggregation by value-added (value of fish production less the cost of purchasing that fish); and 4) disaggregation by a combination of the other three methods by cost category ("mixed" method). Disaggregation by input pounds uses a ratio of the weight of fish purchases for a particular species group to all other fish purchases by the company in that year, applied to all aggregated cost information on the EDC form. Disaggregation by output pounds uses a ratio of fish production for a

---

2   http://www.pcouncil.org/resources/archives/briefing-books/june-2013-briefing-book/groundfishJune2013.
3   http://www.nwfsc.noaa.gov/research/divisions/fram/documents/EDC_Catcher_Vessel_Report_2015.pdf, p. 145.
4   Other species include coastal pelagics, crab, echinoderms, California halibut, Pacific halibut, herring, salmon, shrimp, squid, sturgeon, tuna, and other shellfish.

particular species group to all other fish production by the company in that year, applied to all aggregated cost information on the EDC form. Disaggregation by value-added uses a ratio of the spread between production value and purchase cost for a given species group to overall spread for the company in that year, applied to all aggregated cost information on the EDC form.[5] The "mixed" method, which follows the same general framework of cost allocation for the catcher vessel sector, applies the ratio from one of the aforementioned methods to each cost category (e.g. expenses on electricity, expenses on packing materials, etc.). The remainder of this section will describe the "mixed" method in more detail.

Mixed Method

For some cost categories, particularly fixed costs, we utilized economic theory and knowledge gained through discussions with industry to determine which cost disaggregation method to apply to each cost category in the "mixed" method (Table 1).

Table 1: Mixed Method Cost Disaggregation Determination: Economic Theory.

Cost Category	Chosen Method
Capitalized Expenditures on buildings	Value-added
Capitalized expenditures on equipment	Value-added
Rent and lease on buildings and equipment	Value-added
Repair and maintenance	Value-added
Non-production employees	Value-added
Licensing fees	Value-added
Packing materials	Value-added
Processing equipment	Value-added
Production workers	Value-added
Shoreside monitoring	Input lbs
Sewer, waste, byproduct disposal	Input lbs
Offloading	Input lbs

For other costs, it was less clear which method was the most appropriate. To assist in determining which disaggregation measure to apply to these cost categories, we employed the following regression analyses to determine which cost disaggregation approach demonstrates the most meaningful correlation with the given cost category.

First, we compared the results of the following three regressions and chose the method that yielded the lowest residual sum of squares. In Table 2, we refer to this approach as Analysis 1. In the following equations c denotes cost category, i denotes processor, and t denotes year.

---

[5] We compute value-added at the species level and if value-added is negative, we replace it with zero. This is done at the species level prior to aggregation to the fishery level.

$$Cost_{cit} = \beta InputLbs_{it} + \epsilon_{it} \tag{1}$$

$$Cost_{cit} = \beta OutputLbs_{it} + \epsilon_{it} \tag{2}$$

$$Cost_{cit} = \beta ValueAdded_{it} + \epsilon_{it} \tag{3}$$

Second, we compared the results of the following three regressions (here the disaggregation variables on the right-hand side of the equation are broken out by species group) and chose the method that yielded the lowest residual sum of squares. In Table 2, we refer to this approach as Analysis 2. In the following equations c denotes cost category, i denotes processor, t denotes year, and s denotes species group (Pacific whiting, Non-whiting groundfish, or Other).

$$Cost_{cit} = \beta_s InputLbs_{its} + \epsilon_{it} \tag{4}$$

$$Cost_{cit} = \beta_s OutputLbs_{its} + \epsilon_{it} \tag{5}$$

$$Cost_{cit} = \beta_s ValueAdded_{its} + \epsilon_{it} \tag{6}$$

The two regression analyses recommended similar measures for disaggregation. In cases of discrepancies (nitrogen gas, non-fish ingredients, and off-site freezing and storage), the EDC Program chose to follow Analysis 2, as it allows use of information collected at the species level to inform how to allocate cost information collected at an aggregated level.

Table 2: Mixed Method Cost Disaggregation Determination: Regression Analysis.

Cost Category	Analysis 1	Analysis 2	Chosen Method
Cleaning supplies	Value-added	Value-added	Value-added
Electricity	Input lbs	Input lbs	Input lbs
Freight	Value-added	Value-added	Value-added
Insurance	Value-added	Value-added	Value-added
Natural gas	Input lbs	Input lbs	Input lbs
Nitrogen gas	Value-added	Output lbs	Output lbs
Non-fish ingredients (additivies)	Input lbs	Value-added	Value-added
Off-site freezing and storage	Input lbs	Value-added	Value-added
Production supplies	Value-added	Value-added	Value-added
Propane	Value-added	Value-added	Value-added
Taxes	Output lbs	Output lbs	Output lbs
Water	Value-added	Value-added	Value-added

Listed below are the variables used to disaggregate each cost category for the "mixed" method. For the average processor, 90% of total costs are allocated using the value-added method, 9% are allocated using input pounds, and 1% are allocated using output pounds.

- Costs were disaggregated using input pounds for the following cost categories:

    - Shoreside monitoring costs

    - Electricty

    - Natural gas

    - Offloading expenses

    - Sewer, waste, and byproduct disposal

- Costs were disaggregated using output pounds for the following cost categories:

    - Nitrogen gas

    - Taxes

- Costs were disaggregated using value-added for the following cost categories:

    - Capitalized expenditures on buildings

    - Capitalized expenditures on new and used machinery and equipment

    - Rental or lease of buildings, job-site trailers, and other structures

    - Total repair and maintenance expenses

    - Off-site freezing and storage

    - Packing materials

    - Processing equipment

    - Non-production employees

    - Insurance payments

    - Freight costs

    - Production supplies

    - Cleaning and custodial supplies

    - Non-fish ingredients (additives)

    - Propane gas

    - Water

    - Licensing fees

While over 99% of processor revenue is generated from fish output (which is broken out by species on the EDC forms), some revenue information is not collected by species (e.g. offloading and insurance settlements). We disaggregate this small portion of revenue using input pounds. Costs and revenue

from custom processing activities are collected by species group on the EDC form. Therefore, these are applied directly to the relevant species group.

3.2   Sensitivity Analysis

The cost disaggregation method chosen by the EDC Program to utilize in economic analyses is the "mixed" method. There are several advantages to this method. First, it is reasonable to expect that the appropriate cost disaggregation method will vary across cost categories. Second, the regression analysis behind this method uses existing EDC Program data to help determine which method is likely the most appropriate, by examining which series of data (input pounds, output pounds, or value-added) is most correlated with data for each cost category across companies and years. Finally, this is the same approach used to disaggregate cost data for catcher vessels, which provides consistency across EDC Program sectors.

We conduct a sensitivity analysis to understand the implications of choosing the "mixed" method over the other potential methods. The primary economic indicator employed by the EDC Program is net revenue, both variable cost net revenue (VCNR, revenue minus variable costs) and total cost net revenue (TCNR, revenue minus variable costs and fixed costs). Figures 1-3 show company average TCNR across cost disaggregation methods. VCNR, while not explicitly shown, is represented by TCNR plus fixed costs. Tables 3-5 show the mean and standard deviation of VCNR and TCNR generated by each disaggregation method. Each table compares disaggregation methods for one species group.[6] Tables 6 and 7 show the percent differences between the different methods, using the "mixed" method as the baseline method.

In general, disaggregating by input pounds and output pounds tends to allocate more of the costs of production to Pacific whiting, as it is a high volume fishery. Therefore, the net revenue from processing Pacific whiting is generally highest using the value-added method and lowest using the input pounds method. The opposite is true for the Other species group, which includes high-value species like crab and shrimp. The relationship between methods over time is less consistent for production of non-whiting groundfish.

Pacific whiting production also has the largest differences across methods for both variable cost net revenue and total cost net revenue. Pacific whiting is the only species group where some cost disaggregation methods result in negative net revenue. Not suprisingly, differences between disaggregation methods are higher for total cost net revenue than variable cost net revenue, as a result of high fixed costs.

It is important to note the fairly large standard deviations for all measures. Within this sample of processors, there is a broad variety of business sizes and species processed, which can lead to wide

---

[6]   The number of processors is sometimes lower for the value-added method. If a processor makes zero or negative profits on a species group, this method will attribute no costs to production of that species, even if fish was produced. These situations generally describe fish that is unprocessed that was received as bycatch from vessels or fish that was offloaded for another company. Both cases would likely imply little processing costs on the part of the facility.

distributions for measures of net revenue. We also calculate the median VCNR and TCNR, which are lower in magnitude than the averages (Tables 8-10). The input pounds and output pounds methods yield more negative values for VCNR, which also provides evidence in favor of the "mixed" method as we would expect most companies to cover their operating costs on an annual basis.

Figure 1: Pacific whiting production: Average total cost net revenue (revenue minus variable costs and fixed costs). Variable cost net revenue is represented by total cost net revenue plus fixed costs.

Figure 2: Non-whiting groundfish production: Average total cost net revenue (revenue minus variable costs and fixed costs). Variable cost net revenue is represented by total cost net revenue plus fixed costs.
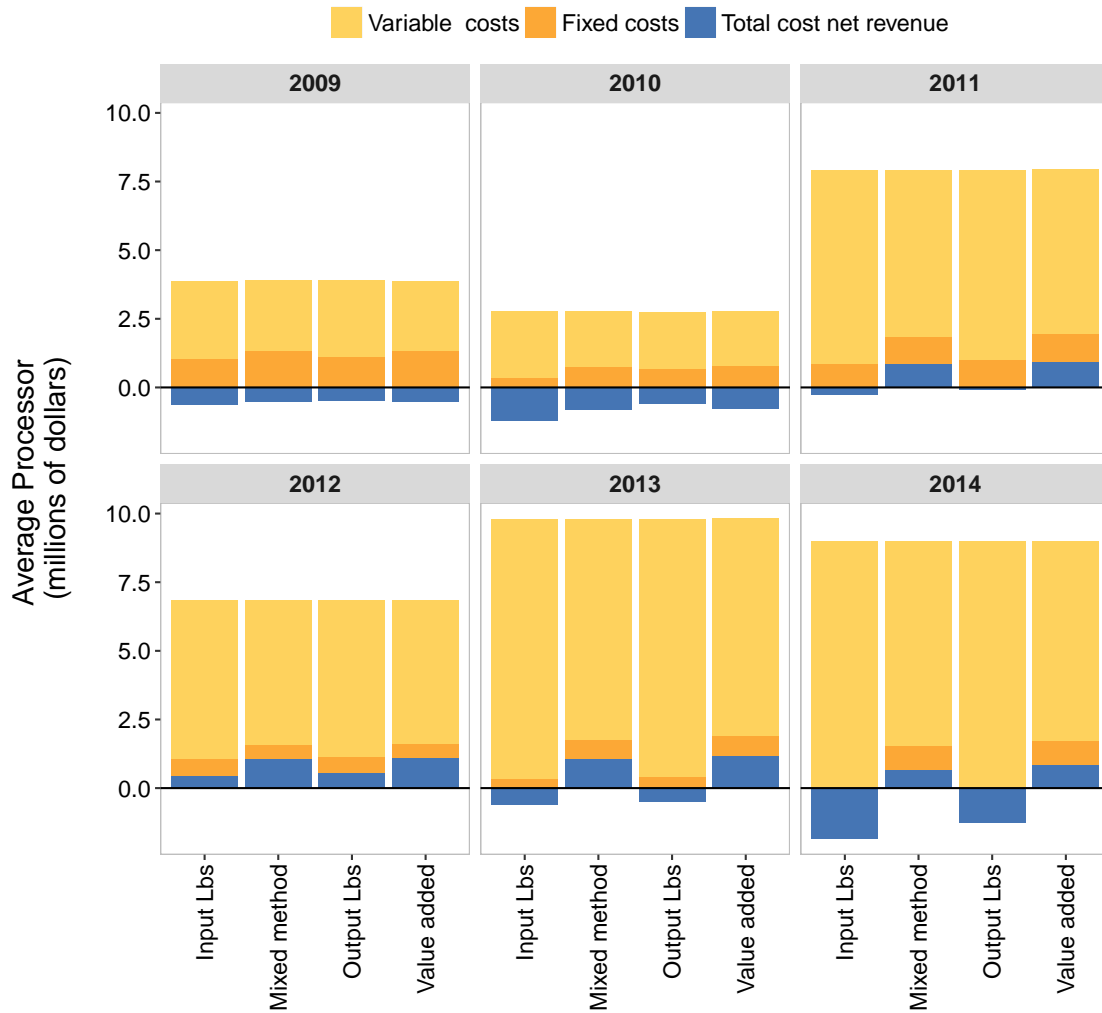
Figure 3: Other species production: Average total cost net revenue (revenue minus variable costs and fixed costs). Variable cost net revenue is represented by total cost net revenue plus fixed costs.
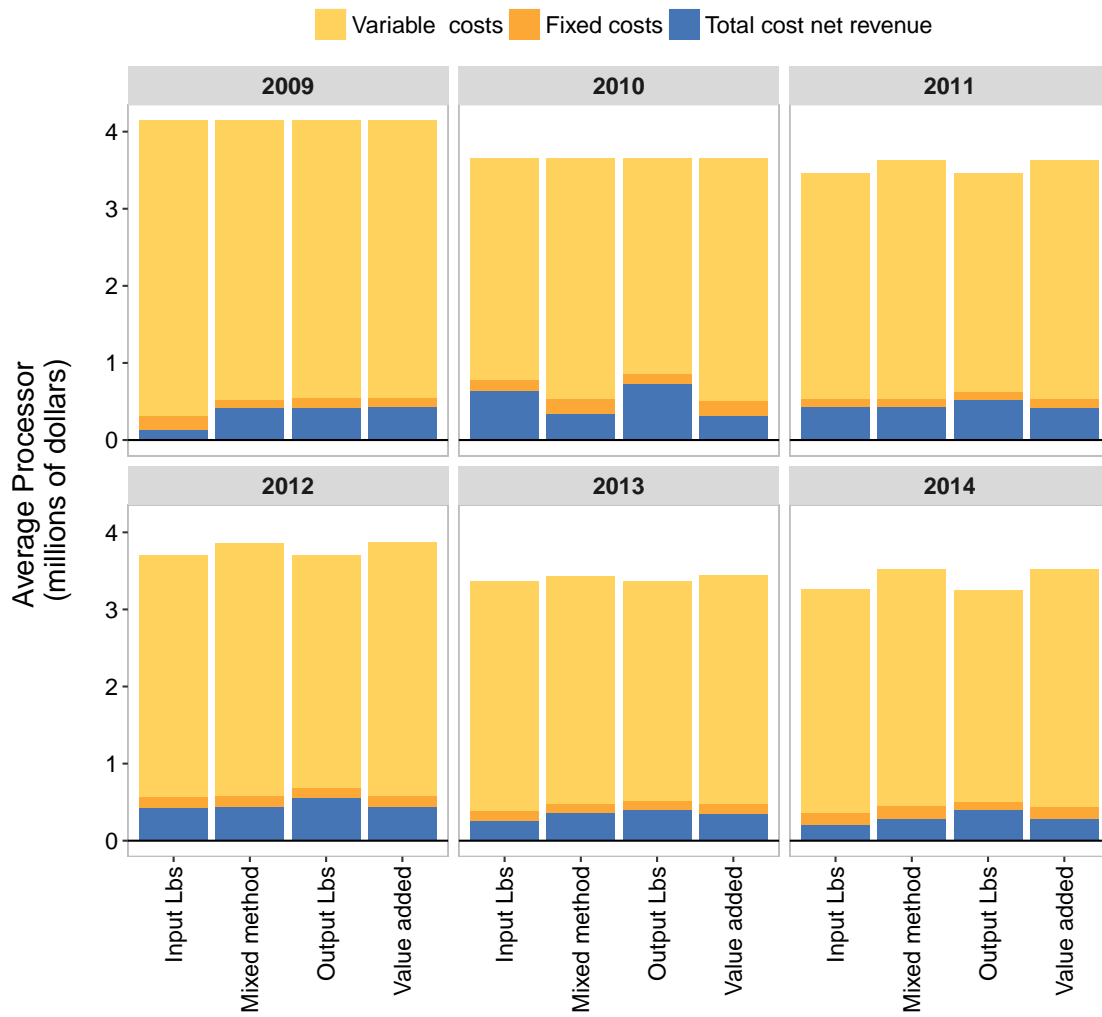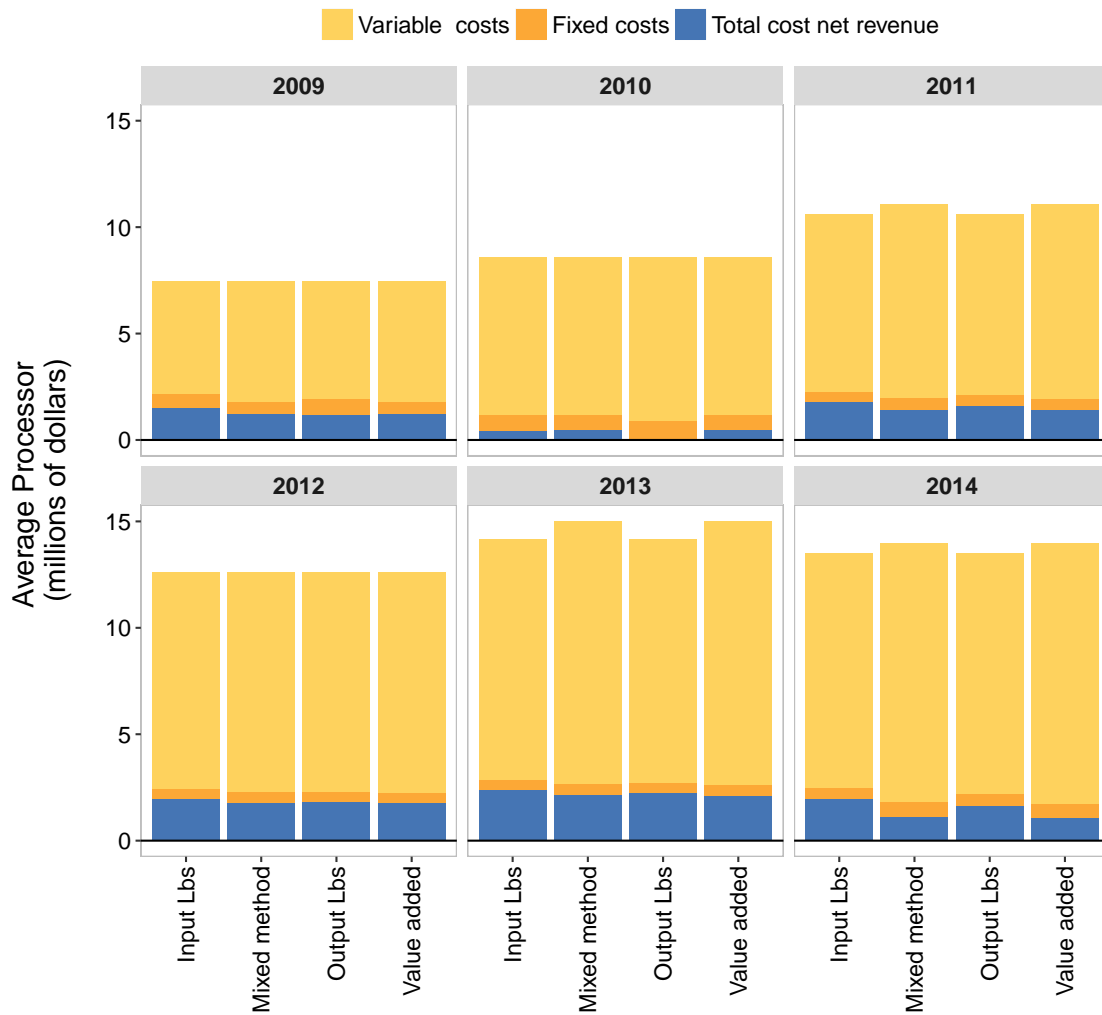
Table 3: Sensitivity analysis. Shoreside Pacific Whiting fishery average variable cost net revenue (VCNR) and total cost net revenue (TCNR) by cost disaggregation approach (thousands of $). N = number of EDC Processors with non-zero, non-NA responses. Standard deviations in parentheses (thousands of $).

Metric: Approach	2009 Mean	N	2010 Mean	N	2011 Mean	N	2012 Mean	N	2013 Mean	N	2014 Mean	N
VCNR: Input pounds	$1,053	12	$345	12	$863	9	$1,075	8	$359	8	-$442	8
	($4,016)		($1,542)		($2,441)		($1,468)		($1,436)		($3,676)	
VCNR: Output pounds	$1,100	12	$686	12	$1,021	9	$1,151	8	$421	8	$7	8
	($4,075)		($1,609)		($2,515)		($1,724)		($1,370)		($3,361)	
VCNR: Value-added	$1,349	12	$769	12	$1,941	9	$1,619	8	$1,904	8	$1,737	8
	($3,585)		($1,380)		($1,875)		($1,176)		($1,939)		($2,217)	
VCNR: Mixed method	$1,338	12	$738	12	$1,855	9	$1,581	8	$1,768	8	$1,562	8
	($3,642)		($1,396)		($1,901)		($1,189)		($1,867)		($2,332)	
TCNR: Input pounds	-$621	12	-$1,218	12	-$281	9	$447	8	-$587	8	-$1,841	8
	($1,153)		($1,940)		($2,626)		($1,217)		($1,396)		($3,851)	
TCNR: Output pounds	-$492	12	-$607	12	-$87	9	$546	8	-$499	8	-$1,262	8
	($1,151)		($1,347)		($2,682)		($1,557)		($1,410)		($3,490)	
TCNR: Value-added	-$534	12	-$784	12	$953	9	$1,101	8	$1,191	8	$827	8
	($1,850)		($2,617)		($2,397)		($801)		($2,055)		($2,231)	
TCNR: Mixed method	-$544	12	-$815	12	$867	9	$1,062	8	$1,055	8	$651	8
	($1,796)		($2,586)		($2,397)		($813)		($1,973)		($2,319)	

Table 4: Sensitivity analysis. Non-whiting groundfish fishery average variable cost net revenue (VCNR) and total cost net revenue (TCNR) by cost disaggregation approach (thousands of $). N = number of EDC Processors with non-zero, non-NA responses. Standard deviations in parentheses (thousands of $).

Metric: Approach	2009 Mean	N	2010 Mean	N	2011 Mean	N	2012 Mean	N	2013 Mean	N	2014 Mean	N
VCNR: Input pounds	$320 ($1,307)	17	$785 ($1,350)	19	$527 ($980)	21	$567 ($1,175)	20	$393 ($1,362)	21	$360 ($1,022)	21
VCNR: Output pounds	$550 ($1,547)	17	$864 ($1,420)	19	$620 ($1,196)	21	$685 ($1,377)	20	$518 ($1,682)	21	$510 ($1,455)	21
VCNR: Value-added	$547 ($1,613)	17	$507 ($1,156)	19	$529 ($889)	20	$581 ($921)	19	$477 ($1,134)	20	$442 ($1,073)	19
VCNR: Mixed method	$527 ($1,591)	17	$534 ($1,157)	19	$539 ($907)	20	$584 ($942)	19	$482 ($1,170)	20	$447 ($1,072)	19
TCNR: Input pounds	$134 ($1,300)	17	$641 ($1,190)	19	$424 ($882)	21	$432 ($1,090)	20	$261 ($1,278)	21	$212 ($866)	21
TCNR: Output pounds	$411 ($1,519)	17	$722 ($1,282)	19	$528 ($1,118)	21	$565 ($1,306)	20	$402 ($1,625)	21	$397 ($1,348)	21
TCNR: Value-added	$436 ($1,570)	17	$311 ($988)	19	$415 ($771)	20	$439 ($793)	19	$350 ($983)	20	$281 ($933)	19
TCNR: Mixed method	$416 ($1,547)	17	$338 ($976)	19	$425 ($788)	20	$442 ($813)	19	$355 ($1,020)	20	$286 ($923)	19

Table 5: Sensitivity analysis. Other fishery average variable cost net revenue (VCNR) and total cost net revenue (TCNR) by cost disaggregation approach (thousands of \$). N = number of EDC Processors with non-zero, non-NA responses. Standard deviations in parentheses (thousands of \$).

Metrics: Approach	2009 Mean	N	2010 Mean	N	2011 Mean	N	2012 Mean	N	2013 Mean	N	2014 Mean	N
VCNR: Input pounds	$2,161	19	$1,163	21	$2,239	24	$2,414	24	$2,850	23	$2,473	23
	($3,094)		($3,298)		($2,742)		($2,382)		($4,661)		($4,309)	
VCNR: Output pounds	$1,926	19	$896	21	$2,099	24	$2,291	24	$2,714	23	$2,180	23
	($2,787)		($3,063)		($2,564)		($2,351)		($4,508)		($3,632)	
VCNR: Value-added	$1,771	19	$1,172	21	$1,935	23	$2,253	24	$2,646	21	$1,755	22
	($2,611)		($2,694)		($2,180)		($2,204)		($3,658)		($3,443)	
VCNR: Mixed method	$1,796	19	$1,165	21	$1,960	23	$2,265	24	$2,698	21	$1,817	22
	($2,639)		($2,744)		($2,211)		($2,216)		($3,728)		($3,460)	
TCNR: Input pounds	$1,539	19	$419	21	$1,790	24	$1,961	24	$2,417	23	$2,001	23
	($3,419)		($3,732)		($2,628)		($2,067)		($4,376)		($3,872)	
TCNR: Output pounds	$1,210	19	-$2	21	$1,625	24	$1,817	24	$2,258	23	$1,631	23
	($3,194)		($3,778)		($2,449)		($2,049)		($4,209)		($3,150)	
TCNR: Value-added	$1,214	19	$470	21	$1,410	23	$1,763	24	$2,089	21	$1,082	22
	($2,605)		($2,917)		($2,013)		($1,848)		($3,214)		($3,100)	
TCNR: Mixed method	$1,239	19	$463	21	$1,436	23	$1,775	24	$2,141	21	$1,145	22
	($2,644)		($2,969)		($2,043)		($1,859)		($3,282)		($3,084)	

Table 6: Percent difference between methods for variable cost net revenue with mixed method as baseline.

Species Group	Year	Input pounds (%)	Value-added (%)	Output pounds (%)
Pacific whiting	2009	-21.30	0.80	-17.80
Pacific whiting	2010	-53.20	4.20	-7.10
Pacific whiting	2011	-53.50	4.60	-45.00
Pacific whiting	2012	-32.00	2.50	-27.20
Pacific whiting	2013	-79.70	7.70	-76.20
Pacific whiting	2014	-128.30	11.20	-99.60
Non-whiting groundfish	2009	-39.40	3.80	4.30
Non-whiting groundfish	2010	46.80	-5.10	61.80
Non-whiting groundfish	2011	-2.30	-1.80	14.90
Non-whiting groundfish	2012	-2.90	-0.50	17.20
Non-whiting groundfish	2013	-18.40	-0.90	7.50
Non-whiting groundfish	2014	-19.50	-1.20	14.00
Other	2009	20.40	-1.40	7.20
Other	2010	-0.20	0.60	-23.10
Other	2011	14.20	-1.30	7.10
Other	2012	6.60	-0.50	1.10
Other	2013	5.60	-1.90	0.60
Other	2014	36.10	-3.40	19.90

Table 7: Percent difference between methods for total cost net revenue with mixed method as baseline.

Species Group	Year	Input pounds (%)	Value-added (%)	Output pounds (%)
Pacific whiting	2009	-14.20	1.90	9.70
Pacific whiting	2010	-49.50	3.80	25.40
Pacific whiting	2011	-132.40	9.90	-110.00
Pacific whiting	2012	-57.90	3.70	-48.60
Pacific whiting	2013	-155.60	12.80	-147.30
Pacific whiting	2014	-382.60	26.90	-293.70
Non-whiting groundfish	2009	-67.70	4.80	-1.10
Non-whiting groundfish	2010	89.60	-8.00	113.40
Non-whiting groundfish	2011	-0.30	-2.30	24.30
Non-whiting groundfish	2012	-2.30	-0.60	27.80
Non-whiting groundfish	2013	-26.30	-1.20	13.40
Non-whiting groundfish	2014	-26.00	-1.90	38.50
Other	2009	24.30	-2.00	-2.30
Other	2010	-9.50	1.50	-100.50
Other	2011	24.70	-1.80	13.20
Other	2012	10.50	-0.70	2.40
Other	2013	12.90	-2.40	5.50
Other	2014	74.90	-5.50	42.50

Table 8: Shoreside Pacific whiting: Median variable and total cost net revenue (thousands of $).

Method_Measure	2009	2010	2011	2012	2013	2014
VCNR: Input pounds	81.14	-113.47	-332.74	750.16	134.56	70.44
VCNR: Output pounds	216.91	-53.99	-355.23	808.02	219.83	295.71
VCNR: Value-added	596.26	160.01	1,378.24	1,575.84	1,591.87	1,161.93
VCNR: Mixed method	515.67	93.33	1,142.65	1,494.98	1,551.48	919.95
TCNR: Input pounds	-193.29	-424.67	-1,543.62	257.84	-624.23	-1,042.95
TCNR: Output pounds	14.10	-160.81	-702.95	460.71	-129.82	-389.22
TCNR: Value-added	45.93	-1.51	1,104.62	1,084.45	618.12	631.36
TCNR: Mixed method	32.38	-9.97	869.03	1,003.58	577.73	447.55

Table 9: Non-whiting groundfish: Median variable and total cost net revenue (thousands of $).

Method_Measure	2009	2010	2011	2012	2013	2014
VCNR: Input pounds	8.59	107.56	41.29	26.02	8.15	-1.09
VCNR: Output pounds	7.69	72.89	74.51	50.90	18.30	3.74
VCNR: Value-added	54.53	42.98	39.62	71.08	53.19	40.59
VCNR: Mixed method	49.21	51.45	52.58	52.18	43.08	29.63
TCNR: Input pounds	-3.22	83.64	-0.54	12.92	4.30	-1.10
TCNR: Output pounds	-4.42	62.19	21.20	15.52	7.41	-20.11
TCNR: Value-added	-0.54	-0.22	25.26	53.52	9.50	18.89
TCNR: Mixed method	-0.81	-0.95	22.03	39.36	11.51	17.05

Table 10: Other species: Median variable and total cost net revenue (thousands of $).

Method_Measure	2009	2010	2011	2012	2013	2014
VCNR: Input pounds	1,357.73	470.68	1,002.02	1,985.40	1,140.69	693.98
VCNR: Output pounds	1,156.35	470.69	923.62	1,896.30	1,147.25	684.32
VCNR: Value-added	838.46	436.14	774.28	2,038.43	1,132.18	297.68
VCNR: Mixed method	903.07	430.58	845.86	2,035.46	1,132.88	320.57
TCNR: Input pounds	311.24	151.58	559.11	1,560.99	840.14	565.79
TCNR: Output pounds	233.49	138.53	533.00	1,414.85	763.02	342.27
TCNR: Value-added	220.43	121.10	549.63	1,515.10	1,078.50	163.37
TCNR: Mixed method	220.76	158.21	551.31	1,518.77	1,079.19	186.21