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WORKING PAPER

Sales Organizations, Industrial Organization and Economic Value in Norway

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Sales Organizations, Industrial Organization and Economic Value in Norway[1]

by

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Abstract

In Norway fish sales organizations have the right to set the terms of all transactions between member fishers and prospective buyers. This report studies the impact of sales organizations on the value of the harvest sector. We study how two of the largest sales organizations, Norges Sildesalgslag and Sunnmøre og Romsdal Fiskesalslag (SUROFI), affect the value of the harvest of its member fishers. We find that sales organizations create significant value for member fishers. By organizing auctions, fishing firms are able to receive higher prices for their harvests than if the same fish were sold through contracts. We also find that prices reflect market fundamentals such as the degree of competition on both the buyer and seller sides. This may have consequences for future developments in a market characterized by consolidation on both sides.

1. Background

Under the Fish Sales Organisations Act (2013), all first-hand sales of wild fish and shellfish in Norway must be conducted through fishermen's organizations. This gives sales organizations the right to control the forms of sale, namely auctions and contracts, and the ability to set minimum prices and dictate the conditions for the sale of wild fish and shellfish. These organizations act as cooperatives and set the terms of all transactions between member fishers and prospective buyers. This report studies the impact of sales organizations on the value of the harvest sector. Specifically, we study how two of the largest sales organizations, Norges Sildesalgslag and SUROFI, affect the value of the harvest of its member fishers.

Norges Sildesalgslag (Norwegian Fishermen's Sales Organization for Pelagic Fish, NSS) is one of the sales organizations and a sole organization that is in charge of specified pelagic species such as mackerel, herring, capelin and others. NSS facilitates an online auction system to match buyers and fishers. While auctions are the main form of transactions, term contracts between buyers and fishers are also allowed with approval of NSS.[2] Our study includes data from 2001-2018, and we focus on three key species in our analysis: mackerel, Norwegian spring-spawning herring and North Sea herring.

Sunnmøre and Romsdal Fishermen's Sales Organisation (SUROFI) was founded on July 24th, 1945 and is the country's second largest sales organization in the whitefish sector. SUROFI has exclusive rights to all first-hand sales of whitefish and shellfish in the Sunnmøre and Romsdal

[2] Small landings (100t for consumption use and 300t for oil/mean use) are exempted from auctions and may be allowed to deliver directly to buyers.

districts. We focus on the period 2010-2018 and include saithe and cod, which are both economically important fisheries for Norway.

Fishers register fish to be sold at an auction or in contracts to registered buyers. Transactions specify the vessel, fish species, consumption/oil/meal purpose, quantity, size distributions, and where delivery will take place. In an auction, registered buyers within a specified bidding area may bid by specifying the price per kilogram (NOK/kg) corresponding to the size and the grades being offered. Buyers may simultaneously make bids for catch from several vessels and for each fish species. Such buyers have rights to restrict their purchase to maximum and minimum quantity and/or maximum number of vessels to accept. Buyers outside of the bidding area are allowed to make bids, but the fishers reserve the right to select the winner in the case that an outside bidder has the highest bid. Fishers also have the right to select the winner when equal bids occur.

In the auctions a minimum price for each species and size category are set in advance of a season, and within the season minimum prices are dynamically adjusted. In addition to the common minimum prices, the individual vessel may set its own minimum prices so long as it exceeds the common minimum price. In situations where the winning bids fall below the minimum prices, the fisher need not accept the bid and the fish may be offered at a supplemental auction. The fish may also be sold directly to a buyer with agreement with NSS. Transportation costs are born by fishers, but NSS may provide a subsidy on transportation cost for equalization.

Fishers and buyers can also enter a term contract in a permitted period specified for each species. For mackerel, between January 1st and March 31st, and between October 1st and December 31st are the permitted periods. For North Sea herring (NSH), it is between August 1st and November 30th. For Norwegian spring-spawning herring (NSSH), that period is from April

1st to August 30th. The minimum contract period is a month. The vessel can only deliver to the buyer with whom it has entered into a contract.[3]

Given the importance of sales organizations in the market for wild capture seafood in Norway, we ask the following question: "How does the sales organization (defined by the market organization using spot markets and term contracts) affect the value to different market actors?" Put differently, we ask how the use of spot markets and term contracts affects the value of fishery resources to fishing firms.

We begin by reviewing the economics literature relevant to this question. In Section 3 we provide preliminary evidence based on descriptive statistics using data from NSS and SUROFI. In Section 4 we provide empirical estimates of the impact of the auction structure on prices obtained by fishing firms.

2. Literature Review

We first note that a central lesson from microeconomics (particularly industrial organization) is that market structure on the demand or supply side impacts the equilibrium price that is achieved through bargaining. In this instance, the creation of the sales organization would likely transfer some of the market power from buyers to sellers by allowing changing the way buyers are allowed to purchase fish. In the spot market buyers do not negotiate prices with

[3] See https://www.sildelaget.no/no/fiskeri/generelle-meldinger/rundskriv/eldre-rundskriv/2009/januar/rundsk riv-0309-retningslinjer-for-langsiktige-leveringsavtaler-for-konsumformaal/ and https://www.sildelaget.no/media/80120/Img05016.pdf

individual fishing firms, but rather buyers compete in a centralized auction. This reorganization would likely increase the price in the spot market relative to the case of individual negotiations (when there are limited buyers and many firms selling a relatively homogenous product). The question of *how much* the sales organization impacts the value to fishing firms is an open question.

We focus on auctions vs term contracts in this review. We organize around several themes that emerge in the literature. First, we describe the fundamental relationship between spot prices and forward (term) contracts in the commodities literature. In order to understand this relationship, we provide a brief review of commodities markets, including the role futures play in allowing hedging and mitigating risk. We then turn to understanding various market characteristics and environmental conditions affect the analysis. These include uncertainty over harvest, the role of storage, timing of demand fluctuations, and market power on the demand and supply sides of the market.

In addition to studies specific to fisheries, we draw on examples from other markets including commodities, minerals, and electricity and natural gas. Where possible we point to parallels or differences between fisheries and the market(s) studied in the literature.

Finally, we review the relevant empirical Industrial Organization literature. With detailed transaction-level data, we propose a structural econometric approach that can be used in this study. The final approach taken will depend on the variation in the data, changes in the fraction sold in the auction vs. term contracts, or other market changes over the time period studied.

2.1 Overview

We will refer to the spot price as the price that a particular good can be sold at for immediate delivery. In the application here, the spot price is determined by an auction facilitated by the Sales Organization. Similarly, the forward price is quoted for a particular good to be sold on a future date and at a given location.

Forward contracts are negotiated by two parties (buyer and seller) with opposite positions. In the absence of futures markets, a forward contract carries counterparty risk (the risk of the counterparty on a contract defaulting). Futures markets are often present when the market for forward contracts is sufficiently thick, meaning that there are a sufficient number of active participants on the buyer- and seller-side. A futures contract is a financial contract that does not involve physical delivery of the product and can be used as a risk hedging tool. A futures contract specifies a maturity date, and at the maturity date the owner of the contract gets paid an amount based on the spot price.

In the most basic economic model, the futures price can be calculated by taking the spot price for a given quantity of commodity, adding the storage costs for the specified time, and multiplying the result by *e* raised to the risk-free interest rate multiplied by the time to maturity. That is, if the spot price is *p*, the annual risk-free interest rate is *r*, the number of months for the future contract is *m*, and the storage costs for *m* months is given by *c*, the futures price is simply $(p + c) * e^{(\frac{m}{12} * r)}$. We use the base of the natural logarithm, *e*, to incorporate the time value of money as determined by the risk-free rate.

However, this relationship does not always hold in practice. Markets are forward-looking, individual actors may have different expectations (or risk preferences), and there could be uncertainty about availability of the commodity; imperfect competition; macroeconomic shocks

(or expected fluctuations); or a host of other complications. Much of the empirical literature focuses on studying how the relationship between spot and future prices is affected by these other factors.

An excellent overview is provided in Pindyck (2001), and he lays the theoretical foundation for the dynamics of spot and futures prices. He illustrates how prices, production rates and inventory levels are interrelated through cash markets for the commodity and the market for storage. Changes in these interrelated markets are linked to price volatility, and he discusses the impact and sources of market volatility. The empirical application is to petroleum.

2.2 Examples in Literature

A. Commodities

The primary example of spot vs. forward (and future) markets comes from studies of commodities such as grains. The production of grain is subject to uncertainty due to shocks (e.g. weather, pests), and the price obtained by a producer is subject to considerable uncertainty due to global supply shocks, changes in demand, or macroeconomic concerns such as exchange rate volatility. Others focus on the production choice. For example, Chavas and Holt (1996) develop a framework for studying acreage decisions for soy and corn, taking into account risk preferences, changes in technology and market uncertainty.

There are a large number of producers and little product differentiation, so producers are typically assumed to be facing a competitive market. Moreover, commodities are storable, so the canonical model above provides a reasonable approximation of the conditions facing producers. A large literature attempts to exploit one type of shock to examine the impact on the spot-future relationship or whether different risks can be hedged (e.g. using indices from the Chicago

Mercantile Exchange). A recent example is Bialkowski et al (2018), which focuses on dairy products.

B. Electricity

Tangerås and Mauritzen (2018) develop a theoretical framework to analyze the link between real-time and day-ahead market performance in a hydro-based electricity market. Because producers could strategically hold back water in reservoirs, there could be room for market manipulation. They find sufficient evidence to reject a competitive market, but their findings could be consistent with risk aversion as well as market power.

Electricity markets are fundamentally different from commodity markets, as electricity is not storable (at least economically at scale with current technologies). In the case of production from fossil fuels or renewables with intermittent production (e.g. solar, wind), the timing of production is critical, and the literature focuses on market efficiencies/inefficiencies due to the regulatory environment or market power.

Bushnell et al (2008) study electricity markets but focus on vertical structure (as opposed to horizontal market power). Vertical structure refers to the number of buyers and sellers at different points in the supply chain. Horizontal structure, in contrast, refers to the number of market participants at one level, such as the number of fishers and the presence of market power. Vertically-integrated wholesalers (i.e. those with long-term contracts) have less incentive to raise wholesale prices when retail prices are determined beforehand. They simulate bounds on the range of static oligopoly prices using three restructured markets, and they find that vertical arrangements have a substantial impact on market outcomes. Their study suggests that horizontal market structure accurately predicts market performance only when vertical structure is properly modeled.

C. Fisheries Literature

Among studies of fisheries, relatively few studies are directly relevant. Asche et al (2016) examine the spot-forward price relationship for Atlantic salmon market using N Sea Herring Pool data. They find that spot and lagged futures prices are cointegrated but that movements in the spot price affect futures prices, which they attribute to the market being relatively new. They do we do not find support for the hypothesis that futures prices provide a price discovery function, but rather that spot prices influence futures prices. In mature commodities markets the futures prices should offer an unbiased prediction of future spot prices, which informs both buyers and sellers as they make input decisions.

A few studies focus on the impact of the *type* and *extent* of auctions on the price for fish (e.g. Gallegati et al 2011, Guillotreau et al 2011), but these studies do not consider the joint impact of auctions and contracts simultaneously.

Helstad et al (2005) study the relationship between contract and auction prices for fresh and frozen fish in Northern Norway. They use monthly prices for size-graded cod and haddock between 1997–2003. The study focuses on the statistical relationship between prices, and they find that the auctioned product prices were higher than for term contracts. Their empirical setup does not allow one to determine whether the increased use of auctions also increased prices of the contract prices. And while they discuss the importance of market power (or the number of agents on either side of the market), their empirical analysis does not consider these impacts.

D. Empirical Industrial Organization

Few studies directly address the core question: how does the Sales Organization affect the value to fishers? Or, stated differently, what share of sales in the spot market would maximize the value to fishers? There are, however, studies from the empirical industrial organization (IO) literature that gives us guidance on a structural approach to determine how auctioning (or the share of output put in auction vs. term contracts) affects the value received by fishing firms.

One empirical example is in Bajari et al (2008), which studies auction vs. contract negotiations. They study how the outcome depends on the market structure, including the number of market participants. Their application is to procurement contracts by California, but the empirical strategy could be extended to other markets.

Another direct comparison of auctioning and negotiated prices is in Chow et al (2015). Their model is of real estate pricing, though their model could potentially be extended to other markets. They show in theory and empirically (using data from Singapore) that auctions generate a higher price than negotiated sales when demand is strong and when the asset being sold is more homogenous.

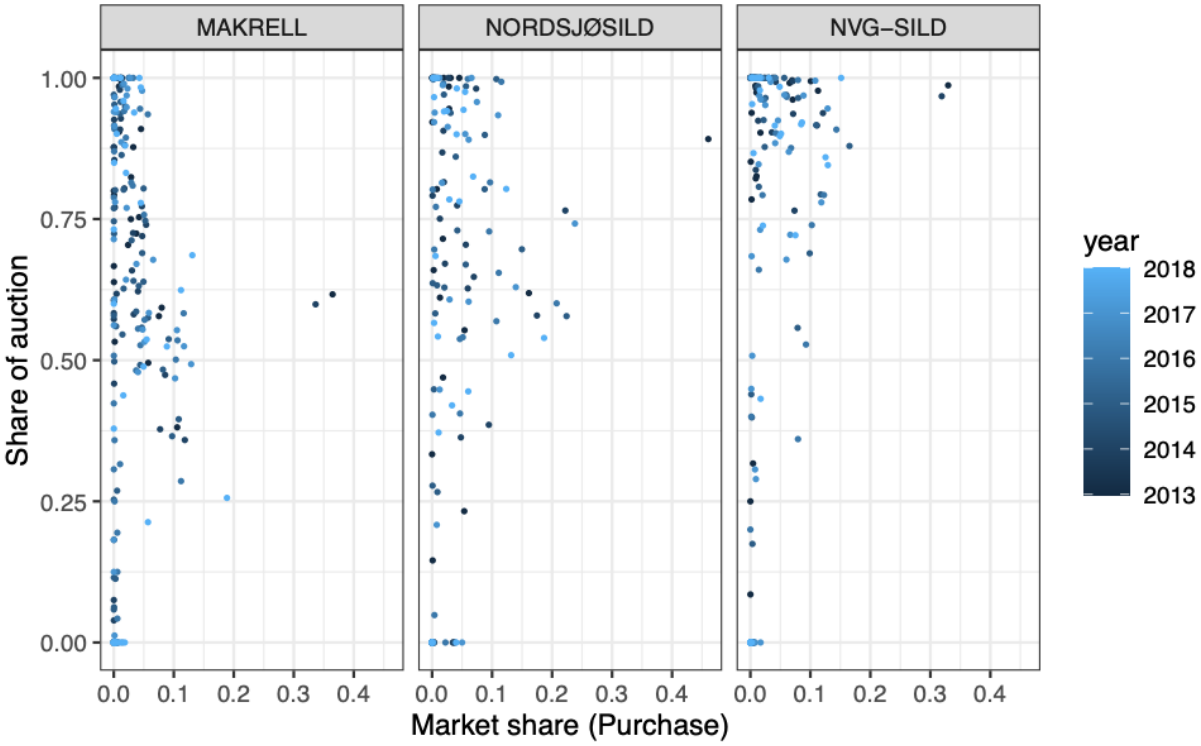
A structural econometric model of a multi-seller auction would be possible, but that is beyond the scope of this preliminary analysis. In what follows we provide reduced-form estimates of the impact of market characteristics on the price paid by buyers.

3. Descriptive Analysis

3.1 Market Structure

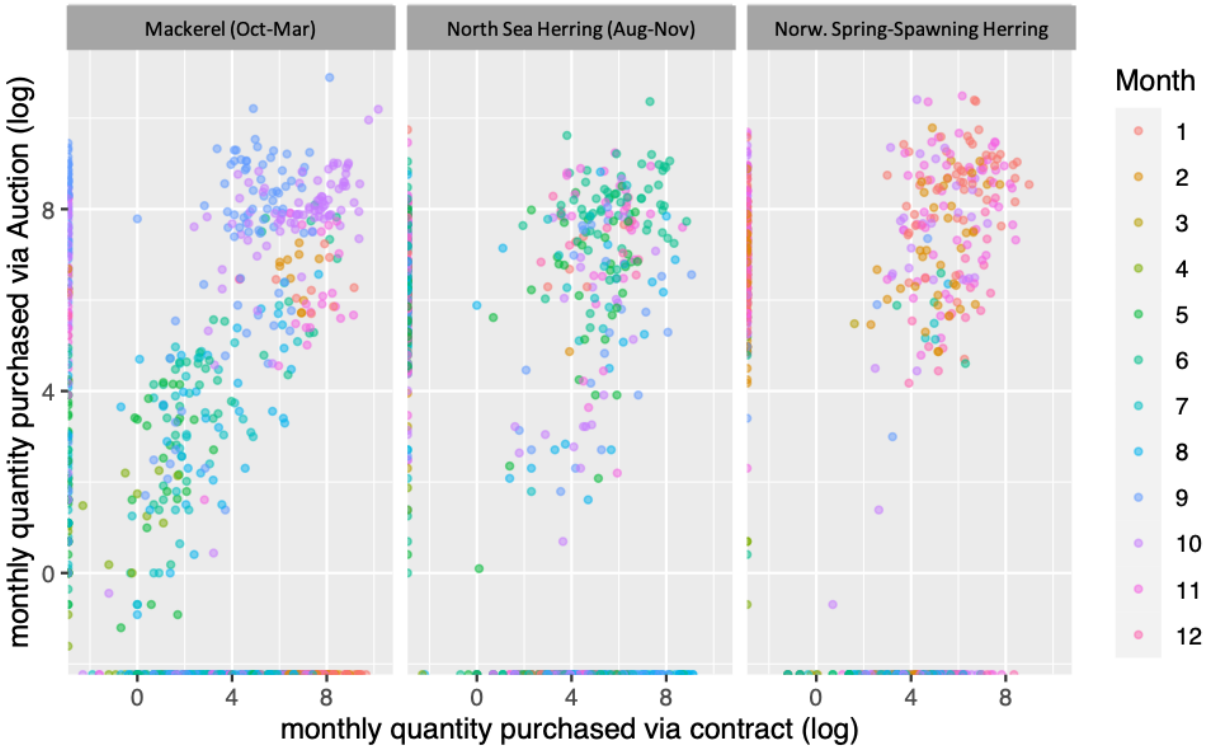
The sales organizations fundamentally change the structure of the marketplace by forming cooperatives that give fishers, collectively, more market power than if they were to operate competitively. It is also important to consider the role of buyers in determining prices in each market. In Figure 1a the share of the sales in auction is plotted against the market share by buyers separately for mackerel, North Sea herring (NSH) and Norwegian spring-spawning herring (Norsk vårgytende, hereafter NSSH). Figure 1b plots auction quantities against contract quantities by month and excludes month-species combinations where no contracts are allowed. In general there is a positive relationship between the proportion in auction and the market share of buyers. That is, the proportion auctioned increases as the market share of buyers increases. This is an important factor to consider in the following section when we model bidding behavior and subsequently analyze the role of auctions in determining the value of harvest.

Figure 1a: Market Composition



Notes: The figures plot, for mackerel, North Sea herring and NSS herring, the share of the market in auction plotted against the market share of buyers.

Figure 1b. Market Composition, Excluding Months/Species with Auction Requirement

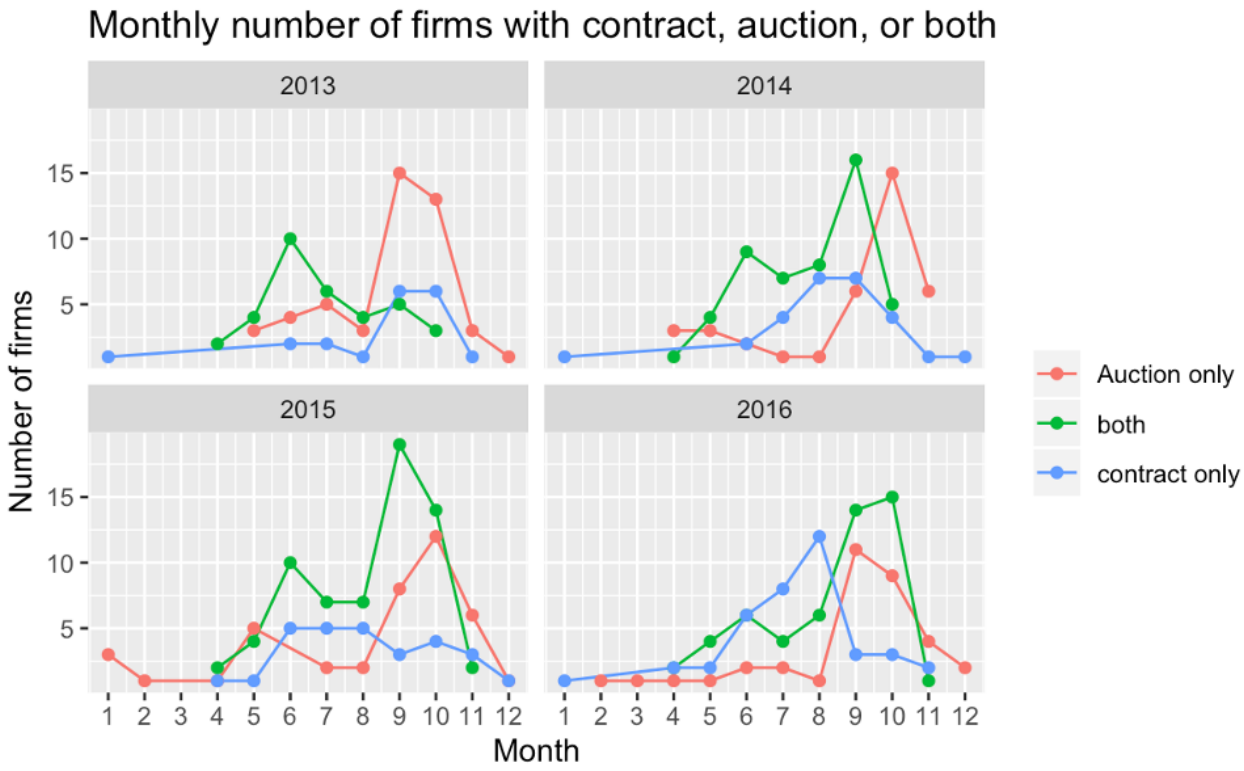


Notes: The figures show, for mackerel, North Sea herring and Norwegian spring-spawning herring, the share of the market in auction plotted against the market share of buyers. Month/Species groups with no contracts permitted are excluded.

Figure 1b shows a general positive relationship between the quantity sold in auction and the quantity sold in contracts for mackerel, NS and NSS herring. In Figure 2 we show participation by buyers in contracts, auctions and both for years 2013-16. There are some firms that participate in auctions and buy through contracts; in some months more buyers are participating in auctions and contracting for some purchases than utilizing only auctions. In mid-2016 there were more buyers exclusively using contracts than exclusively going to auction. In the next section we explore the drivers of bidding behavior for different species and then examine the drivers of prices in

contracts and auctions. But first we will summarize trends in prices and the share of total harvest sold at auction for key species.

Figure 2. Buyer Participation in Auctions and Contracts



Notes: Data from NSS. Monthly number of buyers participating in auctions and/or contracting with fishers for mackerel, North Sea herring and Norwegian spring-spawning herring.

Prices and Quantities

1. **Mackerel**

We now illustrate trends with descriptive measures of quantities and prices (mean and standard deviation) for Mackerel and NSSH. We illustrate each descriptive statistic for auctioned and contract sales. The plots in Figure 3 show illustrate prices and market trends for mackerel. Figure 3a shows the quantities harvested since 2001, and figure 3b shows the share auctioned each month; the majority of mackerel is sold at auction, though there has been an increasing trend in

the share of contract sales in recent years. Figure 3c excludes vessels that are exempt from the auction requirement, and the trend looks similar. Figure 3d illustrates the quantities of mackerel sold in auction and through contracts in September and November of each year 2013-2018.

The effect of auctions, and hence the role of the sales organization in adding value, may best be illustrated in mackerel. The catch is concentrated in September and October due to seasonal migration patterns and the high fat content, which commands a higher price. As described in the background section, delivery agreements in the form of term contracts are allowed between January 1st and March 31st and between October 1st and December 31st. In September most participating vessels must sell in the auction, but in November term contracts are also allowed. This is shown in the sales data graphically in Figure 3d and 3e, and we will return to this point in the empirical analysis.

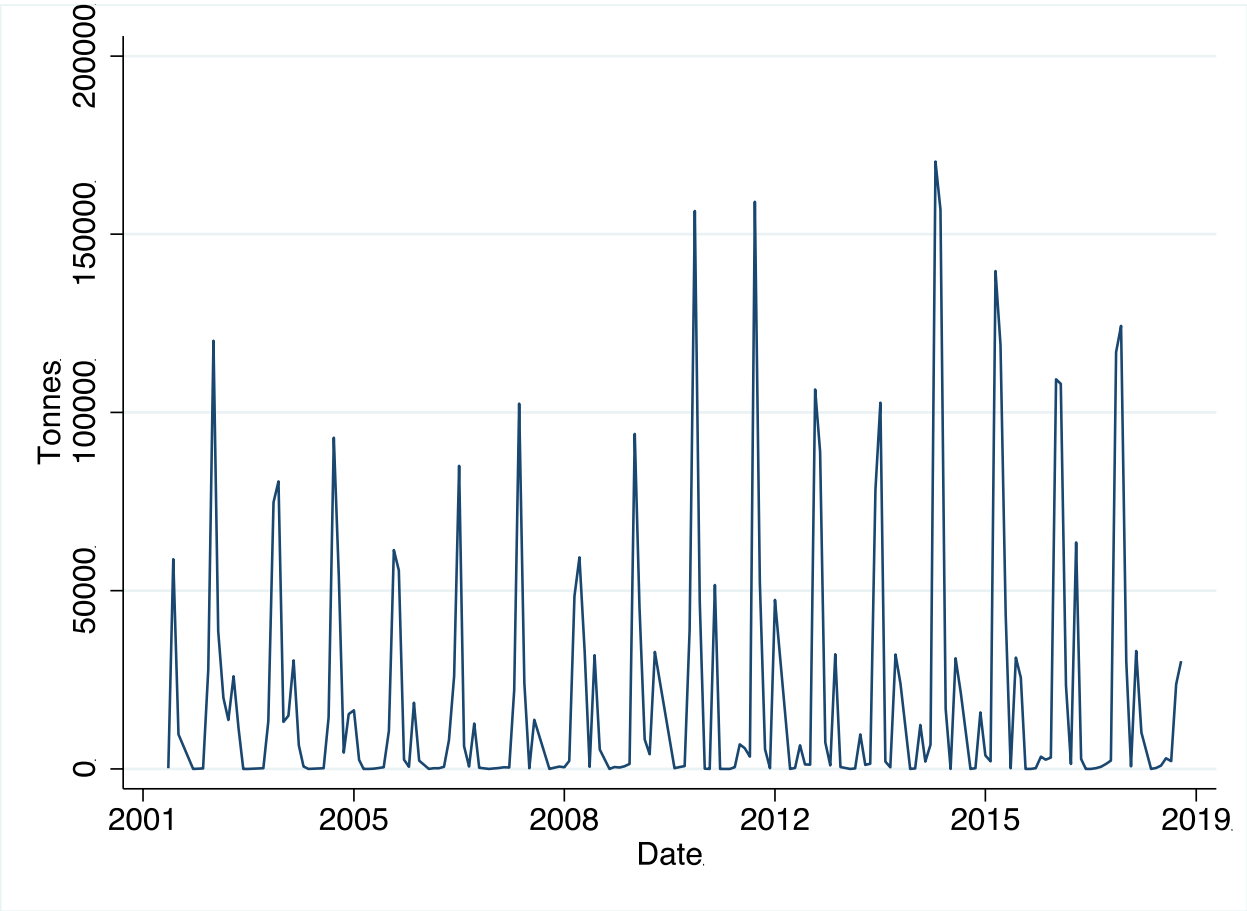
2. NSS Herring

Average monthly prices and corresponding standard deviations are shown for NSSH in Figures 4a-4d. Auction prices tend to be higher, but there is year-to-year variation in the magnitudes and the difference between auction and contracted prices.

3. Saithe and Cod

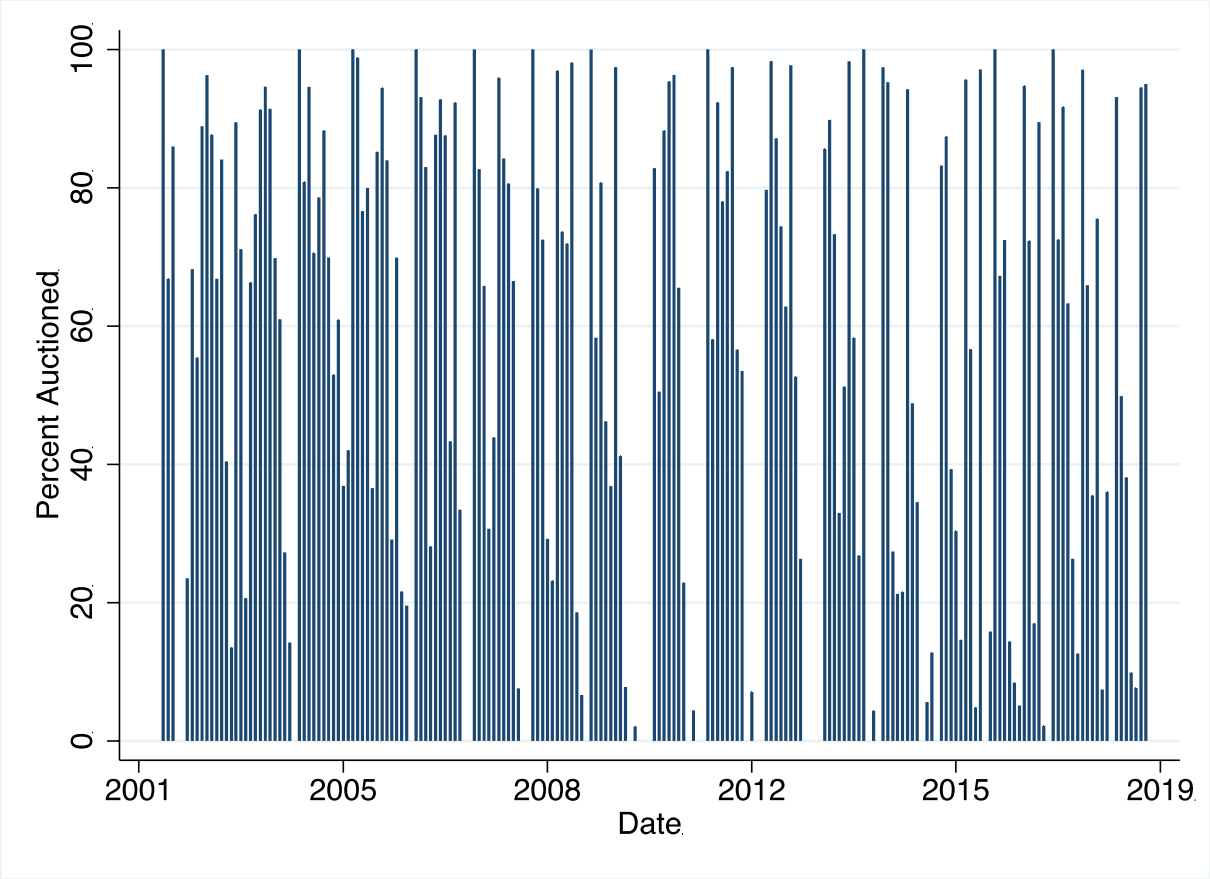
We now plot the same trends for saithe and cod in Figures 5a-c and 6a-c, respectively. While there are also fluctuations in harvest over the decade shown, importantly for our study there appears to be a decreasing share of harvest being sold at auction for both saithe and cod. Prices for contracted sales tend to track auction prices for both species, and in both cases the auctioned price appears to be generally higher. We now move to a more formal analysis of bidding behavior and the determinants of prices.

Figure 3a. Monthly Mackerel Harvest



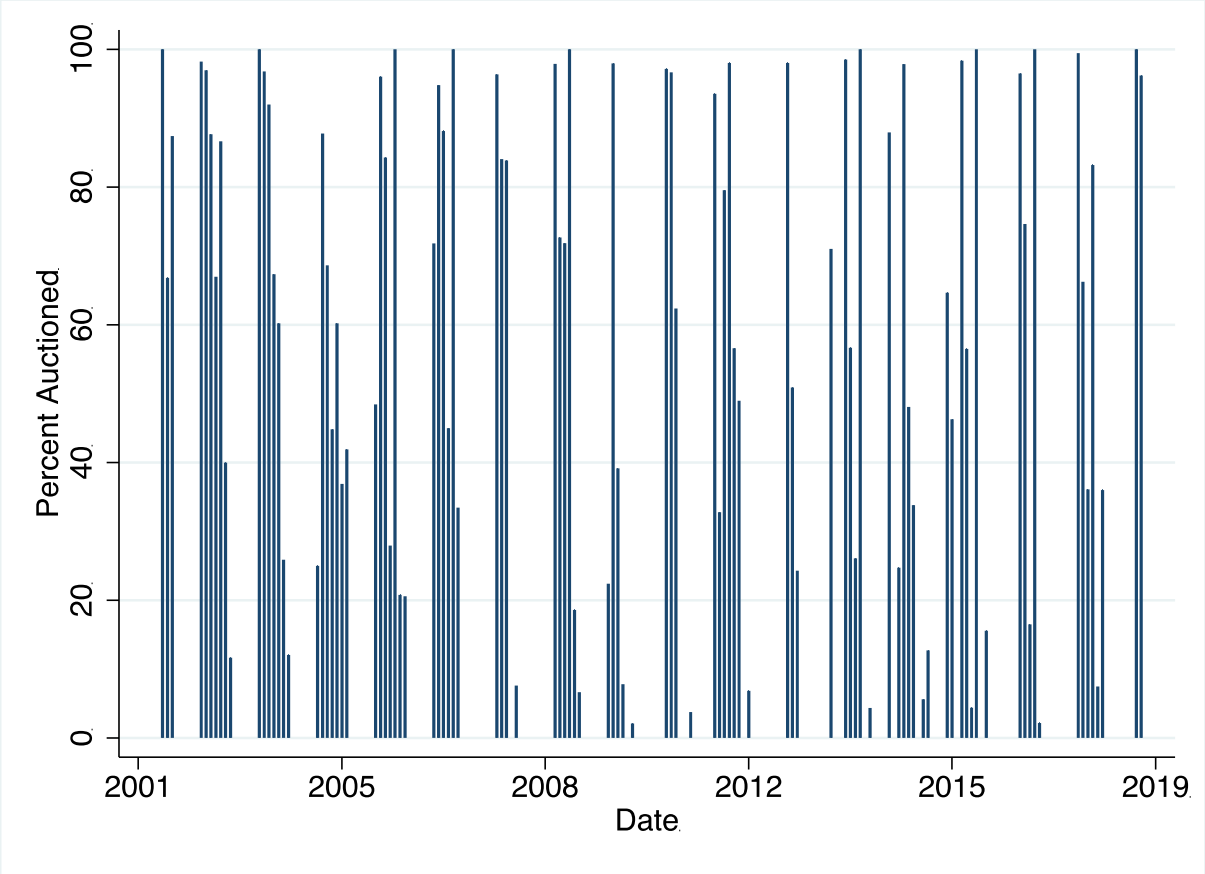
Notes: Data from NSS. Monthly total mackerel harvest in metric tonnes.

Figure 3b. Percent of Monthly Mackerel Harvest Sold at Auction



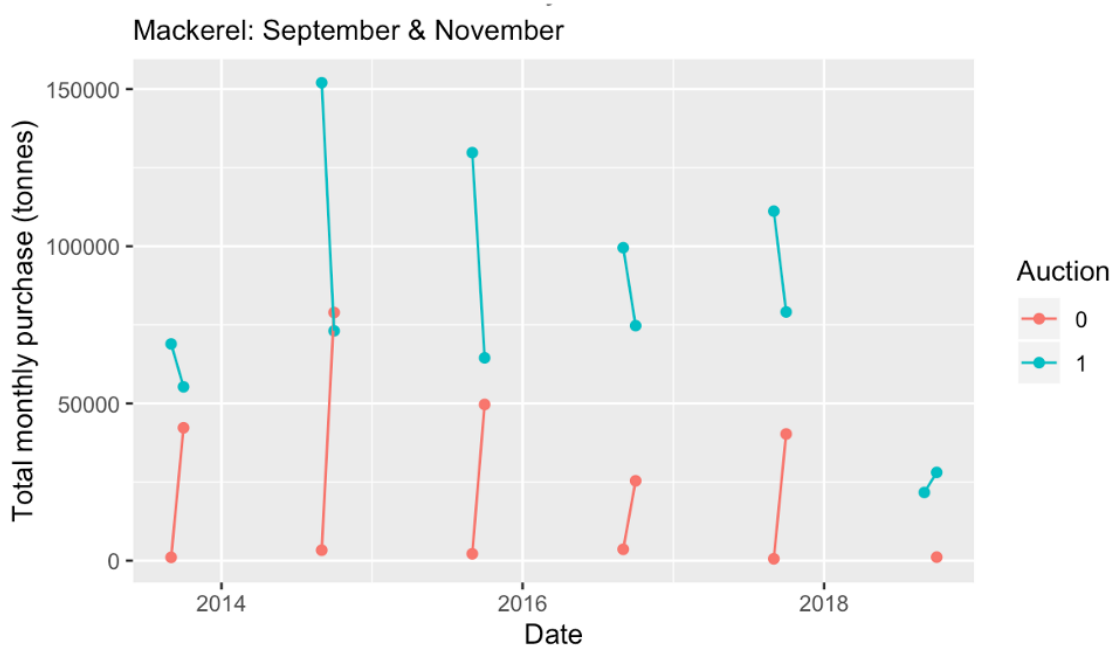
Notes: Percent of overall harvest of mackerel that was sold at auction. Data from NSS. Author's calculations.

Figure 3c. Percent of Monthly Mackerel Harvest Sold at Auction, Excluding Exempt Vessels



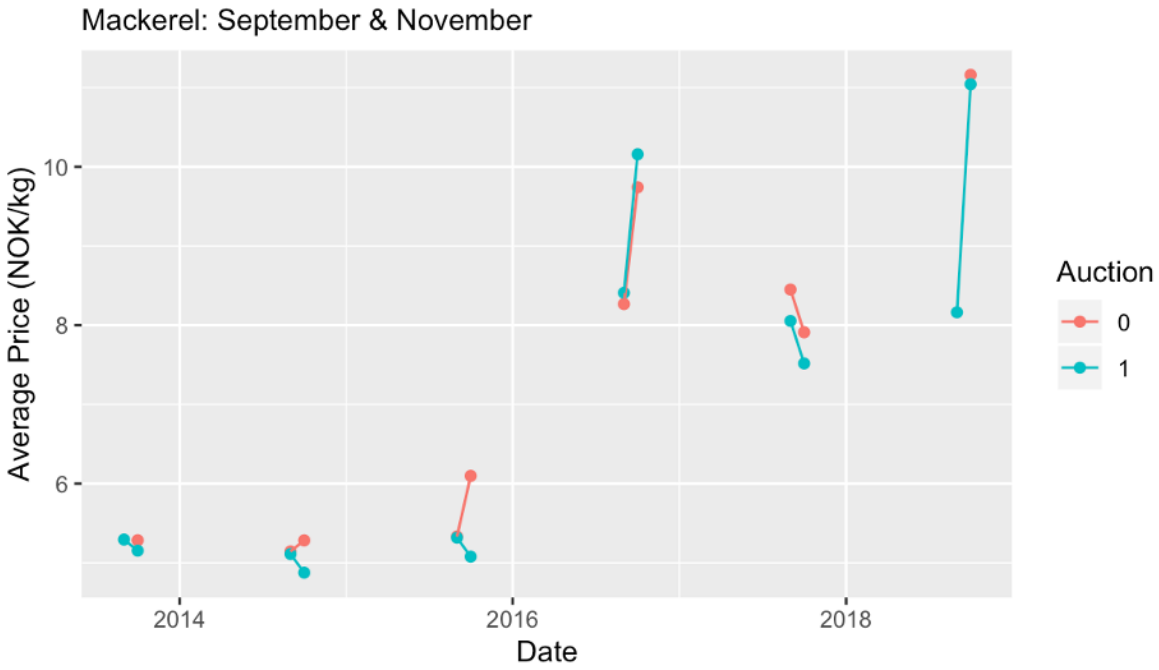
Notes: Percent of overall harvest of mackerel that was sold at auction, excluding vessels exempt from auction requirement. Data from NSS. Author's calculations.

Figure 3d. Mackerel Quantities Sold by Auction and Contract in September and November



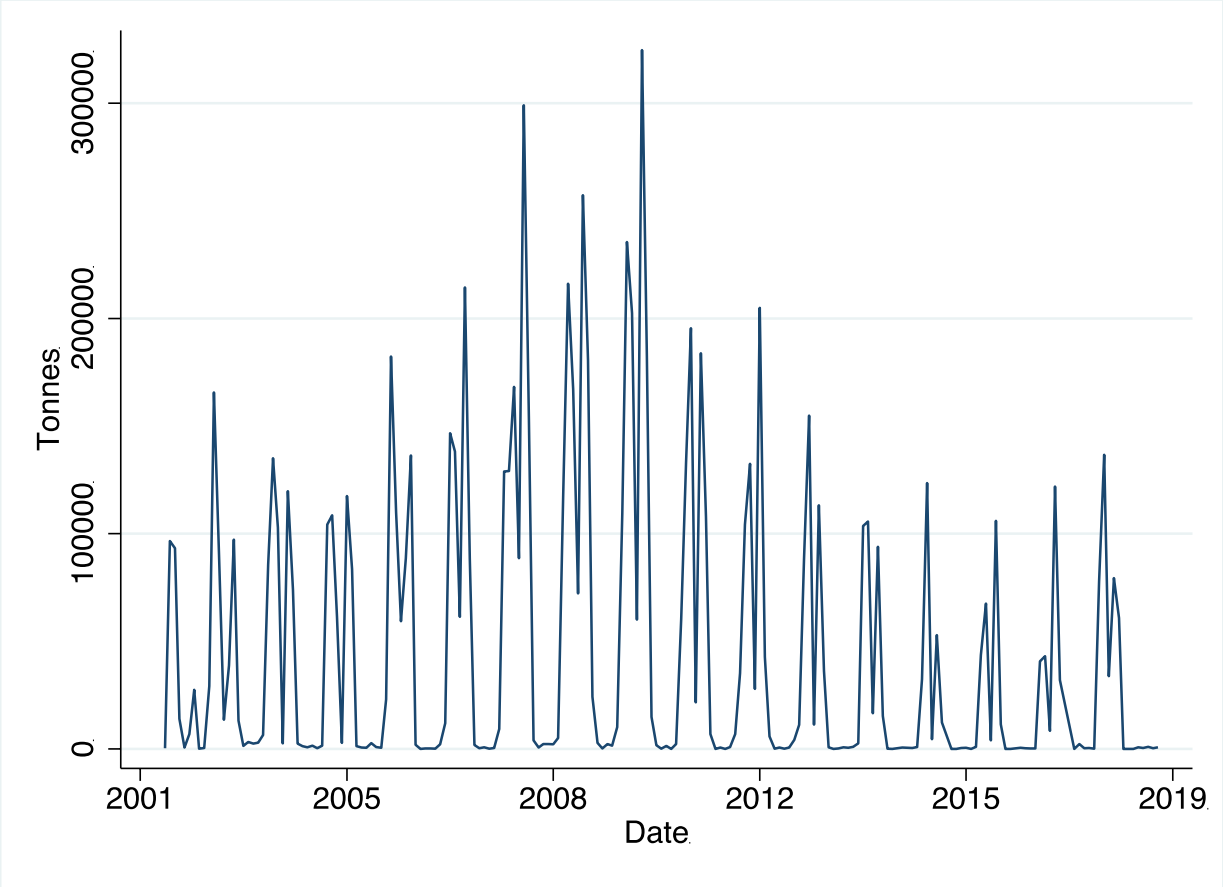
Notes: The figure shows the total quantities sold in contract (Auction=0) and auction for September and November in each year of 2013-18. In September most participating vessels must sell in the auction, but in November term contracts are also allowed.

Figure 3e. Fall Mackerel Average Prices for September and November



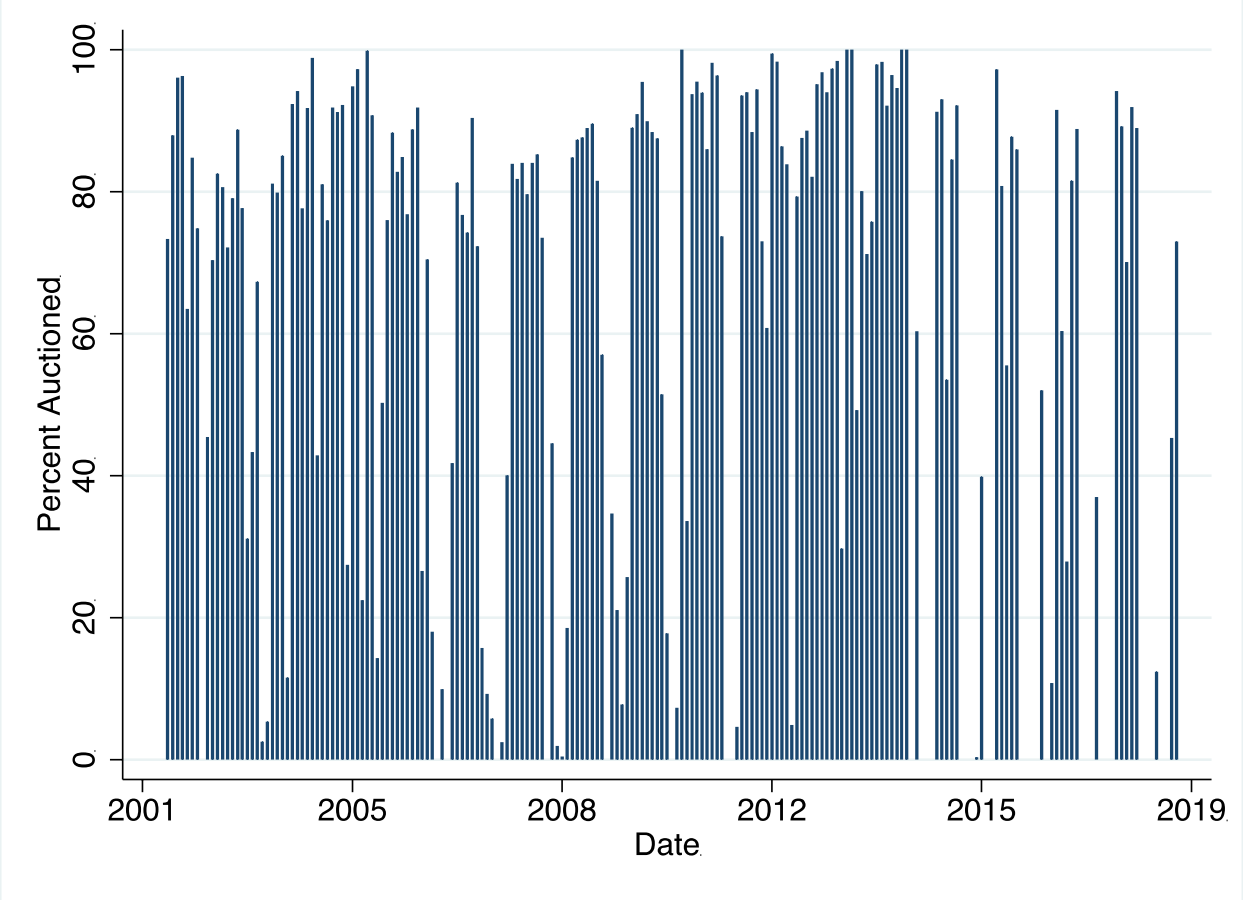
Notes: The figure shows the total quantities sold in contract (Auction=0) and auction for September and November in each year of 2013-18. In September most participating vessels must sell in the auction, but in November term contracts are also allowed.

Figure 4a. Norwegian Spring-Spawning Herring Harvest



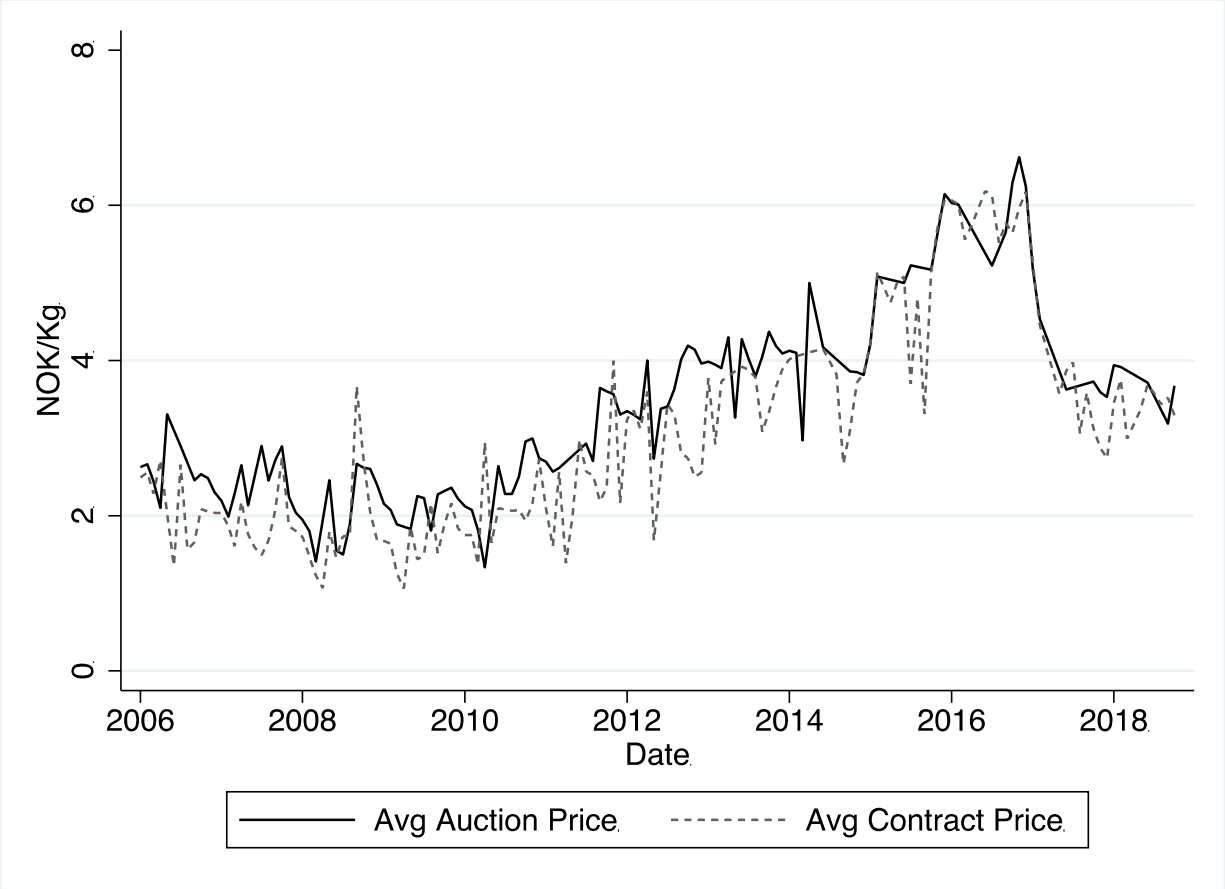
Notes: Total Norwegian spring-spawning herring harvested. Data from NSS. Author's calculations.

Figure 4b. Percent of Norwegian Spring-Spawning Herring Harvest Sold at Auction



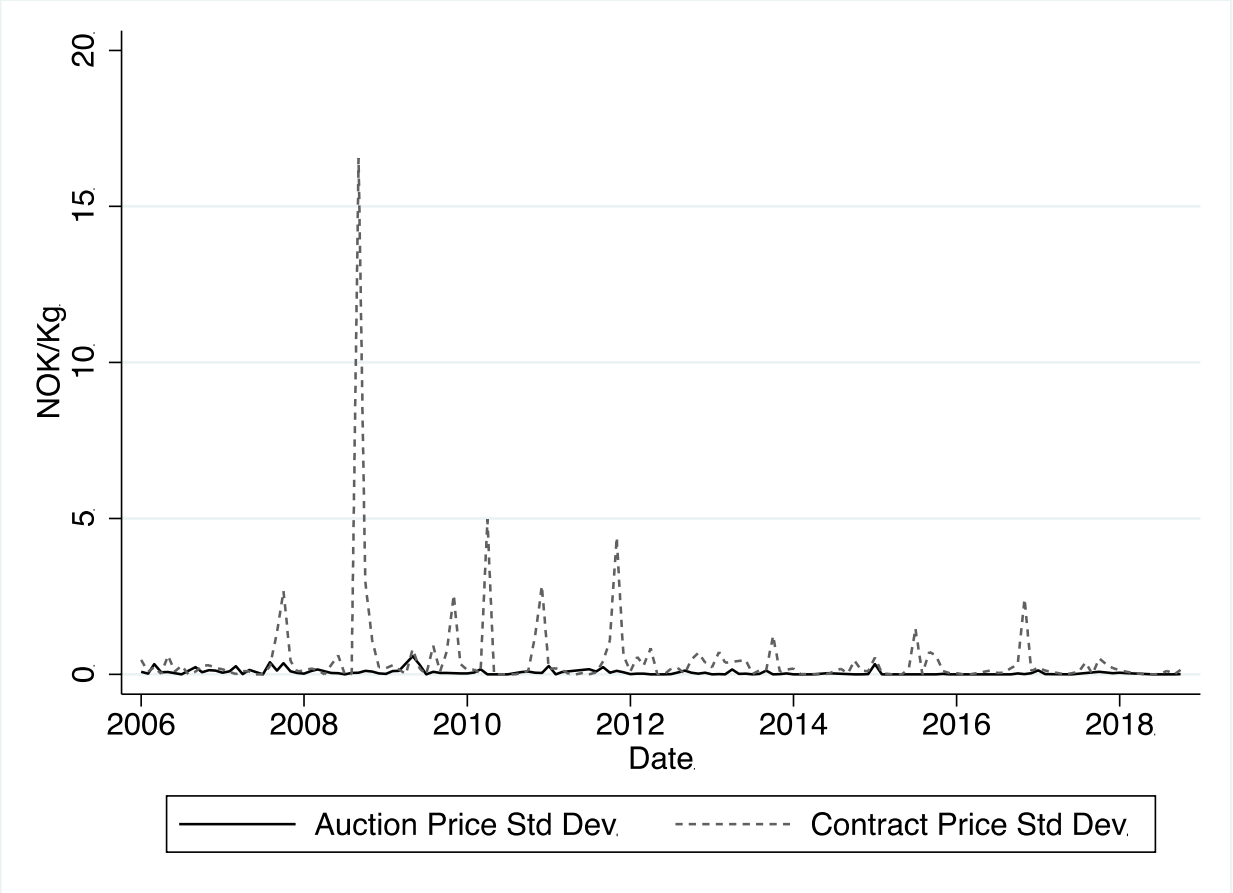
Notes: Percent of overall harvest of Norwegian spring-spawning herring that was sold at auction. Data from NSS. Author's calculations.

Figure 4c. Prices for Norwegian spring-spawning herring



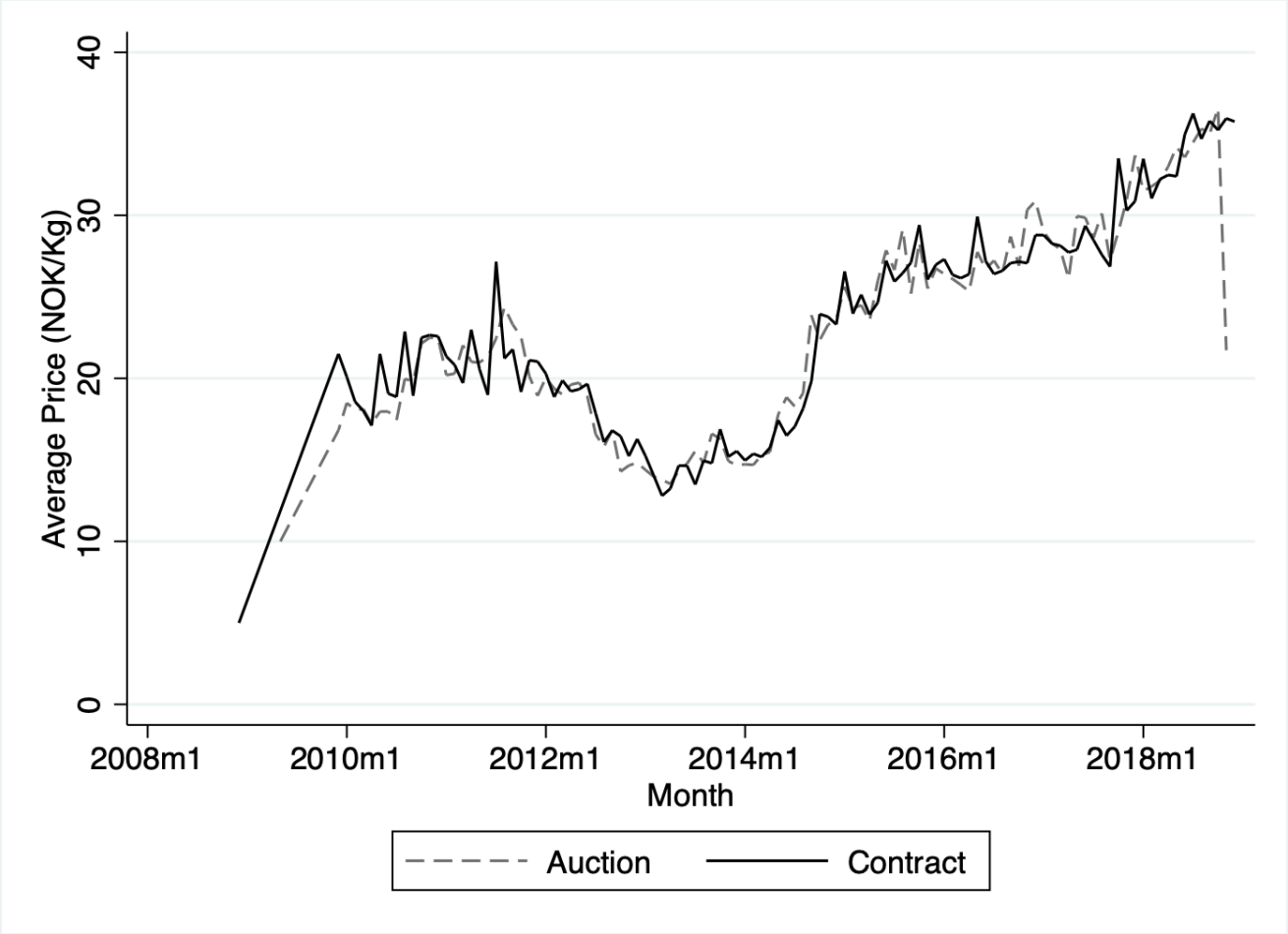
Notes: Monthly mean price of Norwegian Spring-Spawning Herring, by sales method. Data from NSS. Author's calculations.

Figure 4d. Standard Deviations of Prices for Norwegian Spring-Spawning Herring



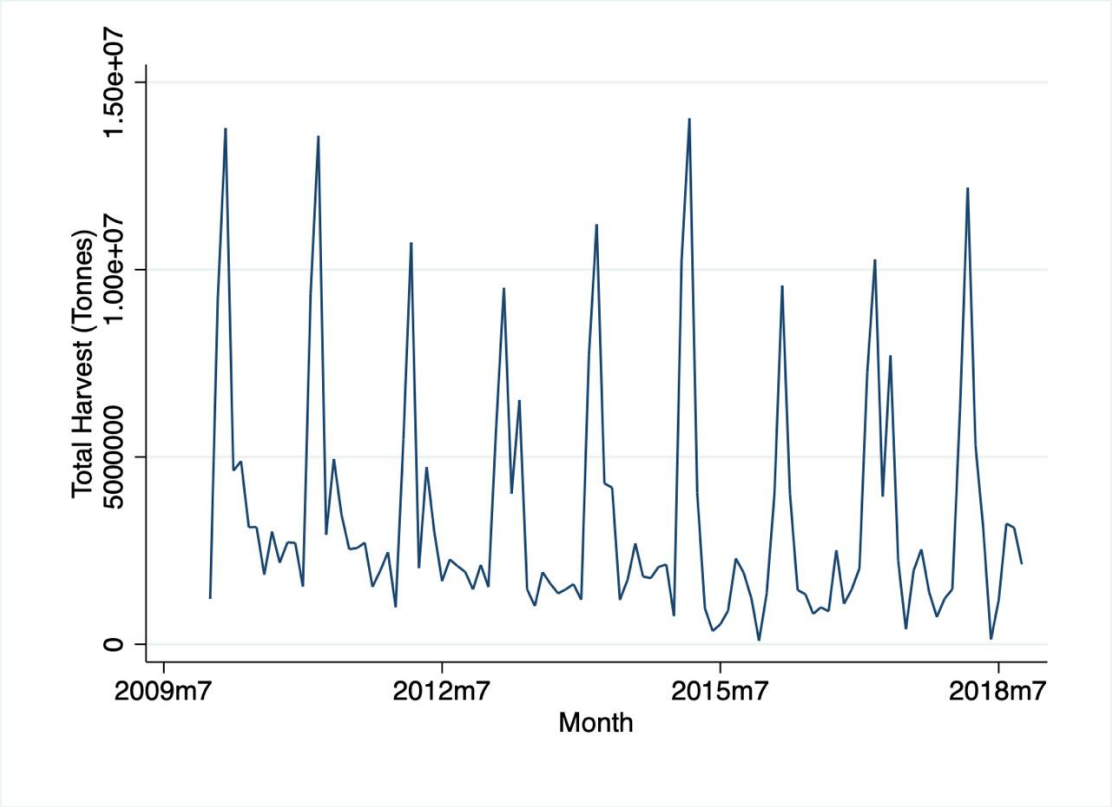
Notes: Monthly price standard deviation for Norwegian spring-spawning herring, by sales method. Data from NSS. Author's calculations.

Figure 5a. Monthly Average Saithe Prices



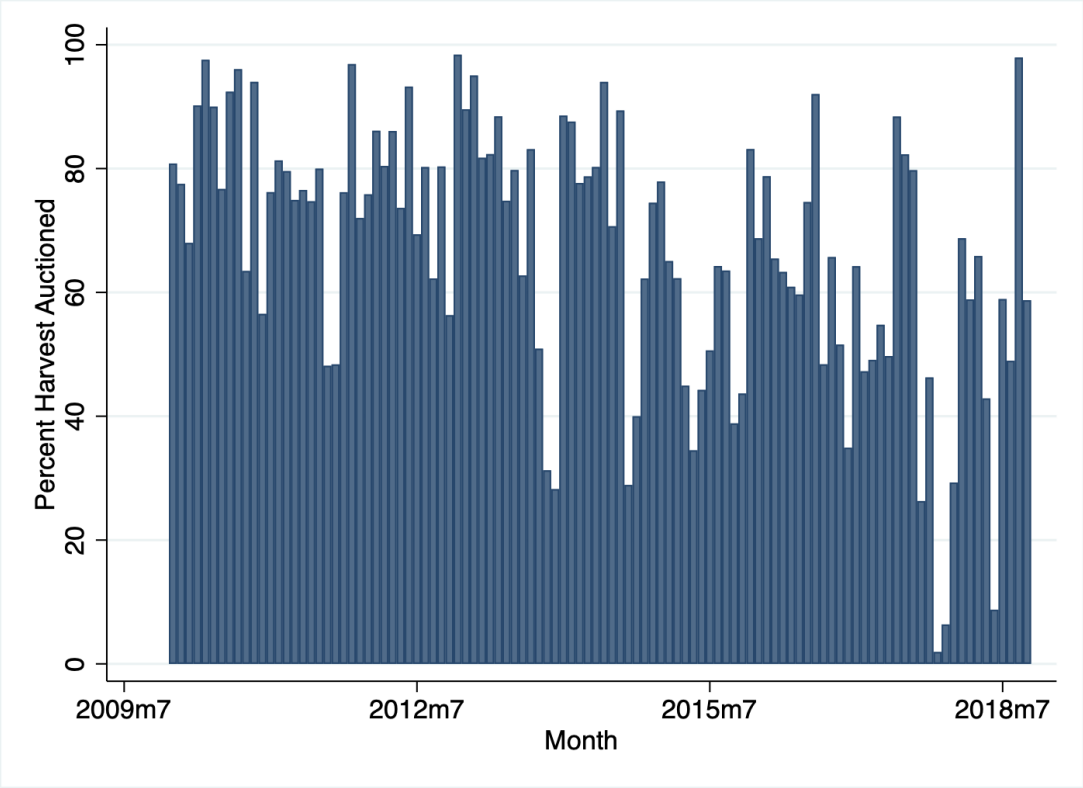
Notes: Average monthly saithe price, by sales method. Data from SUROFI.

Figure 5b. Saithe Harvests



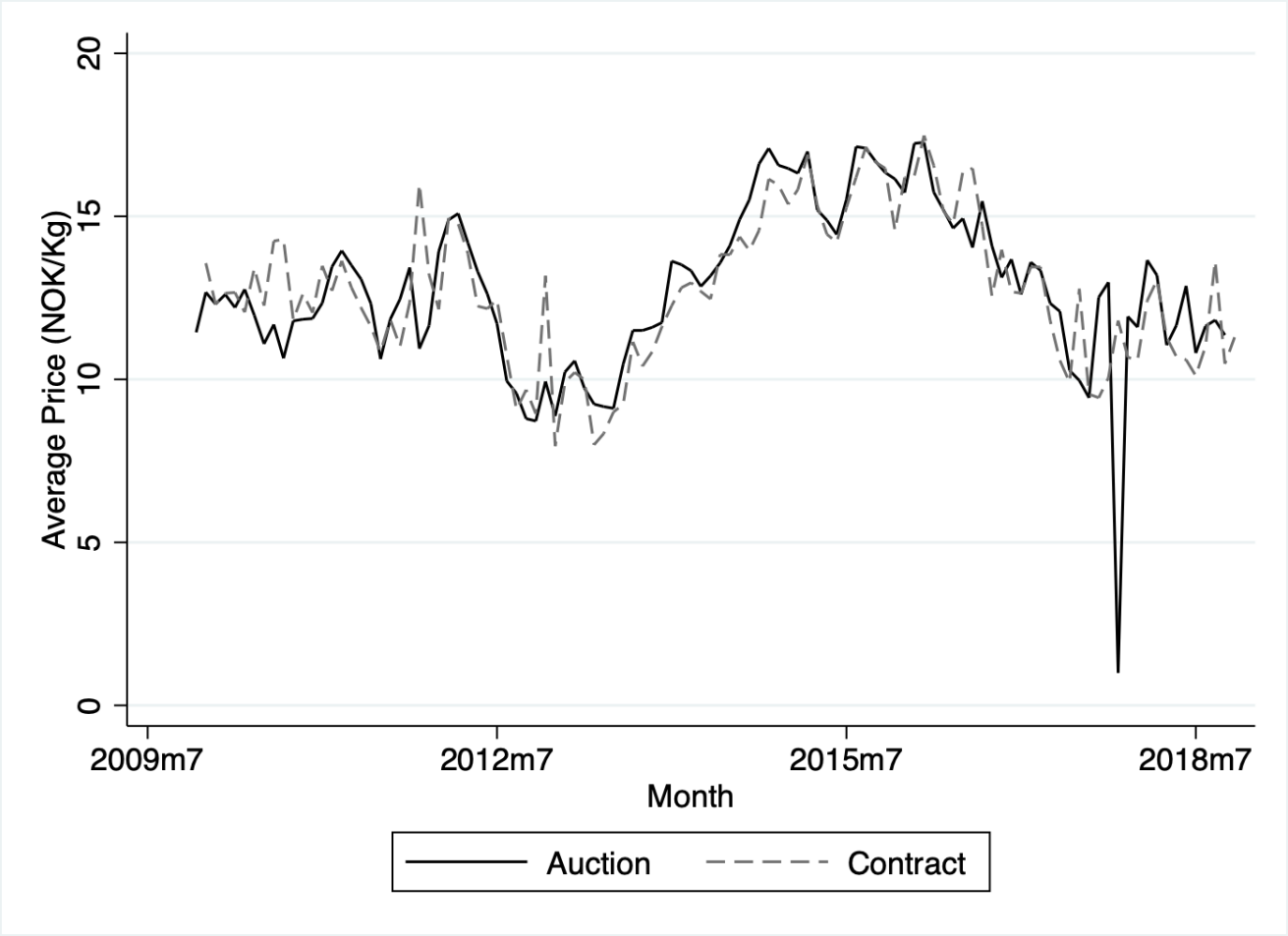
Notes: Total monthly saithe harvest. Data from SUROFI.

Figure 5c. Share of Total Saithe Harvest Auctioned (Monthly)



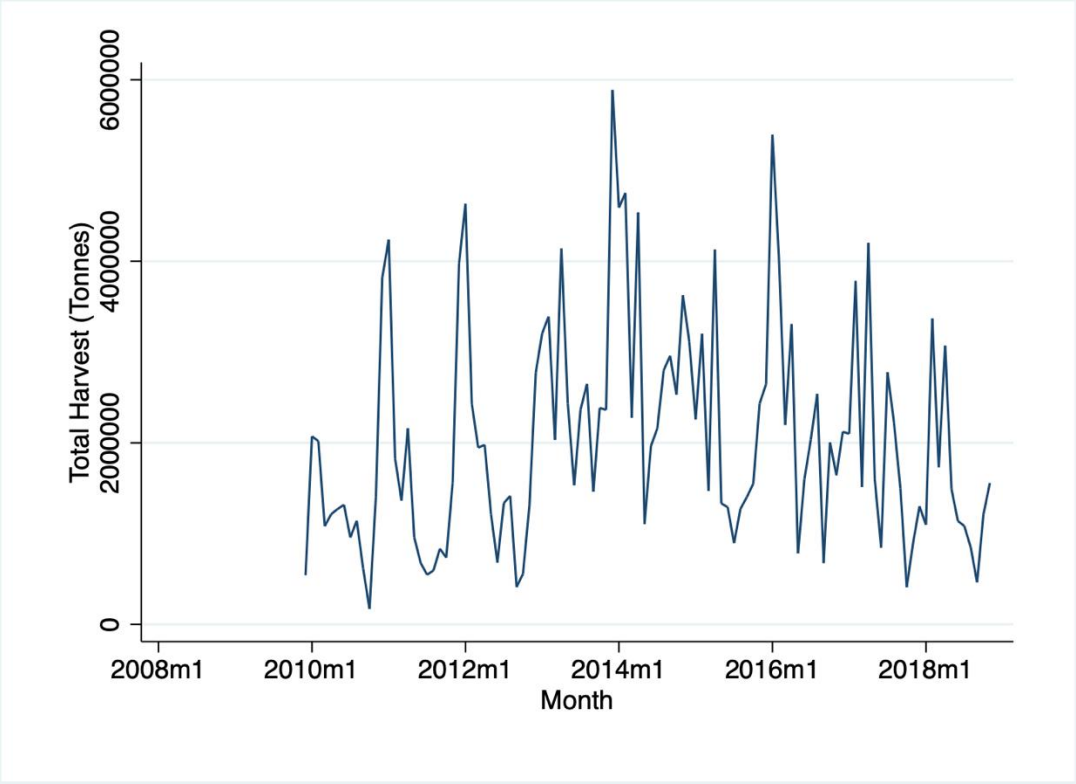
Notes: Share of total monthly saithe harvest sold in auction. Data from SUROFI.

Figure 6a. Monthly Average Cod Prices



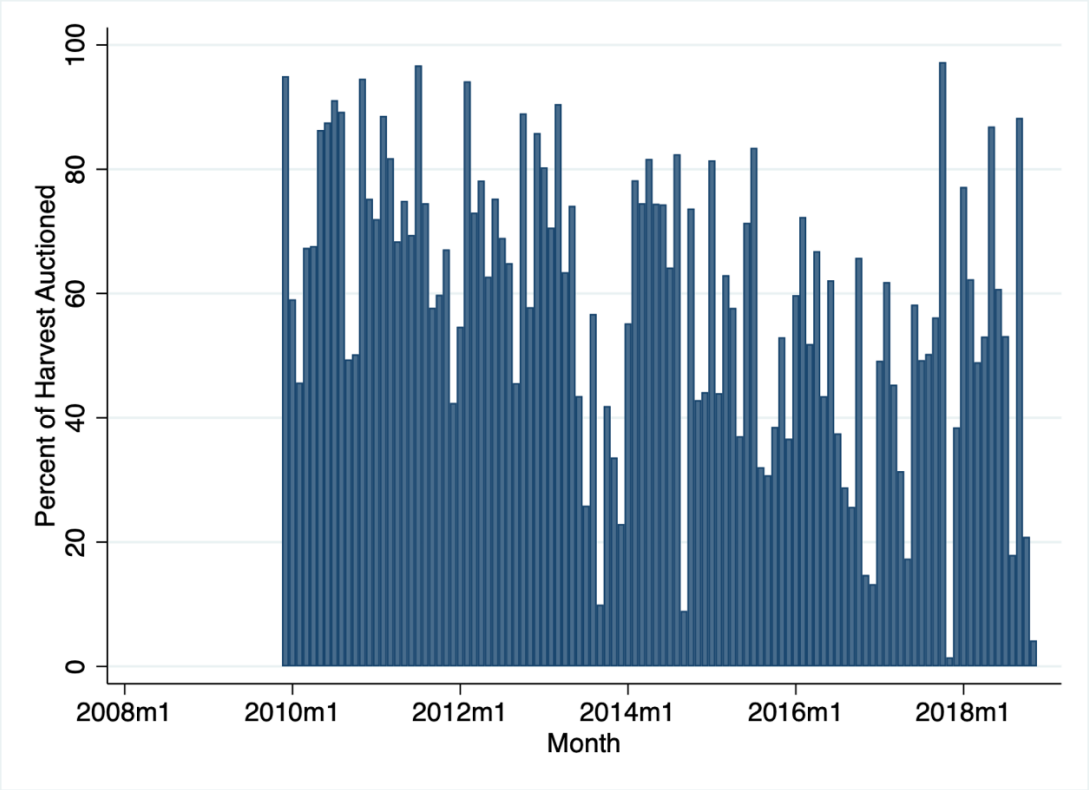
Notes: Prices are measured in NOK/Kg. Data from SUROFI. Author's calculations.

Figure 6b. Cod Harvests (Monthly)



Notes: Total monthly cod harvest. Data from SUROFI.

Figure 6c. Share of Cod Auctioned (Monthly)



Notes: Share of total monthly cod harvest sold in auction. Data from SUROFI.

4. Analysis of Prices

How does the sales organization structure affect the value for different market actors in Norway? The review of the literature suggests that the primary impact would be on the price received by sellers. All else equal, if fishers organize and coordinate, that should shift the balance of market power toward the sellers. Rather than a system of many buyers purchasing from many sellers through bilaterally-negotiated transactions, the sales organization system creates an auction system, where prices are known to other sellers and whereby the use of term contracts is limited.

4.1 Buyers' Bidding Behavior

We proceed by estimating a model of bidding behavior for buyers as a function of market factors, including the number of bidders in an auction, the quantity sold (tonnes), and the total quantity auctioned in the previous day. Because an individual buyer's bidding strategy would likely depend on the quantity auctioned in the previous day, we include that measure as well.

There are likely unobserved, "fixed" and invariant characteristics that influence prices. Put differently, our aim is to understand how firms bid in an auction, while holding constant the time-invariant characteristics that make each firm unique. We also control for the characteristics of the product being sold in auction.

We take a standard "fixed effects" econometric model that controls for contemporaneous shocks with year fixed effects, seasonality with month fixed effects, and buyer- and vessel-specific fixed effects to absorb any unobserved time-invariant heterogeneity. We also control for product type (fresh/frozen) as well as the product purpose (human consumption or fish oil/meal).

We estimate species-specific specifications, with each column illustrating the results for one species group. We are interested in estimating a regression of the following form:

$$ln(B_{ijtmy}) = \beta_1 \mathrm{N}_t + \beta_2 \mathrm{Q}_{it} + \beta_3 \mathrm{A}_t + \beta_4 \mathrm{P}_{j,t-1} + \varphi_j + \mu_m + \gamma_y + \delta_i + \varepsilon_{ijt}$$

where the dependent variable is the natural log of the bid for vessel *i*'s harvest by bidder *j* on date *t*, month *m*, and year *y*. We assume that it is linear in a suite of control variables, including the number of bidders (N), the quantity Q being sold by *i*, A is the number of auctions that day for the same species, and $P_{i,t-1}$ represents the purchase by bidder *j* the previous day. We allow for common contemporaneous shocks (month and year fixed effects), buyer fixed effects, seller fixed effects, and an idiosyncratic error.

The inclusion of fixed effects allows us to isolate within-individual variation over time. The vessel fixed effects also indirectly hold constant the regulatory group to which a vessel belongs, and the time fixed effects ensure that we are isolating variation within a month and year.

Tables 1 and 2 illustrate the regression results using data from NSS. Table 1 restricts the sample to harvest from purse seiners, while Table 2 includes all vessels. In addition, Table 2 includes a specification restricted to Fall months for mackerel, when there is variation in rules regarding auction participation.

The regressions explain a large share of the variation in the bidding price (Adjusted R^2 ranging from 0.7 to 0.85). For mackerel, each additional bidder is associated with an increase in the bidding price of 0.7 percentage points for purse seiners and 0.9 percentage points in the 'all vessels' specification in Table 2. Buyers tend to bid less when there are more auctions taking place, which is the result of increased competition among fishers. And buyers tend to bid less when they purchased large quantities in the previous auction.

Table 1. Bidding Behavior (Purse Seiners)

	(1)	(2)	(3)
	Mackerel	N Sea Herring	NSSH
Number of Bidders	0.0070***	0.0137***	-0.0029
	(0.0009)	(0.0031)	(0.0017)
Quantity (thousands of metric tonnes)	0.0062	0.0640*	-0.0140
	(0.0083)	(0.0253)	(0.0143)
Number of Auctions	-0.0005***	-0.0017**	-0.0002
	(0.0001)	(0.0005)	(0.0003)
Total Lagged Purchase (thousands of tonnes)	-0.0037***	-0.0002	-0.0064***
	(0.0005)	(0.0039)	(0.0013)
Adjusted R-Squared	0.8294	0.7393	0.8487
N	12151	4599	4070

Notes: Data from NSS. Each column represents a separate regression. The dependent variable in each column is the natural log of the price per kilogram. In addition to the independent variables shown, each specification also controls for fixed effects for fisher, month fixed effects, year fixed effects, and the type of product. Heteroskedastic-robust standard errors shown in parentheses. *,**,*** denote significance at the 5%, 1%, and 0.1% levels, respectively.

Table 2. Bidding Behavior, All Vessels

	(1)	(2)	(2)	(3)
	Mackerel		N Sea Herring	NSSH
Number of Bidders	0.0090***	0.0072***	0.0072*	0.0043**
	(0.0012)	(0.0008)	(0.0033)	(0.0014)
Quantity (thousands of tonnes)	-0.0044	-0.0010	0.1745**	-0.0054
	(0.0110)	(0.0105)	(0.0515)	(0.0087)
Number of Auctions	-0.0005***	-0.0004***	-0.0016***	-0.0003
	(0.0001)	(0.0001)	(0.0004)	(0.0002)
Lagged Purchase (thousands of tonnes)	-0.0030***	-0.0029***	0.0002	-0.0074***
	(0.0005)	(0.0005)	(0.0052)	(0.0010)
Adjusted R-Squared	0.8107194	0.8294	0.7038491	0.8091226
Seasons Included	All	Fall	All	All
N	14893	12151	6935	7596

Notes: Data from NSS. Each column represents a separate regression. The dependent variable in each column is the natural log of the price per kilogram. In addition to the independent variables shown, each specification also controls for fixed effects for fisher, month fixed effects, year fixed effects, and the type of product. Heteroskedastic-robust standard errors shown in parentheses. *,**,*** denote significance at the 5%, 1%, and 0.1% levels, respectively.

We estimate analogous models for saithe and cod, respectively, using data from SUROFI. The results are qualitatively similar, despite the different characteristics of the market. Each additional bid increases the price in auction by 4.3% for Saithe (again holding quality, size, product type, buyer, seller, year and month constant). The magnitude of the impact for Cod is virtually identical at 4.3%. The results indicate that an increase in competition among buyers increases the price received in auction. In the saithe auctions, additional contemporaneous auctions by other vessels decreases the bids, but it is not significant in the case of cod.

As expected, buyers adjust their bids according to the degree of competition, and an increase in demand for the products (as proxied by the number of buyers) increases the price received in auction significantly. We now move to an analysis of the price received by fishers for auctioned and contracted transactions.

Table 3. Bidding Behavior for Saithe and Cod

	(1)	(2)
	Saithe	Cod
Number Bids	0.043***	0.043***
	(0.004)	(0.005)
Number Auctions	-0.432***	-0.102
	(0.095)	(0.128)
Quantity Sold	-0.002**	0.000
	(0.001)	(0.001)
N	4434	3944
Adj. R^2	0.746	0.831

Notes: Data from SUROFI. Each column is a separate regression model, with coefficients and heteroskedastic-robust standard errors in parentheses. In addition to the variables shown, each specification includes year fixed effects, month fixed effects, and buyer-specific fixed effects. We also control for quality, size, and the amount purchased by that buyer in the previous period. Statistical significance indicated by asterisks. Statistical significance indicated by asterisks.

4.2 Market Prices

How do market factors affect the market-clearing price? To answer this question, we estimate a similar reduced-form model, but we estimate these regressions with the dependent

variable measured in levels (not logs) because the key explanatory variable, Auction, is binary. The results when taking the natural log of the dependent variable are qualitatively similar. Again we control for year, month, buyer- and vessel-specific fixed effects, product type (fresh/frozen) and product purpose (human consumption or fish oil/meal).

We again estimate a model for each species separately. The results show that auctioned prices are higher than contract prices, holding constant the quantity sold, the previous period's total sale, and the transport distance. For mackerel, NS herring and NSSH, the results indicate that auctions yield respective prices that are 1.25, 0.10, and 1.92 NOK/kg higher than contracts for purse seiners. When considering all vessels, the respective price premia are 0.64, 0.18, and 0.22 NOK/kg, and the results are significantly different from zero in each case.

Table 4. Price Determinants, All Vessels

	(1)	(2)	(3)
	Mackerel	NSH	NSSH
Auctioned	1.2452*	0.1087	1.3716*
	(0.4686)	(0.1165)	(0.6928)
Quantity (thousands of tonnes)	-0.0101***	-0.3469**	-0.0832
	(0.0011)	(0.1144)	(0.0564)
Transport Distance (thousands of km)	-0.2576	-0.4449	-0.1017
	(0.1718)	(0.5016)	(0.0729)
Adjusted R-Squared	0.4752	0.6052	0.4906
N	11467	6688	8522

Notes: Data from NSS. Each column represents a separate regression. The dependent variable in each column is the natural log of the price per kilogram. In addition to the independent variables shown, each specification also controls for fixed effects for fisher, month fixed effects, year fixed effects, and the type of product. Heteroskedastic-robust standard errors shown in parentheses. *,**,*** denote significance at the 5%, 1%, and 0.1% levels, respectively.

Table 5. Price Determinants, Purse Seiners

	(1)	(2)	(3)
	Mackerel	NSH	NSSH
Auctioned	0.6389**	0.1798*	0.2231**
	(0.2147)	(0.0809)	(0.0814)
Quantity (thousands of tonnes)	-0.0009	-0.6113*	-0.0016*
	(0.0039)	(0.2487)	(0.0007)
Transport Distance (thousands of km)	0.1111	-0.5355	0.0000
	(0.3491)	(0.2801)	(0.0001)
Adjusted R-Squared	0.6856	0.5865	0.7835
N	3316	4079	1649

Notes: Data from NSS. Each column represents a separate regression. The dependent variable in each column is the natural log of the price per kilogram. In addition to the independent variables shown, each specification also controls for fixed effects for fisher, month fixed effects, year fixed effects, and the type of product. Heteroskedastic-robust standard errors shown in parentheses. *,**,*** denote significance at the 5%, 1%, and 0.1% levels, respectively.

For saithe and cod we estimate models shown in Table 6. As illustrated graphically in the previous section, it is difficult to distinguish between prices when not controlling for the other product and market characteristics. The dependent variable is the price per kilogram, and the excluded category is Auctioned, so we can interpret the results as relative to the price received in auction, holding constant all other characteristics.

For saithe, self-acquisition leads to significantly lower prices than auction, with a point estimate of nearly 4.4 NOK lower per kilogram. Saithe sold under contract leads to an average decrease of about 0.56 NOK/Kg, again holding all else equal.

For cod the story is similar. Self-acquisition leads to a lower settling price of roughly NOK 3.5, and cod sold under contract receives about 0.2 NOK/Kg less than in auction, holding all else equal.

Table 6. Price Determinants for Saithe and Cod

	(1)	(2)
	Saithe	Cod
Self-Acquisition	-4.398***	-3.515***
	(0.254)	(0.372)
Contract	-0.556***	-0.206*
	(0.060)	(0.091)
Quantity (tonnes)	0.002***	0.007***
	(0.000)	(0.001)
N	15654	18300
Adj R^2	0.672	0.852

Notes: Data from SUROFI. Each column is a separate regression model, with coefficients and heteroskedastic-robust standard errors in parentheses. In addition to the variables shown, each specification includes year fixed effects, month fixed effects, and buyer-specific fixed effects. We also control for quality, condition, size, and the amount purchased by that buyer in the previous period. Statistical significance indicated by asterisks. The excluded category for the sales method is auctioning.

4.3 Discussion

The empirical strategy used here relies on a host of "fixed effects" for buyer, vessel, seasonality, and as well as sale-specific characteristics. As such, the estimation leverages *within* variation over time, and the month and year fixed effects control nonparametrically for trends and seasonality. The results are robust to a variety of alternative specifications, including transformations of the dependent variable or key explanatory variables.

Our estimates use data over a long period of time, and there are constantly changes in the regulatory, economic, and environmental conditions. Our results shed light on the consequences of these dynamics. For example, if the number of landing sites is decreasing, that has implications for spatial competition. If that change leads to an increase in the number of buyers in an auction for a specific landing location, that should increase the price received by fishers. Alternatively, the results also highlight the tradeoff that exists when there are many auctions occurring simultaneously at a given site.

Some fishers appear to prefer contracts to auctions, as highlighted in the mackerel example comparing September and November. There is still a price premium for those participating in an auction, on average, but when term contracts are permitted a large share of the harvest is sold through contracts instead of auctions. Fishers may prefer contracts because they provide predictability and certainty, but auctions also play an important role of determining the spot price when buyers compete for the purchase.

The results here also show that the organizations add significant value to fishers by shifting the balance of market power to sellers in auctions, and that is true both in the pelagic species of NSS as well as the cod and saithe in the SUROFI data. Our models of bidding behavior (Tables 1-3) show that *individual* buyers respond to market conditions, and auctions lead to higher prices (Tables 4-6). Taken together, the results suggest that the sales organizations have succeeded in creating value for Norwegian fishers.

5. Conclusions

The sales organizations in Norway move market power from buyers to sellers. The question we ask here is, what is the impact on the market and for sellers?

There are a few caveats worth noting. First, our analysis allows us to estimate the impact of auctions on prices under the current market conditions, but our estimates should not be interpreted as structural parameters. We also note that while the sales organizations increase the value to fishing firms, our analysis does not consider the welfare effects to buyers (who pay more) or others in the supply chain, such as consumers. The aggregate welfare effects of this market structure could be studied in future work.

Our results suggest that sales organizations create significant value for fishers by supporting the price, but there are also lessons about the critical importance of the market structure in determining the price paid to fishers. We find that the price depends on the degree of competition amongst both buyers and sellers, which could have implications as consolidation occurs on both the capture and buyer sides. More market concentration among buyers would make the sales organizations even more important to fishers, as the cooperatives work to transfer market power to the fishing firms. And consolidation among fishing firms would, in turn, decrease the number of simultaneous auctions and therefore likely increase the price received by fishing firms.

The sales organizations in Norway function as cooperatives that have a significant impact on the price and conditions of sales of fish from capture fisheries. This analysis of the transaction data suggest that the Sales Organizations create a significant amount of value for fishing firms. By creating a marketplace that moves market power from buyers to sellers, the market price increases significantly. Furthermore, by facilitating auctions, the resulting price paid to fishers increases significantly. This is true in the NSS fisheries that we consider as well as the demersal species in SUROFI. The magnitudes vary by species, but the premium associated with auctions is significant.

The auction premium for mackerel, for example, is roughly 1 NOK/Kg, holding all else constant. Given the total harvest of mackerel among NSS vessels, this represents an enormous impact on the value of the fishery. Similarly, the auction premia for cod or saithe for SUROFI harvests suggests that the value-added of the sales organizations to the fishing fleet in Norway is substantial.

Without the sales organizations, the market structure of Norwegian fisheries would be markedly different. By allowing harvesters to operate as a cooperative, the resulting auction leads buyers to bid against each other under a system of recognized rules. Our analysis shows that

harvesters receive a premium under auction relative to contract sales, and the premium per kilogram is economically important. Considering the total quantities sold in Norwegian capture fisheries, this represents a significant source of value that can be captured by harvesters due to the market structure.

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In Norway fish sales organizations have the right to set the terms of all transactions between member fishers and prospective buyers. This report studies the impact of sales organizations on the value of the harvest sector. We study how two of the largest sales organizations, Norges Sildesalgslag and Sunnmøre og Romsdal Fiskesalslag (SUROFI), affect the value of the harvest of its member fishers. We find that sales organizations create significant value for member fishers. By organizing auctions, fishing firms are able to receive higher prices for their harvests than if the same fish were sold through contracts. We also find that prices reflect market fundamentals such as the degree of competition on both the buyer and seller sides. This may have consequences for future developments in a market characterized by consolidation on both sides.

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