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Time for fishing: bargaining power in the Swedish Baltic cod fishery

Johan Blomquist¹, Cecilia Hammarlund², Staffan Waldo³

Abstract

How are market conditions affected by a change in fishery regulations? Who benefits and who loses? The paper discusses the price effects of a reform in the Swedish Baltic cod fishery where vessels using active gear were given annual quotas rather than the previously applied quarterly quotas. We investigate whether the bargaining power of fishers using trawlers have improved after the reform using a difference-in-difference approach. Since fishers have more freedom to fish for cod over the year and processors are keen to have regular landings of fish (in order not to have unused capital), we suggest that prices are likely to increase following the reform. The results indicate that prices have increased due to the increased bargaining power of fishers after the reform. We control for the effects of fish size, fish quality, landing port and landing date. We also investigate whether the price change that we have found is driven by changes in reservation prices and find that this is not the case. Thus, we conclude that introducing yearly quotas is likely to have changed bargaining power between fishers and buyers in the Swedish Baltic cod fishery.

Keywords: Bargaining power – Difference-in-difference – Fishery management -Baltic Cod

JEL classification: Q21, Q22, D47

1. Introduction

Faced with excess capacity and overfishing, fisheries management has largely focused on reducing fleet size and improving ecological conditions. Property rights, such as Individual Transferable Quotas (ITQs), have the potential to reduce capacity and increase profitability in the sector (Andersen et al., 2010; Arnason, 2008; Gómez-Lobo et. al., 2011; Suitinen, 1999; Waldo and Paulrud, 2012). However, the introduction of property rights and the way these are designed might have effects not only on fleet size and thus the cost structure of the fleet, but also on the distribution of rents between fishers and processors in the ex-vessel market for fish (Hackett et al., 2005; Matulich et al., 1995; McEvoy et al., 2009). By studying reform-related price changes it is possible to understand how rent distribution is affected, and why there might be resistance to reforms.

In this chapter, we contribute to the literature by analyzing price formation in the Swedish Baltic Sea cod fishery when the management system changed from quarterly to annual quotas. The new management system introduced more flexibility for fishers since the obligation to land on a quarterly basis was removed. This could result in landings becoming more irregular if, for example, costs are

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lower during certain time periods or if alternative fishing possibilities generate higher rents during certain periods. Processors, on the other hand, are reliant on regular landings, since processing capacity is fixed in the short run and hence capital and labor resources might be wasted with more irregular landings. In addition, down-stream markets (i.e. wholesalers and retailers) might be willing to pay more for fish that is regularly delivered. Thus, in the short run, processors might be negatively affected, and concerns about supplies for processors were accordingly raised in the proposal for the new management system (Swedish Board of Fisheries, 2010a). The obligation to land part of the quota each quarter remains from a rationing system with weekly landing obligations imposed to ensure regular landings for the processing industry (County Administrative Board of Skåne, 2005).

The purpose of this chapter is to examine whether the new management system has altered the price formation process in the ex-vessel market. There is considerable dependency between fishers and buyers (processors) on the Baltic Sea coast of Sweden, and both groups operate on markets with limited entry, which implies that there is a bargaining situation on the market. More specifically, as the fishers' flexibility to allocate landings within the harvest season has increased, we hypothesize that the bargaining power of the fishers should improve. To test the hypothesis of increased bargaining power of fishers empirically, we use detailed price data from landing tickets submitted to the Swedish Agency for Marine and Water Management. To identify the bargaining power effect, we utilize the fact that the regulatory change only applied to vessels using active gear (i.e. trawls). Thus, the segment of passive gear (i.e. nets and hooks) is used as a control group, and the effects are operationalized as changes between the two groups. To the best of our knowledge, the quasi-experimental approach used in this study is a novelty in the literature on the relative bargaining power of fishers and processors.

Earlier studies have analysed price effects when introducing new management systems in fisheries, for example Herrman (1996), Hermann (2000), Grafton et al (2000), Alsaharif and Miller (2012) and Dupont and Grafton (2001). Although the full price effect of a new management system might be interesting as such, it is difficult to determine exactly what factors contribute to such price changes. For example, reform-related price changes can occur if the quality of fish changes, or if fish is landed in certain ports on certain dates when fishing costs are low. Our study investigates the effects of the reform on bargaining power, and focuses on the idea that the reform made it possible to fish at times more suitable for fishers, but perhaps more unsuitable for processors. By looking at this one aspect, i.e., the bargaining power of fishers, the effect of other reform-related price changes can be left out of the analysis.

The quotas for the Baltic cod stocks (the eastern and the western) are set by the EU each year, but within the system member states have great flexibility to allocate national quotas among their vessels. The Swedish Baltic cod fishery is regulated by non-transferable individual quotas and traditionally, the fishery was regulated by weekly catch rations, i.e. each vessel was allocated a short-term quota lasting for one week and the quota could not be saved for later periods. The aim of the system was to prevent the overcapitalized fishery from landing the entire quota already at the beginning of the year. To protect the small scale fishery the Swedish quota has further been divided since 2007, into one part for the small scale fishery (passive gear) and one part for vessels using active gear. The weekly catch rations were abandoned on 5 April 2010. From this date, vessels using passive gear have been able to operate without catch restrictions (FIFS, 2010). For vessels using

active gear, however, the weekly catch rations were replaced by quarterly catch rations. About a year later, 1 April 2011, yearly quotas were introduced for vessels using active gear (FIFS, 2011).

2. Data

The database used in this study is provided by the Swedish Agency for Marine and Water Management, and includes information about prices, landed quantities, size classes and quality classes. All fish receivers in Sweden are compelled to send this information to the Swedish Agency for Marine and Water Management. The subset of the dataset used in this study includes cod that was commercially traded in Swedish Baltic harbors between 1 April 2010 and 31 December 2011, i.e. the period after the latest regulatory change that affected both vessel types (active and passive). Vessels using passive gear are vessels using nets and hooks and vessels defined as belonging to the coastal segment, whereas vessels using active gear are bottom trawlers. Some summary statistics from the database are presented in Table 1.

Table 1: Summary statistics: Swedish vessels catching cod between 1 April 2010 and 31 December 2011.

Segment	Landings (number of observations)	Number of vessels	Quantity landed in tons	Average price in SEK	Most important ports
Passive	32 416	197	3 542	13.8	Skillinge, Nordersund, Simrishamn
Active	9 799	49	12 297	13.3	Simrishamn, Karlskrona-Saltö
Total	42 215	244*	15 838	13.4	

* The total number of vessels is not the sum of active and passive vessels since two vessels changed their status during the time period.

Table 1 shows the number of landings (i.e. the number of observations) for vessels using active and passive gear. For each landing the following is reported: the amount landed, the price paid for the landing, the id-number of the vessel, the size class of the landing, the quality class of the landing, the port where the landing was registered, the id-number of the buyer and the date when the landing arrived. Vessels using passive gear have more than three times as many landings as vessels using active gear. This is to be expected since vessels using passive gear are generally smaller and thus have smaller storage capacities. There are 197 vessels using passive gear and 49 vessels using active gear included in the dataset. Vessels using active gear also land considerably more cod than vessels using passive gear (12 297 tons compared to 3 542 tons). The average price of cod (all sizes and quality classes) is 13.44 SEK during the time period and passive vessels receive slightly more than active vessels.

The dataset also reveals that the landings of cod are geographically concentrated. The most important ports for landing cod fished in the Baltic are Simrishamn (40 percent of the landed quantity) and Karlskrona-Saltö (25 percent). Vessels using active gear land 79 percent of their cod in these two harbors. The landings by vessels using passive gear are somewhat less concentrated with 50 percent in three ports (Skillinge, Nordersund and Simrishamn).

Taking a closer look at the prices of cod of different size and quality classes, Table 2 reveals that there are price premiums for larger cod and for cod of better quality. Cod in Class E is defined as fish

that must be free of pressure marks, injuries, blemishes and bad discoloration. Cod in Class A and B have similar but slightly lower demands on the quality of the product (European Commission 1996).

Table 2: Average prices of cod of different sizes and qualities during the study period.

Size Classes	Class A	Class B	Class E
>7kilos	17.1	13.8	20.1
4-7 kilos	16.0	12.4	19.4
2-4 kilos	15.5	10.4	18.4
1-2 kilos	15.3	9.9	16.6
0.3-1 kilos	11.9	7.8	12.5

Most of the landed quantity (86 %) is Class A and categorized in one of the smaller size classes, i.e. between 0.3 and 2 kilos. The price discount when cod is classified as Class B is substantial, although only a small proportion of the landings is classified in this category (0.2 percent of the landed quantity). On the other hand, the price premium of landings of cod in Class E is not that large, especially not for the smallest size category. Around 9 percent of the landings are in Class E.

The data show that there are differences between segments, and that different qualities and sizes of cod have different prices. Thus, it is important to take these differences into account when estimating bargaining power. This issue will be further discussed in chapter 3.5.

3. The imperfect market of fishers and processors

There are good reasons to expect most regulated fisheries and ex-vessel markets to be imperfectly competitive. Fishers are restricted by limited entry programs, TAC restrictions, season length restrictions and technical regulations on equipment, and ex-vessel markets are often restricted by inaccessibility because of geographical remoteness and entry costs of the processing industry. These characteristics of the primary fish market are also relevant for the Swedish cod fishery and are discussed below.

Two regulations are especially important in limiting entry into the fishery. First, all vessels above 8 meters engaged in the Swedish Baltic Sea cod fishery need a special permit. In 2012 permits were given to 249 vessels (Swedish Agency for Marine and Water Management, 2012). Second, because of overcapacity problems the fishery was closed to new entrants between 2008 and 2011 (it was not until 2011 that small scale fishers could seek new permits, (FIFS 2011)).⁴ This ban on entry is perhaps the most important regulation limiting competition among fishers.

Rules and regulations can incur fixed costs of entering the processing sector. For example, strict hygienic requirements make it difficult for fishers to sell their catch directly to consumers without making costly investments (Swedish Board of Fisheries, 2010b). Looking at the data, there is clear evidence that the processing industry is characterized by an oligopolistic structure. The majority of the landed volume is bought by a handful of large agents, indicating that the Swedish cod processing sector has economies of scale. To convey an idea of the concentration of the cod processing industry

⁴ Although new vessels were allowed to enter in 2011 the number of passive vessels continued to decrease after the reform (from 181 before the reform to 173 after the reform). Thus, the relaxed entry regulation did not seem to affect competition among vessels.

analyzed in this chapter, Table 2 displays the volume and percentage of cod sold to the five largest buyers in the ex-vessel market in 2010-2011 (there was a total of 55 buyers in the market).⁵

Table 3: Volume (tons) and percentage of Baltic cod sold to the five largest buyers in Sweden 2010-2011.

Processor	Volume (tons)	Percentage of Total Harvest	Cumulative Percentage of Total Harvest
1	5006	25.3	25.3
2	4084	20.6	45.9
3	2351	11.9	57.7
4	2193	11.1	68.8
5	2127	10.7	79.5

As evident from the table, the majority of cod landed is sold to five large buyers that purchased almost 80% of the total landings. In the extreme case when fishers can only deliver to a single processing firm, we would expect the processor to offer a low ex-vessel price close to fishers' average cost and thereby extract all the rents generated in the fishery. In fact, the data used in this study shows that it is not unusual for one buyer to dominate the purchases in many of the smaller ports.

It is also evident from the data that fishers are highly dependent on specific ports and buyers. From 1 April 2010 until 31 December 2011 244 vessels landed cod in 58 Swedish Baltic harbors. Table 3 presents some statistics that show this dependency.

Table 4: Fisher dependency on buyers and ports.

Number of buyers (x)	Share of total number of vessels that sold their landings to x number of buyers	Number of ports (y) visited	Number of vessels that visited y number of ports over the time period
1	65%	1	61.50%
2	20%	2	25.40%
3	12%	3	9.40%
4	2%	4	2.90%
5	0%	5	0.40%
6	1%	6	0.00%
		7	0.40%

Most vessels limited their landings to one particular buyer (65 %) and one particular port (62%), indicating that there is a strong dependency between sellers and buyers. Only 20 % of the vessels turned to 2 different buyers during the time period and 12 % of the vessels turned to 3 different buyers. Turning to more than three different buyers is very unusual; only 3% of the vessels turned to more than three buyers during the time period. The same pattern is revealed looking at the number

⁵ Buyers are assumed to be processors or deliver to processors. We make no particular distinction between them.

of ports visited by the vessels: 25 % of the vessels visited two ports, 9 % visited three ports and only 3.7 % of the vessels visited more than three ports during the time period. In addition, many vessels seem to be attached to one port, making only sporadic journeys to alternative ports.

As processors are highly dependent on a continuous supply of raw fish to make efficient use of their processing capacity and fulfill their commitments in the downstream market, they would like to prevent irregular landings. Irregular landings and seasonal closures force processors to import cod from abroad in order to guarantee a stable delivery of processed fish to food markets and other retailers (Swedish Board of Fisheries, 2010b; County Administrative Board of Skåne, 2005). The weekly catch rations were intended to mitigate this problem. In the new management system with annual individual quotas, fishers can afford to be more patient in waiting for more profitable fishing periods. In this situation, an individual processor may need to offer higher ex-vessel prices to ensure a continuous supply of fish. If there is competition among processors, this price-raising action may induce other processors to raise their prices in order not to lose future contracts in the downstream market. Thus, we expect the new management system to increase ex-vessel prices through the increased bargaining power of fishers, especially since the fishery is more or less closed to new entrants.

4. The bilateral bargaining model

Some researchers have considered fisheries as consisting of an oligopsonistic processing sector buying fish from oligopolistic fishers (see Matulich et al., 1995 and the references therein). As noted by Fell and Haynie (2011) and Matulich et al. (1995), most of the relevant aspects discussed above can be captured in the bilateral bargaining model suggested by Blair and Kaserman (1987) and Blair et al. (1989). In this framework, an upstream firm (oligopolist) sells its products to a downstream firm (oligopsonist) and the firms bargain over how to split the profit resulting from their joint activities. The intermediate good price (in our case the ex-vessel price) reflects the bargaining outcome, and can be modeled as a linear combination of the price that would emerge from complete domination by the fisher and complete domination by the processor. We can illustrate the general idea by the following equation for the ex-vessel price:⁶

$$p = \alpha(p^d - p^u) + p^u, \quad (1)$$

where p^d is the downstream firm's (processor's) reservation price and p^u is the upstream firm's (fisher's) reservation price. That is, the fisher would prefer not to fish if he is offered a price below p^u . Similarly, a processor would not accept a price above p^d . For a transaction to occur, it is required that $p^d \geq p^u$. While the second part of (1) constitutes the lower bound of p , the first part is subject to negotiation between the fisher and processor. The coefficient α , which lies between 0 and 1, signifies the level of fishers' strength in determining the ex-vessel price. For example, if $\alpha = 0$, processors will capture all of the profits generated by the fishery as the ex-vessel price is equal to the fishers' reservation price (if there is no outside option for the fisher, the reservation price equals the average cost of catching a unit of fish). On the other hand, if a large number of processors compete for raw fish, we expect $\alpha > 0$ so that the price of cod is above p^u . The next section describes our approach to analyzing the effects of the new management system on the first part of (1).

⁶ This is basically the same formula as equation 4 in Blair and Kaserman (1987) and equation 2 in Fell and Haynie (2011).

5. Estimating the price effects of a change in bargaining power

Equation (1) above suggests that the bargaining power could be estimated given observations on p^d and p^u . However, the reservation prices are typically not observed. Moreover, α may not be constant over time. To overcome these difficulties, Fell and Haynie (2011) propose an unobserved-component model to decompose the observed ex-vessel price into its unobservable components (α, p^d, p^u) . Estimation of the model is carried out by the use of nonlinear filtering techniques and requires the authors to specify the two functions determining the reservation prices, and a time series model for the bargaining coefficient. Although promising, a precise estimate of the bargaining power requires an adequate specification of the functions determining the reservation prices, and data on relevant explanatory variables. Failing this, we may obtain spurious estimates of the bargaining power coefficient.

In this paper we follow Fell and Haynie (2011) in that we allow the bargaining power to be time-varying. However, in contrast to them, we make use of a quasi-natural experiment to explore the changes over time. The idea is very simple: to measure the effect of the increased flexibility, we are interested in the price difference before and after the new management system, $p^a - p^b$. Here, p^a denotes the realized ex-vessel price if the fisher benefits from increased flexibility, and p^b is the ex post counterfactual outcome. If, on the other hand, the fisher is not affected by the regulatory change, p^b will be realized and p^a will be the ex post counterfactual. Of course, we cannot observe both p^a and p^b because a fisher cannot be in both states. Instead, we use ex-vessel prices for fishers observed in one of the two groups (fishers using active and passive gear) in one of the two time periods (before and after the new management system). That is, while we are primarily interested in the group of fishers who benefit from the new management system (fisher using active gear), the segment of passive gear is used as a control group and the bargaining power effects are operationalized as changes between the two groups. More specifically, let p_{tlsq} be the average cod price at date t , in landing port l , for a particular size, s , and quality, q . We calculate the price difference between the groups as, $\tilde{p}_i = \tilde{p}_{tlsq} = p_{tlsq}^a - p_{tlsq}^b$ where the superscripts a and b , indicate the group (active gear and passive gear, respectively) and $i = 1, \dots, N$. We consider two time periods, $M \in \{0,1\}$, which correspond to the two management periods (before and after the regulatory change). The so-called difference-in-difference (DID) estimator is given by

$$\hat{\pi}_{DID} = (\overline{p_1} - \overline{p_0}), \quad (2)$$

where $\overline{p_m} = \sum_{(i|M=m)} \tilde{p}_i / N_m$ is the average price difference in management period m . By taking differences between groups we remove potential biases that could be a result of time trends (demand and supply fluctuations etc.) unrelated to the regulatory change. Similarly, the differencing over time removes any biases, which could be the result from permanent differences not related to the new management, in second period comparisons between the groups. To illustrate the benefit of the difference-in-difference approach, we use a slight modification of equation (1),

$$p = p^u + \epsilon, \quad \text{where } 0 \leq \epsilon \leq p^d - p^u, \quad (3)$$

where ϵ reflects the markup over the fisher's reservation price. Combining equation (2) and (3) we obtain

$$\hat{\pi}_{DID} = ((\overline{p_1^u} + \overline{\epsilon_1}) - (\overline{p_0^u} + \overline{\epsilon_0})), \quad (4)$$

with obvious definitions of $\overline{p_1^u}, \overline{p_0^u}, \overline{\epsilon_1}$ and $\overline{\epsilon_0}$. Assume for the moment that there is no systematic difference in reservation prices between fishers using active and passive gear, or that the difference in reservation prices is constant over time. In this case, $E(\tilde{p}_i^u) = 0$, which implies that $E(\hat{\pi}_{DID}) = E(\overline{\epsilon_1} - \overline{\epsilon_0})$. In other words, using the DID approach we can test whether fishers gain a higher markup in the new management period, controlling for a variety of confounding factors such as the quality and size of fish, port-specific characteristics that change over time and aggregate time trends such as supply and demand fluctuations. In practice, of course, it is not known if the reservation prices vary systematically between the groups, making it difficult to attribute an increase in price differences to increased bargaining power. We elaborate on this issue below.

An estimate of $\hat{\pi}_{DID}$ can be obtained from the dummy variable regression

$$\tilde{p}_i = \beta + \pi_{DID} \cdot W_i + u_i, \quad (5)$$

where u_i is the error term and W_i is an indicator variable, taking the value 1 in the new management period (after 1 April 2011) and 0 otherwise. That is, we are primarily interested in the quantity $E(\tilde{p}_i|W_i = 1) - E(\tilde{p}_i|W_i = 0) = \pi_{DID}$. The overall intercept β , reflects the difference in price between the groups prior to the new management system.

6. Results

The results from regression (5), presented in Table 2, show that there are price differences between the two groups after the reform when controlling for size, quality, port and landing day. The interpretation of the coefficient is that vessels using active gear received 0.24 SEK more on average than vessels using passive gear during the time period following the reform, and that this price increase was unrelated to the size or the quality of the fish, or where and when it was landed. The constant shows the average price difference before the reform and since it is not significant it suggests that there were no price differences between segments prior to the reform when controls are used.

Table 5: Results – price differences before and after the reform

Coefficient	Point estimate	P-value
<i>Constant (before)</i>	0.027	0.454
<i>Difference-in-difference coefficient (after)</i>	0.239	0.000

Note: The number of observations is 1973.

Another way to envisage the difference between the two groups is to estimate the distribution of \tilde{p}_i . Figure 1 shows two density functions estimated using the Epanechnikov kernel density estimator.⁷ The shaded area shows the estimated density of \tilde{p}_i before the reform and the dashed line shows the estimated density after the reform.

⁷ The bandwidth is estimated using the Silverman's (1992) optimal bandwidth estimator.

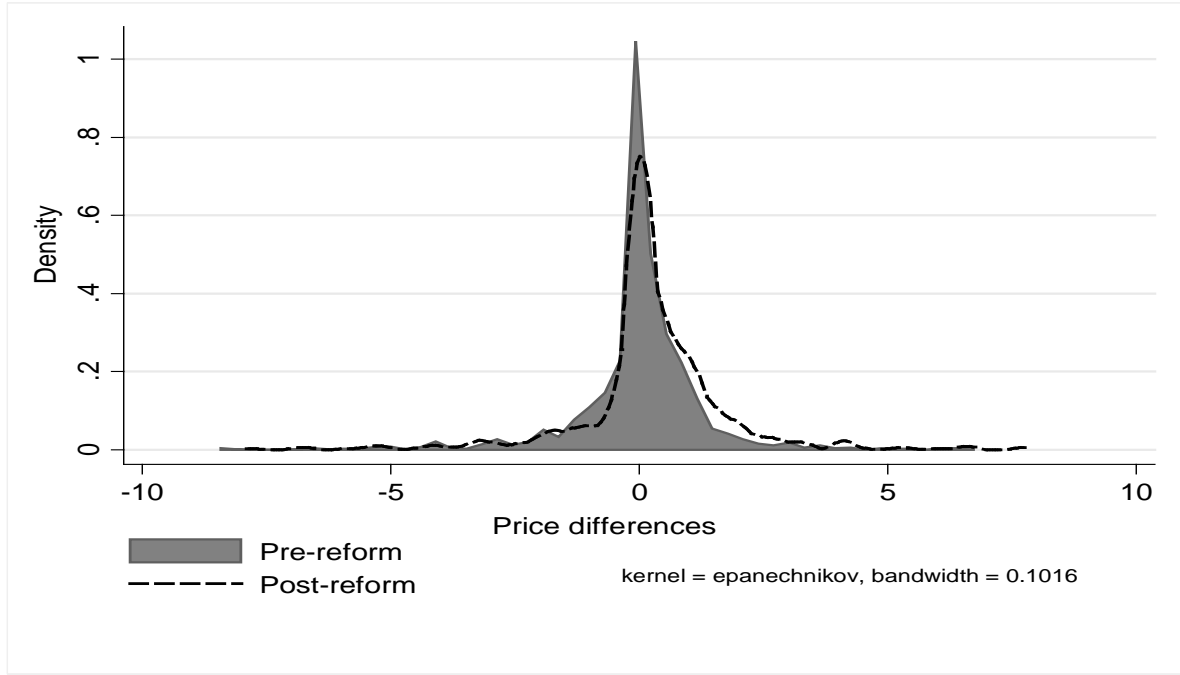


Figure 1: Kernel density estimates pre-form and post-reform

Figure 1 shows that the remaining price differences are slightly larger post-reform, and confirms the results of the regression. The post-reform density curve is to the right of the pre-reform density curve, indicating price differences are larger post-reform.⁸ The pre-reform estimates are closer to zero, and most observations show no differences between vessels using passive gear and vessels using active gear when other factors (size, quality, landing-day and -port) are controlled for in the analysis. The figure also shows that there are no extreme observations driving the results.

While the results in Table 5 and Figure 1 indicate higher ex-vessel prices for fishers who profited from the new management system, they are not indicative of whether the price difference changed abruptly or gradually over the year. Nonparametric regression methods can be used to analyze the behavior of the conditional mean around a particular point in time. Let x be a time-variable representing date and consider $m(x) = E(\tilde{p}_i | x_i = x)$, where $m()$ is some unknown mean function. Instead of using equation (5), we want to estimate the conditional mean directly, without making any assumptions about the functional form of $m()$. In this case, we can use the Nadaraya-Watson estimator⁹,

$$\hat{m}(x) = \sum_{i=1}^N \tilde{p}_i \cdot \lambda_i, \quad (6)$$

where λ_i is a kernel weight function. As above, we use the Epanechnikov kernel. However, when it comes to bandwidth selection, there is no commonly used rule of thumb like the one used above. Instead, we experimented with several different choices for the bandwidth (30, 40, 50, 60, 70, and 80). Fortunately, the qualitative results were not sensitive to this choice, and Figure 2 presents the estimated mean function when the bandwidth is set to 50.

⁸ The hypothesis that price differences are equal before and after the reform is tested using the Kolmogorov-Smirnov test. The hypothesis is rejected at the 1 percent level.

⁹ See for example Racine (2008).

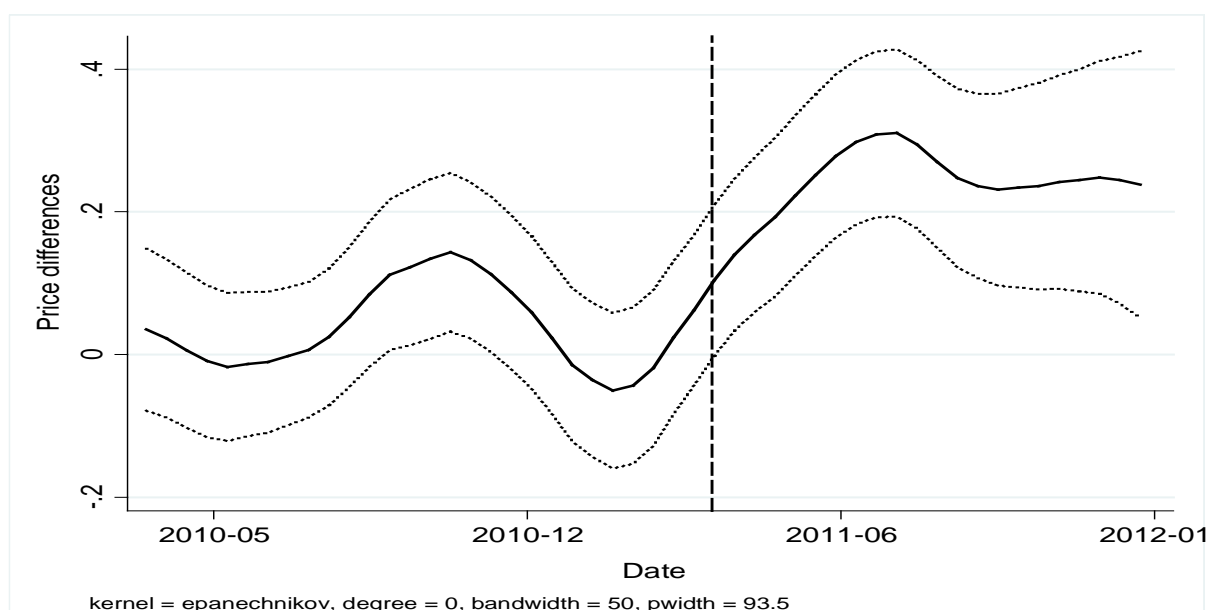


Figure 2. Estimated mean function of price differences

The estimated mean function shows that price differences vary somewhat before the reform, but are larger after the reform. The figure also shows that price differences become larger immediately after the reform, and that they stay at a higher level during the rest of the time period studied. The interpretation is that increased bargaining power of the fishers prevailed throughout the time period.

It is also evident from the figure that there were no other major changes in price differences after the reform. On 1 September 2011 trawl-fished cod from the Eastern Baltic became liable under the Marine Stewardship Council (MSC) labeling scheme. Such a scheme could potentially increase prices to fishers who incur costs when implementing the regulations of the scheme. However, the figure is in line with an estimation of regression (5) for the time period between 1 April 2011 and the end of that year with a break on 1 September 2011; this regression reveals no significant changes in price differences.¹⁰

As the Nadaraya-Watson estimator is a smoothing estimator, it may mask an abrupt shift in the conditional mean around the date of the new management system. To allow for a discontinuity point, Figure 3 displays the results from the Nadaraya-Watson estimator when the mean function is estimated separately for the two management periods.

¹⁰ The number of observations of this regression is 770.

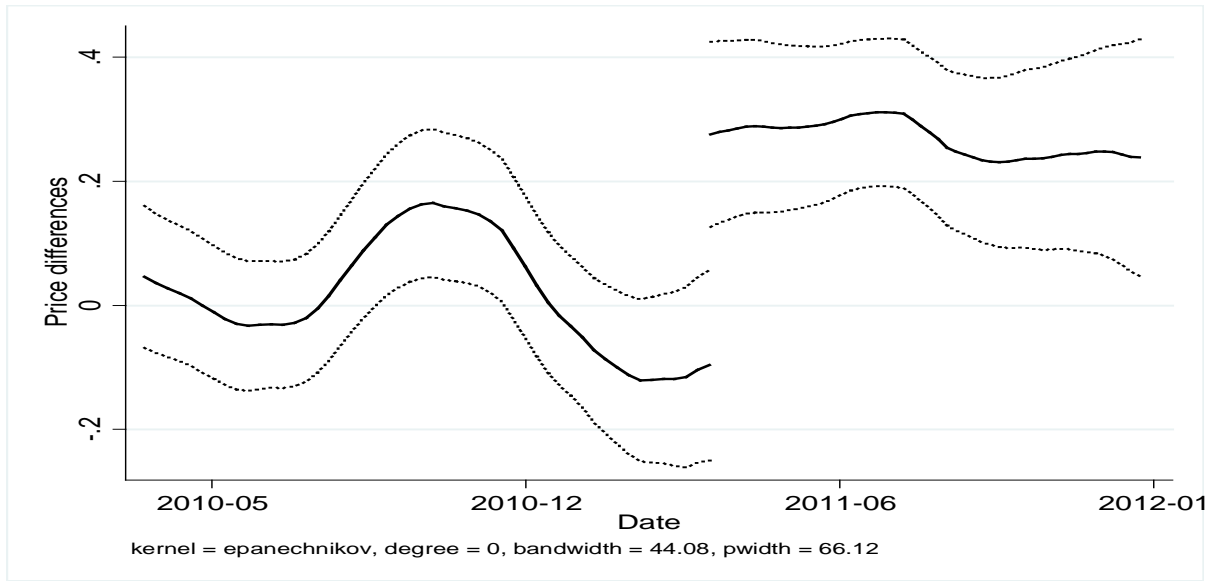


Figure 3. Estimated mean functions for two separated time periods

The figure shows that there is a clear break on the date when the reform was introduced, i.e. on 1 April 2011. Price differences before the reform are smaller than price differences after the reform. Just like Figure 3, it is clear that price differences remained throughout 2011.

The results above clearly suggest that the new management system results in higher ex-vessel prices for fishers using active gear. However, in terms of equation (1), the results are not indicative of whether the higher prices are due to improved bargaining power or a shift in fishers' or processors' reservation prices. For example, the processors' reservation price is likely to be a function of the average variable costs of processing. To investigate this issue, we follow Fell and Haynie (2011) and assume that processing costs are dependent upon the quantity processed. More specifically, we define the variable $\tilde{q}_i = q_{tlsq}^a - q_{tlsq}^b$, where q_{tlsq}^a and q_{tlsq}^b denote the average quantity landed at date t , in landing port l , for a particular size, s , and quality, q , where the superscripts a and b indicate group membership (active gear and passive gear, respectively). The variable \tilde{q}_i can then be included as an explanatory variable in regression (5). If processor reservation prices for the two groups of vessels change disproportionately, this might affect price differences. Similarly, the fishers' reservation price is likely to be determined by their fishing costs. To control for fishing costs, we include the daily changes in diesel price, $d_t = d_i$. Usually, active vessels are more fuel intensive than passive vessels, and if diesel prices change, the reservation price of active vessels might change more than the reservation price of passive vessels. Table 3 shows the results when these variables are included in regression (5).

Table 6: Estimation results from equation (5) with diesel prices and differences in quantities included

Variable	Point estimate	P-value
<i>Constant</i>	-0.011	0.812
<i>Difference-in-difference</i>	0.233	0.000
<i>Diesel price</i>	-0.004	0.993
<i>Difference in quantity</i>	0.017	0.257

The results indicate that reservation prices for processors or fishers have not changed disproportionately between vessel groups. The coefficients of diesel prices and quantity changes are very small and insignificant. Thus, the price effect is more likely to be related to an increase in the bargaining power of fishers.

7. Summary and conclusions

In this chapter we contribute to the literature on how the distribution of rents between fishers and processors changes when a regulatory change is introduced in a fishery. More specifically, we focus on how the bargaining power of fishers is altered when we move from a system of quarterly to annual quotas in the Swedish Baltic cod fishery.

The results indicate that bargaining power increases for fishers, since price differences between vessels affected by the reform and vessels not affected by the reform are larger after the reform holding other factors fixed. On 1 April 2011 active vessels were no longer restricted by the quarterly quota that had been in effect during the previous year. Passive vessels had no quota restrictions during the investigated period. The price increase due to increased bargaining power is estimated to 0.24 SEK, which is equivalent to 1.8 percent of the pre-reform price received by vessels using active gear. The price increase appeared immediately after the reform and also remained during the months following the reform.

The justification for the empirical model is that fishers and buyers bargain over the price of fish. In our study we have a limited number of buyers since the market is dominated by five large agents. Vessels have close-knit relations with their buyers and are also closely connected to specific ports. Thus, a bargaining situation is likely to occur where the actual price ends up somewhere between the reservation prices of the buyers and the sellers.

Using a detailed dataset and a difference-in-difference approach, the study abstracts from other factors that could have affected the prices during the time period. Prices of fish of the same size, with the same quality rating, landed in the same ports, and on the same day are compared for the two segments. Thus, any price changes related to these factors are left out of the analysis. Furthermore, the difference-in-difference approach ensures that all factors which affected prices in a similar manner for the two segments during the time period are left out of the analysis. Such price changes could for example be changes in the demand for cod, macro-economic fluctuations or changes in input prices. Finally, we investigate whether the results are driven by changes in reservation prices. Assuming that processing costs are dependent on the quantities that are processed, we include differences in quantities in the two segments in the regression. Changes in fishers' reservation prices are estimated using diesel prices assuming that these prices reflect fishers'

marginal costs. We do not find any support for the notion that differences in reservation prices changed over the time period and thus affected price differences. Thus, we cannot reject the hypothesis that the bargaining power between fishers and buyers has changed, and that the price effect which appeared immediately following the reform on 1 April 2011 was an effect of the increased bargaining power of fishers.

The discussion on making fishing quotas transferable is an on-going issue in Sweden as well as in the EU, and an introduction of transferable quotas in the Swedish Baltic cod fishery could be realistic in the future, at least for active vessels. The bargaining power of fishers could then raise ex-vessel prices further, since rationalization in the fishery sector could result in the exit of the most inefficient fishers and increased market power of the remaining fishers. The potential bargaining effects of an introduction of transferable quotas and the discussion about compensation to processors are interesting questions for the future. This paper suggests that the bargaining situation between fishers and buyers is affected by a regulatory change, and thus policy makers should consider market distortions when introducing new management systems.

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