Technical Change, price arbitrage and price flexibility; the case of Lobster holding in Québec compared to Eastern Canada

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ABSTRACT

Lobster (*Homarus americanus*) ranks first in Canada's fisheries, but Quebec lobster represents only 6% of eastern Canada landings. During the peak of the fishing season in Quebec as elsewhere, supply is at its maximum and price is the lowest. For this reason, there has been considerable interest in Quebec in developing holding technologies that allow for price arbitrage over time. Such techniques already exist in other parts of Eastern Canada, but are less developed in Québec. This paper looks at the likely impacts of fishermen's associations in Québec adopting lobster holding technologies that enable price arbitrage. We performed a technical and financial analysis that compared several alternative configurations of lobster holding technologies for Grande Rivière Québec. Of the configurations presented, a technique was proposed which seemed to maximize discounted profits. However, these results are nuanced by the fact that the overall effects of price arbitrage on the price signal over time may result in inter-temporal resource rents being competed away. When we compared our results to other areas of Eastern Canada, this raised new questions about long term profitability, especially in a fishery such as Quebec, where management is based largely on input controls. We estimated a price flexibility equation as a function of lagged landings, seasonal dummy variables, the exchange rate between the United Stated and Canada, using SIMETAR-2008. A comparison of the two models, one from Quebec and one from Nova Scotia, suggests that investing in lobster holding technologies causes a smoothing of price variability. The results suggest that fishermen would try to maximize their profits by adopting an inter-temporal arbitrage strategy, but that profits in the absence of output controls, according to fisheries economic theory, could provoke an upward pressure on effective effort which would then accelerate the open access solution. This could negate the price arbitrage effect.

Keywords: Lobster holding, Price arbitrage, Property rights

Introduction:

For many years, American lobster (*Homarus americanus*) has taken first place in Canada's fisheries in terms of value. It ranks first in Canadian marine products exportations (Atlantic lobster summit, 2007). Canadian caught American lobster occupies 50% of the North American market with 52 082 MT produced in 2006 (DFO, 2009). Quebec lobster represents 6% of eastern Canada landings (DFO, 2009).

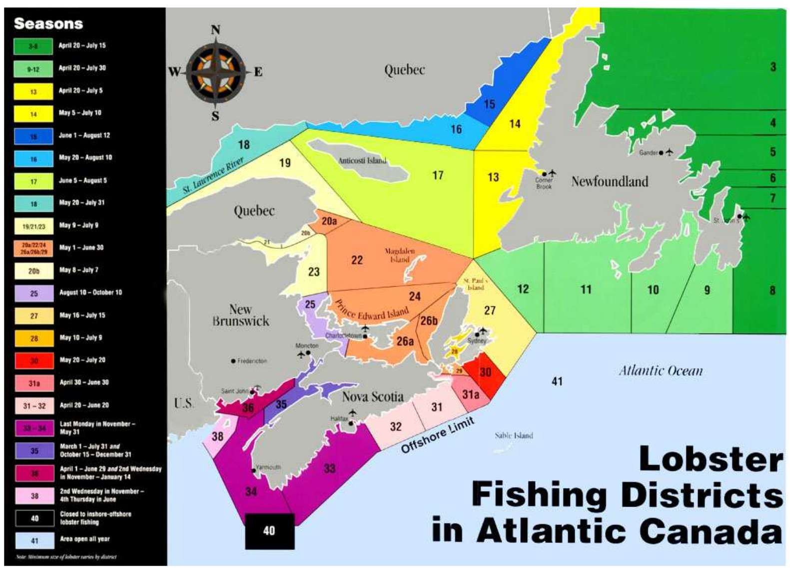
In the Gaspésie in Québec, lobster production represents a quarter (25.7%) of Quebec landings with 830 MT produced in 2006 (Magasouba, 2007). The fishing season starts in April and ends in June. During this period, supply is at its maximum and consequently, the price is the lowest. Moreover, at the end and after the fishing season in Gaspésie, the lobster price is relatively high because of the increased demand at the height of the summer tourist season (Acehson, 2003).

Because of this, communities such as the Grande-Rivière Fisherman's Association are seeking to maximize their profit by capturing inter-temporal price effects, by adopting lobster holding technologies aimed at allowing fishers to hold lobsters and sell them during periods when prices are normally higher. This paper begins by presenting an overview of the technical and financial analysis conducted on a holding system technology (Belhabib, 2010). The idea behind this is that adopting technologies that allow groups of fishermen to engage in price arbitrage over time may lead to better profits for them. This may lengthen the relevant buying season and allow fishermen the chance to capture price effects. Then, we seek to answer two questions. First, is this the best solution for a small community to resolve profitability problems? Second, what are the longer term effects of investment in new technologies aimed at more effective price arbitrage? Not surprisingly, that depends upon the degree to which the evolution of real effort is controlled by public management. To get some insights into these questions, we estimated price flexibility equations for Quebec and Nova Scotia markets, as a function of lagged landings, seasonal dummy variables, and the exchange rate between the United Stated and Canada, in order to capture effects of the export market, time and inflation rate. This was done to filter or account for their effects on past and actual price variations. We discuss the long term effects of holding technologies on price variations by comparing the two models. We explore the impacts of these effects on the evolution of the net present value of profit, under the current management regime in Québec. . We then present some conclusions, and a caution regarding the long term benefits of price arbitrage in fisheries mainly managed by input controls.

An 'optimal' technology for Grande Rivière lobster fishers

Grande-Rivière is situated in the Gaspésie in Québec, one of the most productive lobster fishing areas in Canada. The fishing season starts in April and ends in late June (figure 1). To maximize their profits, the producers '*Les producteurs de homard de Grande-Rivière Inc.*' wanted to invest in holding technologies that allow them to lengthen the fishing season and capture the large price variation effects.

Figure 1. Lobster Fishing Districts in Atlantic Canada.



Source. Fisheries and Aquaculture Nova Scotia, *2007*[1]

We identified 5 holding scenarios in the technical and financial study, based on 2 types of water circulation systems, aimed to hold a maximum of 20000 lb of lobster for the producers in Grande-Rivière, a small fishing community. In the flow through system, where the water is continuously renewed and cooled, two scenarios were analyzed: a system using a concrete basin and a system with fiberglass basins. For the water recirculation system, we considered three different scenarios based on a concrete basin, fiberglass basins and the Aquabitech condo system (small plastic rooms insolating each individual lobster). While performing the technical and financial study we took into account the most important biological parameters (mortality rate and weight loss), water temperature and technical parameters (water use and water cooling cost). The best technology recommended was the scenario using a concrete basin in a closed loop. This configuration maximised the profit of the holding technology assuming prices of 12$/lb, which were at a mean of 4.61 $/lb for the nominal ex-vessel prices and with standard deviation 1.41. The cost of water cooling is minimised because the temperature is held by using an isolation system. Furthermore, the producers proposed using their own materials to reduce the investment cost. The study showed that for most of the cases,

[1] http://www.gov.ns.ca/fish/marine/map/lobster_full.shtml

investing in mid-term holding technology is profitable. It also appeared by performing a sensitivity analysis that price is the most critical parameter which influences the NPV of the project. However, this parameter is estimated through a ten year horizon based on an evaluation of the actual average nominal ex-vessel price of 5$/lb (Magassouba, 2007). This price is the average of the nominal prices, and adjusted for inflation. The figure 2 below represents the variation of prices through time from January 1990 to December 2008.

Figure 2. (a) Variations of filtered and non filtered prices in Quebec Province (January, 1990 - December, 2008); (b) Variations of the monthly inflation rate.

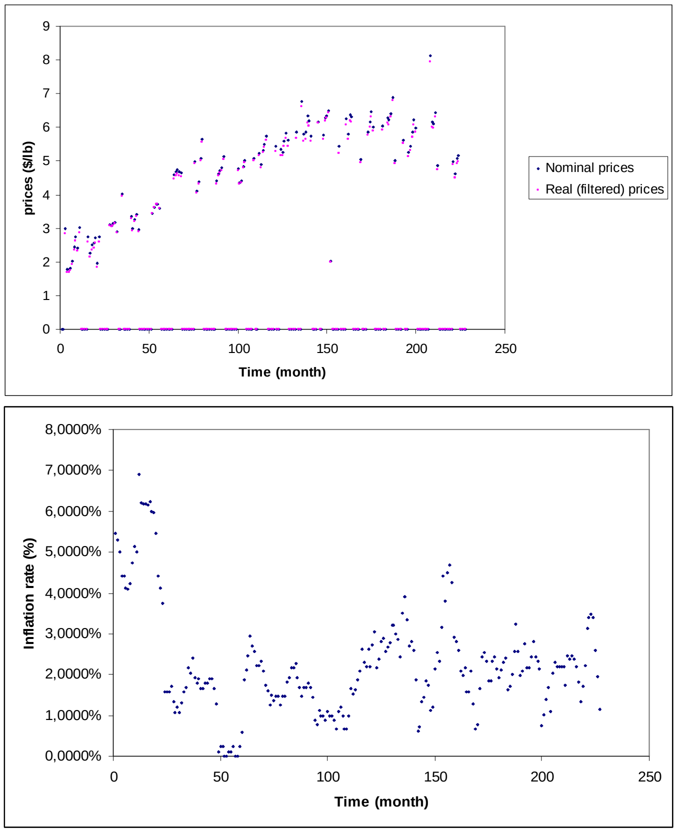


Figure 2 shows that the prices are varying through time with an increasing trend, and not especially related to the inflation rate. This suggests that there are structural changes in the supply-demand relationship for lobster that has driven the price upwards. Even if the inflation rate in average (2.2%) is close to the inflation rate used in the technical and financial study which was fixed at 2%, the standard deviation is relatively high (1.32) showing volatile monthly inflation rates varying historically from 0.0001% to 6.91% (Bank of Canada, 2009). In addition to that, the variation of prices has been estimated at ±30%, which is an indicator of the non stationary prices (for a mean of 4.61$/lb and a standard deviation of 1.41). However, in the technical and financial study we took into account the seasonal variations of prices by differentiating the cost per pound of delivering lobster, and the consumer purchase price estimated by the fishermen at 12$/lb. That is, at the beginning of the fishing season, prices are low. Thereafter, prices are increasing at the end of the fishing season which corresponds to the tourist season. The lobster price variations are cyclical and increasing through time as shown in figure 2.

New holding technologies permit fishers to engage in price arbitrage, which captures the effect of seasonal prices spikes. However, the effects of this price arbitrage on the variations of prices are unknown in the long term. In addition to that, fishermen behaviour could be affected. Consequently, the real question is: what are the long term effects of price arbitrage on the variability of prices and on the behaviour of fishermen and their profit over the long term, considering that effective effort could be increased through time, and resource rents could possibly be competed away. To address this issue, we do a comparative analysis of prices in Nova Scotia compared to prices in Québec.

Ways of looking at price series and arbitrage by comparing Quebec with Nova Scotia

Data analysis

There are many factors directly affecting lobster harvests and therefore lobster prices. One factor is the season length. Nova Scotia has longer season lengths, due to their offshore lobster fishery, and the fact that over time, fishers may have been able to manage their effective effort more efficiently. The second aspect is the adoption of lobster holding technology. The third aspect, and related to the discussions in this paper, is the nature and advancement of property rights in the fishery, and the extent to which these are recognized by the Federal and Provincial management agencies. Nova Scotia has been characterized as a fishery that, in addition to these other characteristics, is moving away from a strictly input-based regulation towards more comprehensive effort management (Millerp and Breen, 2010). This may permit successful adoption of lobster holding technologies and longer seasons, which have been put in place through joint planning agreements. Quebec, on the other hand, has a mainly inshore fishery, which is based upon input controls, and which is managed on the one hand by Federal fisheries managers in the water, but where onshore operations are affected by provincial policy. Therefore, what we would expect to see in comparing the two regions is 1) Comparatively longer seasons in Nova Scotia, and; 2) Comparatively lower variations in price in Nova Scotia, and 3) A similar average price overall between Quebec and Nova Scotia. Ex-vessel lobster prices vary in response to the quantity landed, and typically show considerable seasonal variations in response to changing demand and supply conditions in wholesale and retail markets (Gardner Pinfold, 1991). Platt (2008) shows that the ex-vessel prices vary across years, seasons, and even months based on the supply of harvested fish available at that time. These factors, among others, explain partially the variance of the resource price (Murillas and Chomorro, 2006). In addition to the influence of the quantity landed on price variations, seasonality has its own effect on lobster prices (Wang and Kellogg, 1988). In these cases, seasonality is introduced in the model as seasonal dummy variables. As a twelve month cycle permits a more refined analysis than seasons (Cheng and Townsend, 1993), months are used in this paper.

The estimation of price flexibility will be based on an equation integrating landings. Jaffry *et al.* (1999) defined the own price flexibility of a species as the percentage change in its price due to a 1% change in the quantity landed of that species. This change takes some time to occur; consequently lagged landings at a period of (t-1) were tested and are used in this model. The price flexibility equation can be expressed as:

$$P = f(Lt-1, t, Df, \ldots, Dd) \qquad \text{(Eq. 1)}$$

Where:

P *is the N-Vector of the logarithms of lobster prices,*
Lt-1 *is the corresponding lagged landings Vector (in logarithms),*
t *is the logarithm of time and,*
Df*, …,* ***Dd*** *are dummy variables corresponding to the months from February to December.*

Due to the export market, the exchange rate between US and Canada is introduced into the model. According to the Atlantic Lobster Summit (2007), as the US Dollar declines, the lobster industry in Canada should be shifting away from a dependency on the US market. The same authors point out that this declining value has resulted in an effective price decline in Canadian dollar terms. Equation (1) then becomes:

$$P = f(Lt-1, t, Df, \ldots Dd, ER) \qquad \text{(Eq. 2)}$$

Where:
ER *is the exchange rate between US and Canada expressed in logarithms.*

In order to remove the trend caused by the inflation rate (IR) and to better understand the lobster price variations, prices in this paper are adjusted for the inflation rate (eq. 3). According to Platt (2008), due to the inflationary effects, historic prices may need to be indexed to current dollars. The following method was used:

$$\Pr = P/(1+IR) \qquad \text{(Eq. 3)}$$

The real live lobster price (Pr), therefore, is specified as a function of the lagged landings, exchange rate, time and season as indicated in equation (4). The hypothesized relationship between the dependent variable (Pr) and each explanatory variable is represented by the sign of the explanatory variable: (+) indicates a positive relationship, (-) indicates a negative (or inverse) relationship and a ($\perp$) is a relationship to determine depending on time (dummy variable). The Equation (2) is then expressed as follows:

$$\Pr = f(-Lt-1, \perp t, \perp Df, \ldots \perp Dd, +ER) \qquad \text{(Eq. 4)}$$

This equation was initially estimated by ordinary least squares (OLS) using Simulation For Excel To estimate Risk (SIMETAR-2008). In this case, the general specification of the OLS model using the hypothesized signs is as follows (eq. 5):

$$Ln \Pr t = \beta_o - \beta_1 LnL_{1(t-1)} + \beta_2 LnER_{2t} \perp \beta_3 Lnt \perp \beta_4 Df + \ldots + \varepsilon_t \qquad \text{(Eq. 5)}$$

Where:

$\beta_{\mathbf{k}}$, *is the parameter estimated for the kt^h explanatory variable;*

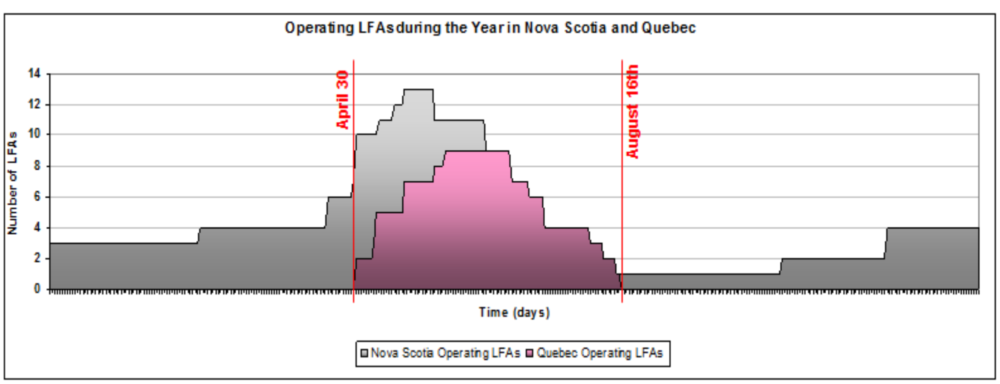
ε_t, *is the error or difference between the observed value and the predicted value for observation t of the dependent variable.*

Note that in the model, excluding the dummy variables, all the variables are expressed in logarithms.

Results and discussion

To better understand the price variations, Figure 3 shows the operating Quebec Lobster Fishing Areas (LFAs) and the Nova Scotia operating LFAs. It appears that Quebec LFAs are operating in the middle of the most productive period of Nova Scotia lobster fisheries. On the other hand, the fishery in Nova Scotia is practically year round. The Nova Scotia LFAs and Quebec LFAs are reducing their fishing activity at the beginning of the tourist season which explains the increasing prices at this period. Thereafter some LFAs in Nova Scotia are still operating. Some of these areas are offshore and some of them are accessible even in winter where the lobster fishery represents a very lucrative export market to central provinces of Canada.

Figure 3. Operating LFAs during the year in Nova Scotia and Quebec provinces



The Nova Scotia market is also characterized by a large investment in holding technologies compared to Quebec province, and an active export market mainly to the United States and central provinces of Canada. The product in Quebec is sold mainly on the Quebec market, and holding technologies are just starting to be used. This market and regulatory structure in Nova Scotia may allow Nova Scotia producers to capture the effect of price increases due to the slowdown in the market during certain periods more easily. However, do these structural differences contribute to lower variability of prices in the long term for Nova Scotia, and if so, what are the implications for Quebec producers and their attempts at inter-temporal arbitrage? We try to answer these questions by looking at the "best fit" price flexibility equations for Nova Scotia and Quebec, knowing that the variables that explain price flexibility in the two cases will be different.

For the Nova Scotia model, the Durbin-Watson test-statistic for serial correlation shows the presence of first order positive serial correlation. In this study, the integration of time and lagged landings may have caused serial correlation which does bias our estimates. Consequently a correction for serial correlation for the Nova Scotia model has been run using the Rho estimator with the method described by Criddle (2007). The equation of lobster prices variations for Nova Scotia using SIMETAR-2008 is expressed below (eq. 6) and the results are summarized in table 1.

$$Ln\Pr NS_t = 0.547 - 0.226 LnER_t + 0.234 Lnt - 0.039 LnL_{(t-1)} - 0.213 D_{May} - 0.436 D_{August} - 0.238 D_{Sept.} - 0.211 D_{November} \qquad \text{(Eq. 6)}$$

Table 1. Results of the multiple regression model for Nova Scotia, corrected from serial correlation using the Rho estimate.

Independant variables	Exchange rate	Time	Lagged landings	Dummy May	Dummy August	Dummy September	Dummy November
Beta	-0.226	0.234	-0.039	-0.213	-0.436	-0.238	-0.211
S.E.	0.159	0.028	0.009	0.034	0.036	0.042	0.034
|t-test|	8.34	4.34	1.57	6.15	12.13	5.61	6.16

Table 2 presents the results of the OLS statistics for the Nova Scotia corrected model.

Table 2. OLS Regression Statistics for Nova Scotia Corrected model.

F-test	**40.184**	**Prob(F)**	**0.000**
$MSE^{1/2}$	0.139	**CV Regr**	22.153
R^2	0.565	**Durbin-Watson**	1.879
$RBar^2$	0.550	**Rho**	0.029
Akaike Information Criterion	-3.924	**Goldfeld-Quandt**	0.534
Schwarz Information Criterion	-3.817		

In the Quebec model, the presence of serial correlation is not significant. This may be due to the lagged landings variable removing from the model (equation 7).

$$\underset{(0.146)}{Ln\Pr QC_t = -0.259} + \underset{(0.032)}{0.092 Lnt} + \underset{(0.112)}{1.094 D_{April}} + \underset{(0.112)}{1.32 D_{May}} + \underset{(0.112)}{1.344 D_{June}} + \underset{(0.112)}{1.397 D_{July}} + \underset{(0.112)}{1.305 D_{Aug.}} \qquad \text{(Eq. 7)}$$

In comparing the two price series visually, we can see that the variation in real or deflated prices is wider in Quebec than in NS, although the time signature does suggest increasing demand, and it seems more pronounced in the Nova Scotia case than in the Quebec case (Figure 4)

Accordingly, it appears that lagged landings in Quebec are not a good explainer of price variations because landings in Quebec LFAs occur when the most of the Eastern Canada LFAs are operating as well. We used a Two Stages Least Squares method to estimate a simultaneous equation system for Nova Scotia and Quebec, and we put Quebec Prices (Ln (Pr Qc_t)) as a dependant variable with the same explanatory variables shown in equation (7) and the explanatory variables of the Nova Scotia model as instrumental variables, to allow the possibility that residuals of both equations are correlated. The results correspond to those found in equation (b) (R^2= 0.674; F-test $_{\text{reduced }(0.05;6;\infty)}$ =75.938). The Mean Absolute Percent Error (MAPE = 14.36%) is a measure of a model's forecasting ability. It is minimized (which is desirable in general when selecting the best forecasting model). the equation (7) becomes the equation (8) and the results are summarized in tables 3 and 4:

$$Ln\,\Pr QC_t = -0.121 + 0.086 Lnt + 1.094 D_{April} + 1.32 D_{May} + 1.345 D_{June} + 1.398 D_{July} + 1.306 D_{Aug.} + \varepsilon$$

(Eq. 8)

Tableau 3. Results of the two Stage Least Square for Quebec model

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Independant variables	Time	Dummy April	Dummy May	Dummy June	Dummy July	Dummy August
Beta	0.086	1.094	1.32	1.35	1.398	1.306
S.E.	0.032	0.112	0.112	0.112	0.112	0.112
|t-test|	2.72	9.788	11.815	12.031	12.509	11.684

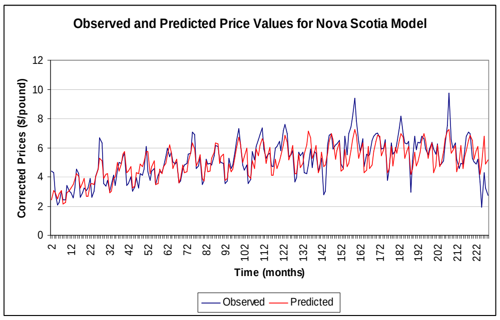
Table 4. OLS Regression Statistics for Quebec Corrected model.

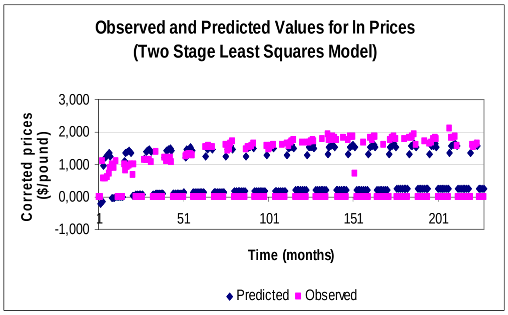
F-test	**75,938**	**Prob(F)**	**0.000**
$MSE^{1/2}$	0.455	**CV Regr**	64.297
R^2	0.674	**Durbin-Watson**	1.865
$RBar^2$	0.665	**Rho**	0.066
Akaike Information Criterion	-1.551	**Goldfeld-Quandt**	0.473
Schwarz Information Criterion	-1.461		

In order to understand the effect of the passage of time (which would capture structural, management, and technical changes overall) on the price variations, a comparison between the trend of real (deflated) prices in Nova Scotia and Quebec was made according to equation (6) and (8) respectively.

Figure 4 illustrates the variations of observed corrected prices on one hand, and the estimated (predicted) values provided by the model on the other hand.

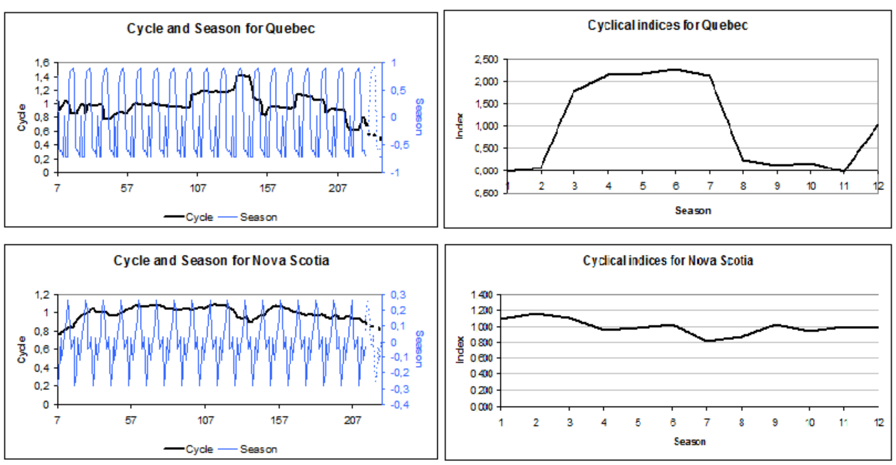
Figure 4. Observed and estimated filtered prices for Nova Scotia and Quebec





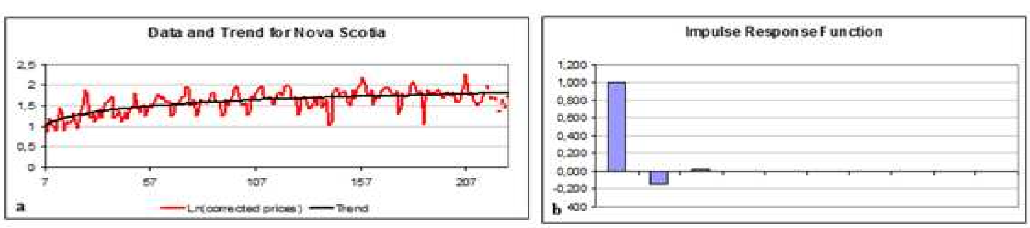
The model for Nova Scotia indicates an increasing trend until the 52^{sd} period (corresponding to march, 1994) where the model started a stationary trend. The series for Quebec indicates a continuously increasing trend. Figure 5 shows a clear cyclical effect caused by the variations of prices due to the touristic season and the fishing seasons for both of the models. To better analyse this effect, a seasonal decomposition of filtered price logarithms has been made. According to Cheng and Townsend (1993), it is desirable to provide an assessment of the estimated parameters to better analyse the cyclical effect raised before. To provide that assessment, data series from 2007 to 2008 were used to determine the out-of-sample predictions for Nova Scotia and Quebec. In this case we dropped monthly data from 2007 to 2008, this data was not used in the overall estimation which was the full sample of 216 months (18 years) minus 12 (the last year) The last period (dotted) shown in Figure 5 demonstrates that in general the predictive performance of the model is quite good for Nova Scotia and Quebec. Indeed, the predictive values follow the pattern of the real situation. It also indicates that for Quebec the cycle appears to have more within season variability, but the seasonality, defined as the repetitive and predictable movement around the trend line in one year or less, is well determined through the years. Seasonality is measured in terms of an index called a seasonal index which is attached to each period of the time series within a year. In this paper 12 separate indices are considered, one for each month. To calculate this seasonal index we used SIMETAR-2008 based on the simple averages method, also called average percentage method because it expresses the data of each month as a percentage of the average of the year (see Sharma, 2009). The cycle, defined as an upturn or downturn not tied to seasonal variation and which usually results from changes in economic conditions (Arsham, 1996), is also calculated using SIMETAR-2008 by expressing each actual value in the time series as a percentage of the calculated trend for the same date, the resulting time series has no trend but oscillates around a central value of 100. In Nova Scotia, seasons are clearly determined, and the cycle much more stable than Quebec through seasons demonstrating a stabilisation tendency of prices. Consequently, there is a significant difference between the live lobster prices tendency in Quebec and Nova Scotia.

Figure 5. Cyclical indices and seasonal decomposition for Quebec and Nova Scotia



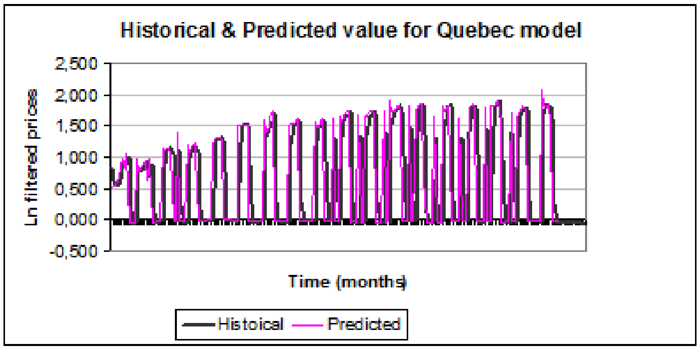
Finally, this model shows the difference between situations where industrials use a holding system technology to take advantage of the increasing prices (Nova Scotia) and another one in Quebec where this technology is less developed.

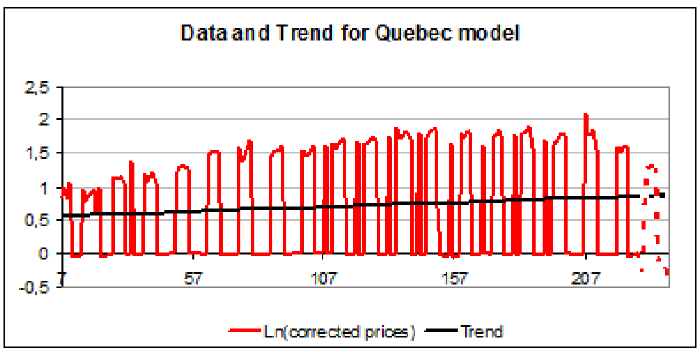
Figure 6. Live lobster prices for Nova Scotia model (technological effect)



The figure (6 a) for the Nova Scotia Model, shows a trend. As seen before, the first period of time is characterized by an increasing tendency of price variations, thereafter the trend becomes stationary. we run an impulse response function used in a vector autoregression to determine the effects of a shock to the system using the method described by Richardson et al. (2004), In Simetar, the impulse response function returns the number of time periods a system takes to stabilize (Richardson et al., 2004). A decreasing impulse response function shown in figure (6b) means the model is stationary for inflation rate filtered prices. This result is confirmed by the Dickey-Fuller Test absolute value (17.67 > $D\text{-}F_{critical,\ 0.05}$=-2.9). This value means that the hypothesis of a non stationary data is rejected. For Quebec, even if prices are filtered for inflation, the structural tendency of prices is towards an increase (Figure 7).

Figure 7. Live lobster real deflated prices trend for Quebec model





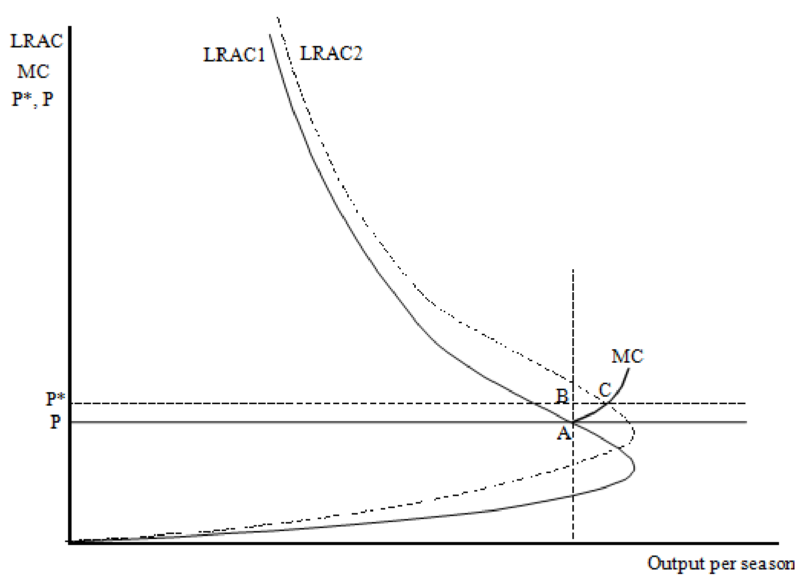
That is, this difference between the trend in Nova Scotia and in Quebec could be explained by differences in the long term induced technology effects, and the structural effects of the market. When both demand and supply are stationary or moving out proportionately and are not limited by stock effects, the effect is a stationary price series. When demand is growing relatively faster than supply, on the other hand, this leads to a consistent upward trend in prices. The fact that Quebec has used mainly input controls, including season length, to manage their fishery may have led to highly variable prices. Passive technological adoption in the fleet may increase real effort, which in the face of stock constraints leads to rising costs. Holding pen technology adoption by fishers associations can be expected to mitigate that variability, bringing seasonal prices more in line with the rest of Eastern Canada, and will likely lead to increased transitional profits for fishers, as the seasonal constraint becomes artificially removed. In Nova Scotia, on the other hand, lobster holding systems are much more wide-spread than they are in Quebec. The introduction of that technology in order to capture the effect of price variations may have caused a smoothing trend of price variations. Indeed, the price spikes due to the tourist season in Nova Scotia in a long term view, is captured by fishers and owners of lobster holding facilities. But why do we see the price trends in Nova Scotia tending towards stationarity? It may have to do with a less imposing stock constraint, increases in productive and management efficiencies that have kept pace with demand, and the widespread use of lobster holding facilities.

However, this begs an important question. What can Quebec fishers expect from a wide-spread adoption of lobster holding technology, given the present public management structure of their fishery?

Wilson (2009) has recently shown that in the lobster fisheries of eastern Québec between 2000 and 2006, the parameters associated with effective effort in the lobster fleet in Gaspé and the Magdalene islands has been increasing overall, despite regulatory measures aimed at controlling it. The reasons why this might happen could be exogenous to this study, which centers upon price. However, fisheries economic theory certainly predicts that price increases, for whatever reason, can have an impact upon the growth in effective effort. Therefore, price arbitrage might reasonably provoke passive technological changes in fleets that lead to cost-price squeeze over time, thereby partially negating the positive effect of that price arbitrage. This is especially true in cases where input controls are predominantly used to limit nominal effort. To see this, look at Figure 8. This is a theoretical representation of a fishery based upon a Gordon-Schaefer yield effort relationship. The long run industry offer curve can be backward bending, but in this case we assume that it is the sum of individual vessel marginal cost curves, and is not necessarily always at competitive long term equilibrium. We make no particular assumption about homogeneity of vessels, although in the case of Quebec, the productive units seem fairly homogeneous. Although the fishery faces a stock constraint, management measures may be such that it allows the collective group to capture rents. The fishermen group has the choice of promoting a change in industry structure away from input controls, which would lead to a gradual lowering of the long run costs at P, or adopting on-shore holding technologies and enjoying the possibility of having a long term price net of the costs of holding at P*, but keeping input controls in the fishery.

In this case, each fisher does enjoy an increase in profit that is comparable to what might have been obtained with management restructuring (P*BPA), and if the group is small enough and contracting costs are low enough, (and costs of exclusion are small, and spill-over effects with other groups slight) such a technology adoption could yield long term profit gains (point B). However, because inputs can be substituted, fishers gradually engage in active and passive technological adoption, that increases the real effort of the fleet. In the face of a stock constraint, this pushes up the average costs of the industry, which then in the long run will compete away the profits created by the technological adoption of holding technologies (point C). In addition, suppose that this technology is subsidized by a government agency, as a means of providing relief to fishers. The resulting equilibrium would then undermine any efforts by that same government, or another level of government, at stock re-building and management.

Figure 8. Rent capture and dissipation arising from the adoption of holding technologies. For simplicity, we assume that the industry is a long run common pool equilibrium at point A. Reorganization and technological adoption could result in rents (P*BPA). Increasing real effort in the fishery could cause the LRAC to rise with rents being dissipated (C).



Because of this, the adoption of lobster holding technologies may be a very good thing for fishers in the short to medium term, if it is something that can be done in conjunction with more fundamental changes in the management structure of the fishery, using approaches that reinforce or develop an effective system of property rights. However, encouraging these methods without more fundamental management change may provoke both over-exploitation of stocks and the competing away of these transitory gains.

Concluding remarks

We started the paper and discussion by describing the lobster pound technologies that were being studied by the fishers association in Grande Rivière Québec. Using a standard technical and financial analysis, we found what seemed to be the best technology for them. However, subsequent discussions on the likely long term gains led us to compare price flexibility equations for Quebec and for Nova Scotia, where such technologies are wide-spread. We found that price variability was lower there, but then we noticed that the actual legal seasons were longer, and that may have been related to other factors, including the style of public management of the fishery there. These revelations raised a number of questions about the Quebec case. The inevitable reduction in price variations as a result of adopting this technology will also extend the season artificially, but are the in-season controls on real effort efficient? Is there a discernable difference between collective public management structure and industry structure? Will the gains in profit experienced by fisheries associations which adopt lobster holding technology be competed away, because the fishery is based mainly upon input controls which make real effort growth in the sector harder to control? And finally, how isolated is the Quebec live market in reality?

Regional development agencies are often enthusiastic about the possibilities of proposing different technical solutions for local fishermen's groups aimed at improving profitability. Adopting techniques that allow producers to engage in price arbitrage seems to be an easy way to improve profits of fishers, and even to promote a more even distribution of a valuable commodity over time. The fact that such activities strongly resemble other arbitrage activities, such as forward contracting, reinforces the perception that adopting such technologies is a move towards greater efficiencies. We share that enthusiasm with two caveats. First, Quebec is arguably a province where relations between Federal and Provincial instances seem less coordinated. Land based policies promulgated by MAPAQ, a Quebec minister with interests in fisheries, might be promoted to improve the livelihoods of fishers, but there may not be a clear understanding of the links between these policies and the challenges of public management at the Federal level, and vice-versa. In the case of competing policies, sustainable management may actually become more difficult. Second, industry members must be made aware that until property rights and incentives in the fishery itself are organized such that the asset value of the stock being exploited is truly being managed by the stock holders, prisoner's dilemma common pool behavior can set in, leading to passive technical change and subsequent cost squeeze. If governments use direct and indirect subsidies to help regional fishers adopt such technologies, these competitive effects may become accentuated. There is some reason to believe that even in a fishery as well-managed as the lobster industry in Quebec, the property incentives in the industry are not yet to a point where these incentives are limited.

The very nature of arbitrage implies a leveling out of price variations over time, as has been seen in other areas like Nova Scotia. Both of these phenomena can eventually put competitive pressure on fishers even with the new holding technology. Our message therefore could be that in addition to encouraging the adoption of holding pen technology, development agencies and fisheries management agencies should work together at better defining property rights that are compatible with behaviors which are sustainable.

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