# THE IMPACT OF ECLECTRONIC AUCTION SYSTEMS ON FISH PRICES

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## ABSTRACT

Game and experimental theorists have specified the conditions under which different auction systems may lead to distinct price levels. By changing the sales organisation, the introduction of electronic auction systems on first-hand fish markets is expected to have modified bidders' habits, hence affecting the price levels. A demand model based on weekly series between January 1999 and December 2003 is estimated for *Nephrops norvegicus* in two French ports where different electronic systems have been introduced, in order to identify a structural break concurrent with the date of implementation. Because unit root tests led to reject the non-stationarity of series, a recent standard model searching for multiple breaks has been estimated. Evidence for a single breakpoint within the sample is found and discussed in socioeconomic terms.

**Key-words:** electronic auction, fish prices, structural change

## INTRODUCTION

The implementation of electronic markets for fishery products responds partly to the economic objectives of reducing transaction costs and eliminating market power by bringing transparency to markets, particularly on the demand side. Live markets are meant to be largely imperfect and tend to decrease in influence because of the number of intermediaries, the congestion of sellers coming into the market, the possible collusive behaviours through the personal relationships among buyers and/or sellers preventing the largest expression of private interests. The new technology of information systems is likely to build up "perfect" markets.

However electronic markets can also be considered as institutions translating the influence of stake-holders. Nobel prize R.H. Coase himself criticises the widespread ignorance that economists have about market institutions. If they consider financial markets as nearly perfect, it is simply because this type of transactions is largely formatted. Therefore his belief is that quasi-perfection of competition is linked with the adoption of a complex set of rules, not only by the free entry and exit of a multitude of agents [11]. The influence of economics and economists is not neutral in this process, far from it.

The purpose of this paper is to analyse the impact of the introduction of electronic markets on fish prices with respect to empirical and theoretical expectations. A simple demand model has been designed on the first-hand market of *Nephrops norvegicus* (Norwegian lobsters) of Lorient (France). This model is tested with weekly series of prices and quantities through a multiple break searching procedure ([4], [5]). The result of this procedure, confirmed by other structural change standard tests, identifies a break date close to the date of implementation of an electronic system. Explanations for this break have been investigated by face-to-face interviews with a few stake-holders (three managers of fish auction markets, one fishermen's representative, one computer engineer, one director of the Chamber of Commerce managing seven fish auction markets). The impact on prices in one of the markets is more due to the shift of system, from disorganisation to auctioning, than to the electronic equipment of a local market. Nevertheless, a wider project of interconnection is planned by the port managers and may affect profoundly the market organisation with uncertain long run effects.

## THE INTRODUCTION OF ELECTRONIC SYSTEMS IN FIRST-HAND FISH MARKETS

"*Auctions are the most prevalent form of pricing for wild-caught seafood in Japan, much of Europe, and many developing nations*" [1]. The adoption of auction systems was nonetheless somewhat controversial: "*In the mid-19th century, there was resistance to auctioning in British livestock markets because sellers feared collusion between buyers*" [16]. In France too, fishermen usually complain against the market power of on-shore primary buyers under the auction room [13]. Electronic markets have been introduced as a solution to solve the disequilibrium issue between buyers and sellers in favour of the latter: the objective of the leading supplier of electronic trading systems in Europe is "*to make your market more competitive, more transparent, and try to keep the added value on the production level as much as possible*" (Luc Schelfhout, Aucxis, cited in [16], p. 178).

The type of sales (ascending English auctions, descending Dutch auctions, Japanese auctions through a closed-seal bid) yet differs substantially from a species to another, sometimes even in the same country (case of the Japanese markets for giant squid and bluefin tuna, described in [1], p.108). In the United Kingdom most of the nephrops are sold though fixed-price contracts, whereas the shout auctions dominate the sales of benthic or gadoid species. The type of sales of the same species can even be different from a port to another [6]. The introduction of electronic markets follows the same heterogeneity in Europe. The Netherlands and Belgium were pioneers by introducing electronic systems in vegetable markets two decades ago, in 1984. The first experience on fish markets was Zeebrugge three years later. This port has a strong advantage with its geographical position close to the biggest European markets, but is limited by the low level of local landings, hence looking for new suppliers and buyers. In the same way, a remote bidding system was first introduced in Bergen (Norway) mainly because of the distance between the landing sites, the limited road network and the low domestic demand.

In France, the first experiences of electronic bidding systems took place in the mid-1980s. In most cases, the use of electronic technology is limited to a local computerised trading system. In 1993, only one third of the fish auction markets in France had substituted the shout system by an electronic device. A decade later the number of equipped harbours has substantially increased. The case of Lorient is interesting with its dual system for coastal and long-distant fleets. On March 19th 2002, the market of coastal species has been totally re-organised with the implementation of a Dutch bidding system under the fish hall, passing from a disorganised market where the fishermen were selling simultaneously to many fishmongers in face-to-face transactions to an auction market organisation where every buyer has an equal access to fish supply. In the same port since 1999 long-distant fishing boats sell their catches differently under a trading room with descending-ascending auctions[1]. The species, the suppliers and the buyers are totally different between the two systems, even though a few processors buy in both markets.

Another spectacular change came from seven ports of south Brittany, all managed by a single entity, the Chamber of Commerce and Industry of Quimper. One of these ports, Saint Guénolé, had first implemented in July 1987 a Dutch system in a trading auditorium where the fish lots pass on a roller bed; 75% of the buyers were also operating in the six neighbour shout auction systems and were able to compare the efficiency of both systems. Fifteen years later (April 2002) the six other auction markets have been equipped in one week by mobile electronic auction clocks[2], with a descending-ascending bidding process.

## EXPECTED IMPACT ON PRICES

### Weak empirical evidence

The empirical impact of electronic auctions remains unclear. "*The argument that would convince most fishermen of the benefits of electronic auctions would be the fact that their introduction leads to the payment of higher prices for their fish. Whilst there is anecdotal evidence that this can be the case, the underlying arguments for the achievement of higher prices at electronic auctions are weak*" ([10], p.56-

57). In particular, there is no empirical reason to expect higher prices if the community of buyers remains unchanged, unless market power could be avoided or transaction costs eliminated with the new system. What is usually expected empirically is that electronic auctions tend "*to slow the rate of fall in a falling market and the extent of fall of prices relative to shout auctions (…) and to increase the spread of prices between high and low quality product than is achieved through other sales mechanisms*" ([10], p. 57). A complete study on this subject brings opposite conclusions according to the port: prices are lower in Lowestoft where the electronic sales take place after the shout auction, and higher prices in Plymouth where a remote system has been implemented [6].

Whatever the impact on prices, it is admitted that electronic systems reduce the management costs of selling fish and they are often promoted as such by the suppliers of electronic systems. In particular they provide good market information and automation of back-office activities (accounting, invoices, transport, insurances, traceability). The time length of sales, particularly in the case of Dutch bidding, is considerably shortened[3], resulting in significant improvements (higher quality of fish, less queuing for the suppliers, faster access to consumer markets). Other indirect effects on prices could even be obtained. Luc Schelfhout believes that the speed of auctioning increases price levels: "*if you put pressure on the market you get higher prices, buyers have less time to think and probably pay a higher price*" (cited in [16], p. 178).

### Theoretical expectations of electronic auction systems

***The economic view.*** Four decades ago, Vickrey has demonstrated the equivalence of revenue between Dutch and closed-seal auctions on the first hand, because information owned by buyers is the same before the process, and between English and seal auctions on the other, under the assumption of independent and identically distributed (*iid*) random private values of risk-neutral buyers [22]. The equivalence means that the expected revenue is the same and that rational bidders follow the same strategy whatever the system. The Symmetric Independent Private Value (SIPV) model derives this equivalence from several assumptions. Among others, three assumptions are central in the model:

- bidders cannot be distinguished by their position on the market (symmetry)
- their private values are *iid* (independence)
- bidders and sellers are risk-neutral

Once after relaxing the assumptions, the revenue equivalence theorem might not hold and pricing appears to be different according to the auction mechanism ([18], [20], [21], [23]). For instance, in asymmetric auctions, a Dutch auction system may not select the bidder having the highest private value. If the auctioneer owns less information on bidders' preferences than the latter own about their rivals, a Dutch (or first-price) auction system is preferable than an English (or second-price) auction system, and the other way around if the auctioneer knows enough about bidders to set up a correct minimum price (Maskin and Riley 1993, cited in [23], p. 387). Secondly, independence means that private values are not positively correlated between each others. When they are (authors speak of 'affiliation'), it affects negatively the outcome of a Dutch auction system (not an English one). Last and not least, Dutch systems are also affected by the attitude towards risk. Risk averters with the highest valuations are not tempted to shade their preferences as they can loose the auction if they wait too long. Dutch systems then can lead to higher prices than achieved with English systems. This theoretical expectation fits remarkably with the empirical intuition of Luc Schelfhout of the last section.

When it comes to electronic markets (e.g. through Internet), the influence of other bidders could be even greater. Even when agents can perfectly calculate the equilibrium of a game, they will not base their decisions on this calculus, but with respect to their expectations of other players' strategies [17]. Expectations of others' strategies might be different with an electronic system than with a shout auction. In particular, Internet technology has modified the strategy of bidders because of asynchronies. For example, the introduction of a time limit for bidding has resulted in "sniping" behaviour, people waiting for the last seconds to make a bid below their private value [14]. A sociological view of the market would give theoretical support to this result: because the calculative algorithm is different, price-setting conditions should also be different, possibly resulting in price changes.

***The sociological view.*** The adoption of new technology in market organisation can be viewed as deterministic. In that view, a technological change causes social changes, as if it was elaborated outside any social influence, having its own intrinsic dynamics. Conversely, a contructionist approach sees technology as fully embedded in the social world. A third way is proposed by the Actor-Network Theory (ANT), which "*seeks to understand the process by which a network is constructed by enrolling social and material elements*" [9], i.e. how do the social groups involved in the innovating process interact through their power relationships. Technology and the social network are not separate elements, and the former is certainly not the output of the latter.

Applied to markets, the ANT approach pays attention to the social and technical mechanisms bringing up an acceptable compromise between agents having different interests. They consider that the diversity of market organisations, even in culturally close economies, provides evidence that markets are not shaped only by economic efficiency and transaction cost reduction motives. The way supply meets demand is analysed as a complex algorithm, i.e. a logical programme defining rules and operations that are simple enough to be calculated by a machine [21]. Obviously, these algorithms are not defined independently from their users: "*In negotiating the form of the technology of the electronic market the negotiation is acting as a surrogate for negotiating the social structure of the market network*" ([16], p. 14).

Two concepts are suggested to make explicit the process by which the rules are designed: **framing** and **overflowing** ([8], p. 16). The first one is inspired by Goffman to describe the frame in which interactions take place and whose meaning and nature impose themselves to the actors. In the context of markets, the traded elements must be properly and objectively defined, disentangled from their initial environment to permit the transfer of property, and calculable. The theoretical underlying idea is to create a space of calculability by making trading relationships as impersonal as possible. Some authors speak about "**lock-in**" to define "*all the mechanisms through which the evolution of a market or an institution becomes more and more irreversible*" (David 1984, cited by [8], p. 48).

The second concept of overflowing depicts the impossibility to keep up the transactions right into the frame. Any attempt to internalise externalities will produce new externalities. Callon uses a metaphor to refuse the division of research between sociologists and economists: his intention is not "*to warm-up the cold homo œconomicus by the additional soul of homo sociologicus (including his values, emotions, moods…)*" [7]. In a simple view, economists would consider that framing is the standard, and overflowing should be avoided, whereas sociologists would claim that framing is expensive and imperfect, and therefore that overflowing should be the standard. It appears far more productive to distinguish between a "cold" environment, when market institutions are locked in and accepted as such by economic agents, and a "warm" context when the institutional format of market is not sustainable. Economic calculus is obviously made easier in the cold framework. For instance, the Coasian theorem advocating bilateral negotiations in any problem of social cost would then only be valid in a "refreshed" context, i.e. when the evolution of property rights is rather low and not in "warm" –i.e. dynamic- situations where the lock-in remains uncertain. "*The intrinsic ability to negotiate (…) lies less in laws and institutions (and the clear allocation of property rights), than in the existence of a technical infrastructure of instruments and devices provided by them*" ([7], p. 420).

## THE BAI-PERRON METHODOLOGY AND RESULTS

It is actually very difficult to isolate the pure effect of electronic markets on prices from other effects. Prices of a same species can fluctuate a lot between different ports because of quality, different grading systems, low volumes, etc.

Two ports have been chosen to compare the price levels of the same species/presentation/quality: alive nephrops (*Nephrops norvegicus*) in Lorient and Le Guilvinec. These two ports, distant of about 100 kms, are quite comparable with respect to landed quantity of nephrops, with an average of respectively 770 t and 600 t per year for Lorient and Le Guilvinec. The sample of average nominal weekly prices covers the period between January-1 1999 and December-52 2003 (figure 1), showing a differential in favour of Le Guilvinec, particularly at the beginning of the period. The reduction of the gap after a certain point is all the more surprising as quantities have increased substantially in Lorient for the last two years of the sample, unlike in Le Guilvinec.

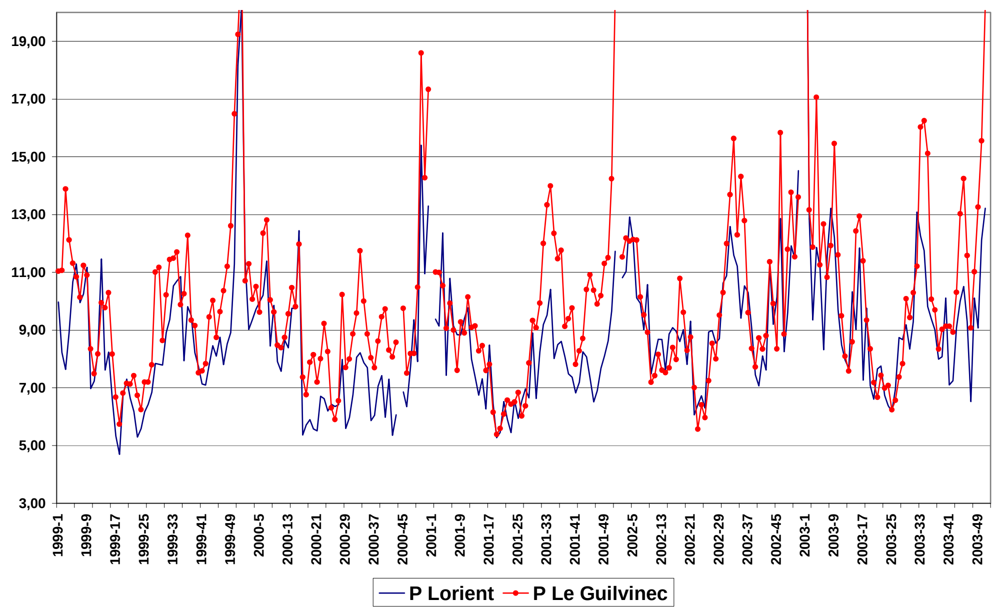


**Figure 1 Weekly prices (€/kg) of alive nephrops in Lorient and Le Guilvinec**
Source : Réseau Inter Criées (RIC) - Ofimer

The logarithm of the data has been applied so as to look at the quality of price transmission between the two ports. Because local prices could somewhat be affected by local changes in quantity, the landings in Lorient have been added to the model[4]:

$$Lplo_t = \beta_0 + \beta_1 Lpgv_t + \beta_2 Lqlo_t + u_t \qquad \text{(Eq. 1)}$$

Where Lplo is the Log of the price of nephrops in Lorient, Lpgv is the Log of the price of the same species in Le Guilvinec, Lqlo is the Log of the quantity of nephrops landed in Lorient and $u_t$ is the error term.

Several types of unit root tests have been performed to the three series (ADF, Phillips-Perron, KPSS, DF-GLS, Ng-Perron) along with different criteria (AIC, MAIC, BIC, HQ, general to specific) and various models (intercept, trend, both). To avoid a tedious presentation the main results are displayed in the appendix[5]. More evidence of stationarity is found for the three series. In most papers using time series of prices, the latter are I(1). In our case study the series have been amazingly found I(0) and have led us to use standard econometric techniques instead of cointegration[6].

Besides standard statistical tests of structural change (see below), the recent method proposed by Bai and Perron ([4], [5]) has been applied to model (1).

$$
\begin{aligned}
y_t &= x_t'\beta + z_t'\delta_1 + u_t \qquad t = 1,\dots,T_1 \\
y_t &= x_t'\beta + z_t'\delta_2 + u_t \qquad t = T_1+1,\dots,T_2 \\
&\vdots \\
y_t &= x_t'\beta + z_t'\delta_{m+1} + u_t \qquad t = T_m+1,\dots,T
\end{aligned}
\qquad \text{(Eq. 2)}
$$

where $y_t$ represents the Log of the price in Lorient, $x_t$ and $z_t$ are vectors of covariates with (px1) and (qx1) elements respectively and $\beta$ and $\delta$ are the corresponding vectors of coefficients. The indices ($T_1$, $T_2$,…, $T_m$) denote the unknown breakpoints.

A pure structural change model means that all coefficients are subject to changes at the same date and the corresponding variables should then be placed in $z_t$ (p=0). In a partial structural change model, some of the variables whose coefficient is not subject to changes can be placed in $x_t$ (with $p\neq0$). The Bai and Perron procedure allows to estimate the number and the date of the possible structural breaks ($T_1$, $T_2$,…, $T_m$) together with their confidence interval and to estimate the unknown regression parameters $\beta$ and $\delta_i$.

First of all, the number of structural breaks is determined. Several criteria can be used for this task: the sequential criterion, the Bayesian Information Criterion (BIC) and LWZ, a modified Schwarz criterion proposed by [19]. These criteria may produce with different results. Following [4] and [5], the sequential procedure has been preferred due to potential heterogeneity across segments. The critical values are computed in [4] and [5]. In our results, one should note that the number of breaks has been very stable between the different criteria.

In the present study, the emphasis has been put on the price integration effect between the two ports, thus placing both landings and the constant into $x_t$, the remaining Lpgv being placed in $z_t$. The results obtained (with more details in appendix) are:

$$
\begin{aligned}
Lplo_t &= \underset{(0.22)}{2.04} + \underset{(0.04)}{0.49}\, Lpgv_t \underset{(0.02)}{-0.11}\, Lqlo_t + u_t \qquad T = 1,\dots,156 \\
Lplo_t &= \underset{(0.22)}{2.04} + \underset{(0.04)}{0.57}\, Lpgv_t \underset{(0.02)}{-0.11}\, Lqlo_t + u_t \qquad T = 157,\dots,260 \\
& \qquad R^2 = 0.816
\end{aligned}
\qquad \text{(Eq. 3)}
$$

The standard errors are in parentheses (robust to serial correlation).The coefficient of Lpgv has increased after the structural change date (156 = last week of December 2001[7]), thus reflecting a better market integration between the two nephrops landing sites after the breakpoint. Another partial structural change model including only the landings in $x_t$ and the two remaining variables in $z_t$ gives similar results with an increase of $\beta_0$ and $\beta_1$ and an identical date of structural change. However, although a pure structural change model gives approximately the same breakpoint ($T_1$=162=February 4th 2002[8]), the parameters change in opposite ways as compared to (3):

$$
\begin{aligned}
Lplo_t &= \underset{(0.34)}{1.98} + \underset{(0.07)}{0.53}\, Lpgv_t \underset{(0.02)}{-0.12}\, Lqlo_t + u_t \qquad T = 1,\dots,162 \\
Lplo_t &= \underset{(0.29)}{2.72} + \underset{(0.04)}{0.50}\, Lpgv_t \underset{(0.03)}{-0.17}\, Lqlo_t + u_t \qquad T = 163,\dots,260 \\
& \qquad R^2 = 0.817
\end{aligned}
\qquad \text{(Eq. 4)}
$$

One reason for this surprising result could be given. After the break, the average gap between the two ports is decreasing, but this reduction has been offset by a substantial increase in the price volatility for the two ports, in particular for Le Guilvinec, as shown in table 1:

**Table 1 Descriptive statistics of the two periods**

| | PGV | PLO | PGV - PLO |
|---|---|---|---|
| Mean 1-162 | *9.7* | *8.3* | *1.4* |
| (Standard deviation 1-162) | *(2.7)* | *(2.3)* | *(0.4)* |
| *Coef. of Var. 1-162* | 0.28 | 0.27 | +1% |
| Mean 163-260 | *10.4* | *9.5* | *0.9* |
| (Standard deviation 163-260) | *(3.4)* | *(2.7)* | *(0.7)* |
| *Coef. of Var. 163-260* | 0.33 | 0.29 | +4% |

Consequently, the higher volatility may increase the price differential between the two ports for some weeks, thus increasing in overall the intercept between the two periods.

A few other standard break tests (Chow, Chow recursive, Cusum and Cusum square) have been performed in order to check up the results of the Bai-Perron procedure. Most of them point out the single date 162 as the possible date of structural change[9]. For instance, the Cusum test for model 1 is shown on figure 2. Even though the statistics comes out of the interval at date 180, the break appears to start earlier around date 160. The Chow recursive test, determining by itself the date of structural change, gives support to the selection of date 162 (F-stat = 38.6, significant at the 1% level). Both Chow breakpoint and Cusum square tests confirm this selection.

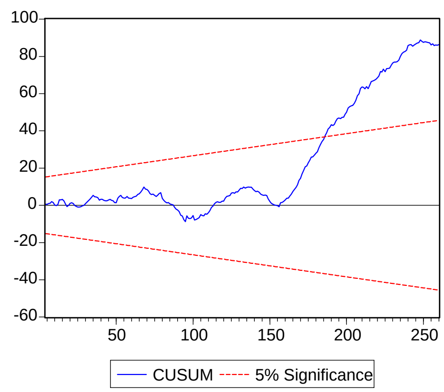


**Figure 2 Cusum test**

## DISCUSSION - CONCLUSION

The results indicate quite clearly that a single structural change has modified the parameters of the model within the considered period. The selected date falls around the last week of December 2001 (t=156) or the beginning of February 2002 (t=162). The confidence interval extends the period by including mid-November 2001 and April 2002. Interestingly, two major events took place during this period and may have affected the price of nephrops: first the implementation of the Euro currency since the 1st of January 2002 and secondly the implementation of electronic auction systems both in Lorient (March 19th 2002) and Le Guilvinec (April 22nd 2002).

Although it is difficult to separate the influence of these two effects, one could consider that the impact of the European currency should have equally affected the two ports. On the other hand the two electronic auction systems adopted in March-April 2002 are significantly different. In Le Guilvinec, the Moby-Clock is not supposed to represent a major change for sellers and buyers, as it reproduces quite faithfully the former shout auction system in force [12]. As shown in section 1, this is certainly not the case in

Lorient where the new electronic system has also represented a tremendous jump in the trading habits by substituting this modern system for the traditional face-to-face trading organisation.

Other effects have followed the implementation of the electronic bidding systems, such as the attraction of newcomers in Lorient both on the demand and supply sides. The director of the port reported that many fishing boats registered in the neighbour ports have joined Lorient, and several fishmongers are now coming daily from towns located 100 miles away from the port. Taking this date of February 4th 2002 as the possible structural break, the landings of nephrops in Lorient have increased from an average 12 tonnes per week before the break to nearly 18 t after, whereas they have only passed from 11 to 13 t per week in Le Guilvinec. Comparing the two periods, the effect on prices has not been negative for Lorient, far from it: the average price has more increased in Lorient (8.3 to 9.5 €/kg, i.e. +14.4%) after the break than in Le Guilvinec (9.7 to 10.4 €/kg; i.e. +7.2%), although it remains higher in the latter port, particularly in periods of market tension. In the three first years of the sample, the high season of nephrops starting in April and ending up in July produced higher prices in Le Guilvinec lasting until the end of the year. Since the implementation of the electronic auction systems, periods of higher prices are shorter and begin later in the season (August-September).

A simple and economic interpretation is to consider that greater transparency given by the electronic auction system in Lorient has pushed market power out of the system, therefore upgrading the price level of nephrops in line with other ports. The choice of a Dutch bidding system, faster for such a number of small lots, has certainly contributed to increase prices, as auction theory predicts it. Since no tradition of auction for coastal species pre-existed in Lorient, the auctioneer may own less information than bidders about their private values, and in such circumstances a Dutch (or first-price) system provides with higher prices than an English (or second-price) auction. This system is not affected by affiliation among bidders because two categories of buyers with independent private valuations are present in Lorient. Every day, during the first hour of the sales, distant fishmongers with high private valuations dominate the auction and are willing to pay higher prices for the fish before leaving the port in the middle of the sales. For the last hour, both local fishmongers and primary processors make the bulk of buyers, pushing the price downwards. As a result, prices can fluctuate a lot between the beginning and the end of auction sales. Finally, the risk attitude of buyers has necessarily changed because entry barriers have been removed. In the traditional face-to-face system, some of the buyers had an exclusive access to high quality products that were pre-purchased and even not passing under the fish hall. The fishermen themselves were price makers in this system and often did not dare to propose too high prices in periods of high demand. With the new system, they are not staying for the sales and prices are set up mechanically without upper limits or so, explaining the higher volatility within the year. As a conclusion, higher average prices observed in one of the ports are certainly more due to the substitution of auctioning for the disorganised market previously in force, than to the use of electronic equipment itself.

Besides this economic analysis, one should note the influence of the port managers on the implementation of electronic auction systems. This equipment represents a tremendous formatting effort, both in financial terms and in habit changes. This effort could have been undertaken earlier, as demonstrated by the example of Saint Guénolé in 1987, but many fish markets have experienced for many years a strong resistance to any type of change, mainly coming from the buyers. Some market difficulties and the introduction of Euro have represented good opportunities for the implementation of electronic auction systems under the pressing support of convinced harbour managers and the assistance of European and regional subsidies. The example of Lorient is very similar to the case of the strawberry market in Sologne (France) where a disorganised market had been converted into a “pure” walrasian auction system with a large amount of money: construction of warehouses, presentation of the commodities into lots described with batches, electronic catalogue of the suppliers, electronic auction clock, etc. [15]. In south Brittany where six ports have been simultaneously equipped, not all of them have been successful to sustain a market activity in spite of the investment. No particular impact on prices was expected in these ports and the achievement fits with expectations. However, the underlying idea is to prepare gradually the economic agents to the project of interconnecting fish markets on a regional or even broader scale. Although local, the new systems include a remote bidding access allowing the primary processors to follow the sales on the computer screen and buy from their office. If the decision is made, the electronic system could allow more distant buyers to participate.

Like for strawberries where the market designer was mentally educated in economics, one should recognise "*the embeddedness of economic markets in economics*" [8], i.e. how economics frames the economy. The diversity of trading and bidding systems in use, sometimes within a single country or region, demonstrates that the selection of market technology is not entirely motivated by economic efficiency, but reveals the negotiation of the social structure in the market ([10],[12],[16]). Some influential stake-holders play the role of mediators between economics and economy, framing the market as it "should" be theoretically. The transfer of economic concepts and tools to the real world can be more or less successful according to the social structure and interests in the negotiating process. A further step in the widening of electronic fish markets is likely to produce uncertain effects on local market organisations, with detrimental social consequences for intermediaries due to the purchasing power of the retailing industry. The enrolment of market devices and social relationships has locked in the market temporarily and somewhat enables sellers and bidders to calculate. The institutional framework is not yet "refreshed" as a wider remote bidding system is likely to emerge in the years to come. Not only new effects on prices should be expected, but some changes in the market organisation would be interesting to forecast in this new frame.

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## ENDNOTES

[1] A launching price is proposed by the auctioneer and then ticks down around the clock. When a buyer makes a bid the clock stops with three lights switched on for about one second each. During this delay, other bidders may intervene and push the clock to increase again until a single buyer remains on the auction. This system takes more time than a simple Dutch system because the price can decrease a lot before increasing again.

[2] This system has been implemented by Aucxis under the name of Moby-clock. It can be defined as "*an electronic auction clock mounted on a battery powered vehicle which can move through the auction hall*" ([16], p. 182).

[3] Some estimations indicate that organising sales of 25 suppliers facing 25 buyers would take around 3 hours in a live system against half an hour only with a Dutch electronic system ([16], p.183). However, the case of Lorient shows that sales in face-to-face transactions taking place simultaneously take as much time (or even less) as electronic bidding organised successively, lots by lots.

[4] The price in Lorient has been defined as the dependent variable because the leading port for the price of nephrops is assumed to be Le Guilvinec. Moreover, Lorient is the harbour where the implementation of an electronic auction system represents the biggest technological jump of the two markets.

[5] More details about the tests could be provided upon request.

[6] Nonetheless, because very few tests acknowledged the possible presence of a unit root, a Gregory-Hansen methodology has been applied as though the series were non-stationary and gave unclear conclusions about the specific date of a structural break. Only when using aggregated data (mixing up all types of nephrops), the GH model produced results comparable to standard models, pointing at the specific date of late January 2002 as the possible break date. However, when using disaggregated data, the different GH models gave distinct and unclear break dates. These results should therefore not be taken into serious consideration.

[7] This date is surrounded by a 95% confidence interval of 150-167 (mid-November 2001 – mid-March 2002).

[8] The 95% confidence interval for this date is 155-170 (late December 2001 – early April 2002)

[9] A Chow recursive test including 51 seasonal dummies has even indicated date 168 (F-stat = 3.76 at the 1% level), i.e. March 18th 2002, the exact date of implementation of the electronic market in Lorient.

## APPENDIX

### Table 2 Has the time series a unit root ?

| VARIABLES | DF-GLS-I | DF-GLS-B | MZa-I | MZt-I | MSB-I | MPT-I | MZa-B | MZt-B | MSB-B | MPT-B |
|---|---|---|---|---|---|---|---|---|---|---|
| LPGV | No (a) | No (b) | No (a) | No (a) | No (a) | No (b) | No (a) | No (b) | No (a) | No (c) |
| LPLO | No (a) | No (b) | No (a) | No (a) | No (a) | No (b) | No (b) | No (c) | No (b) | No (c) |
| LQLO | Yes | No (b) | Yes | No (c) | Yes | Yes | No (c) | No (c) | No (c) | No (c) |

Note: a, b and c denotes a statistic significant at the 1%, 5% and 10% level, respectively.
The MAIC criterion has been used for all the tests.

| VARIABLES | ADF -AIC | ADF -SC | ADF -HQ | ADF -GE | PP | KPSS-I | KPSS -T |
|---|---|---|---|---|---|---|---|
| LPGV | No | No | No | Yes | No | No | No |
| LPLO | No | No | No | No | No | No | No |
| LQLO | No | No | No | No | No | No | No |

Note: the 5% significance level has been considered for all these results
AIC: Akaike information criterion
MAIC: Modified Akaike information criterion (Ng and Perron, 2001)
SC: Schwarz criterion
HQ: Hannan-Quinn criterion
GE: General to especific criterion
I: Intercept
T: Trend
B: Both (intercept+trend)
MZa, MZt,MSB,MPT: Unit root tests proposed by Ng and Perron (2001)

### Table 3 Empirical results (equation 3)

| Specifications | | | | |
|---|---|---|---|---|
| $Y_t=\{Lplo_t\}$ | $Z_t=\{Lpgv_t\}$<br>q = 1 | $X_t=\{1, Lqlo_t\}$<br>p = 2 | M = 3 (1)<br>h = 39 | ε = 0.15 (2) |
| **Tests (3)** | | | | |
| $SupF_T(1)$<br>71.6371* | $SupF_T$ (2)<br>40.8089* | $SupF_T$ (3)<br>25.3118* | UDmax<br>71.6371* | WDmax<br>71.6371* |
| SupF(2\|1)<br>3.8367 | SupF(3\|2)<br>3.8367 | | | |
| **Number of breaks selected (4)** | | | | |
| Sequential | 1 | | | |
| LWZ | 1 | | | |
| BIC | 1 | | | |

**Notes:**

(1) M (Max number of breaks) equal to 2 and 5 has also been taken into account, obtaining similar conclusions.

(2) Other values (0.10, 0.15, 0.20, 0.25) have been considered for the trimming parameter, obtaining similar conclusions. ε equal to 0.05 has been discarded because it is a quite low value for our case study. According to [5], if serial correlation and/or heterogeneity in the data or errors across segments are allowed, a higher trimming is needed.

(3) Serial correlation in the disturbances is allowed. Following [5], the autocorrelation and heteroscedasticity consistent covariance matrix is constructed following Andrews [2] and [3] employing a quadratic kernel with automatic bandwidth selection based on an AR(1) approximation. The residuals are not pre-whitened using a VAR(1).

[(4)] The significance level used for the sequential test $supF_T(l+1|l)$ is equal to 5%.

* Significance at the 5% level.

**Table 4 Empirical results (equation 4)**

| Specifications | | | | |
|---|---|---|---|---|
| $Y_t$={Lplo$_t$} | $Z_t$={1,Lpgv$_t$,Lqlo$_t$}<br>q = 3 | $X_t$={0}<br>p = 0 | M = 3 [(1)]<br>h = 39 | ε = 0.15 [(2)] |
| Tests [(3)] | | | | |
| $SupF_T(1)$<br>85.0812 * | $SupF_T$ (2)<br>66.1916 * | $SupF_T$ (3)<br>34.3575 * | UDmax<br>85.0812 * | WDmax<br>85.0812 * |
| SupF(2\|1)<br>13.1237 | SupF(3\|2)<br>5.4341 | | | |
| Number of breaks selected [(4)] | | | | |
| Sequential | 1 | | | |
| LWZ | 1 | | | |
| BIC | 1 | | | |

**Notes:**

[1] M (Max number of breaks) equal to 2 and 5 has also been taken into account, obtaining similar conclusions.

[2] Other values (0.10, 0.15, 0.20, 0.25) have been considered for the trimming parameter, obtaining similar conclusions. ε equal to 0.05 has been discarded because it is a quite low value for our case study. According to [5], if serial correlation and/or heterogeneity in the data or errors across segments are allowed, a higher trimming is needed.

[3] Serial correlation in the disturbances is allowed. Following [5], the autocorrelation and heteroscedasticity consistent covariance matrix is constructed following [2] and [3] employing a quadratic kernel with automatic bandwidth selection based on an AR(1) approximation. The residuals are not pre-whitened using a VAR(1).

[4] The significance level used for the sequential test $supF_T(l+1|l)$ is equal to 5%.

* Significance at the 5% level.