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The Emergence and Impact of Market Institutions: The Wholesale Market for Fish and Other Perishable Commodities.

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The Emergence and Impact of Market Institutions: The Wholesale Market for Fish and Other Perishable Commodities.

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Abstract

This work introduces a special issue of the Journal of Economic Behavior and Organization on the emergence and impact of market institutions in wholesale fish markets. The analysis of fish markets has a respectable pedigree also in terms of the description of how they function. A major advantage of the analysis of fish markets in this literature is that it often gathers and exploits information that is typically not available in official market statistics. A full understanding of market dynamics, for example, is easier to obtain if one can observe not only the final outcomes of bilateral transactions which are not observed by other market participants, but also the so-called "transactions that did not happen", i.e. offers and counteroffers that were refused by the trading parties. Fish markets exhibit two features that make their analysis appealing for economists. On the one hand, fish is a perishable good, and because stocks cannot be carried over from one day to the next, the formal analysis of this market is simpler. Indeed, with no inventories, successive market sessions can be thought of as independent, at least approximately. The second intriguing feature is that the organization of fish markets varies from location to location with little obvious reason, some with pairwise trading, where prices are not posted, and others based on auctions, where, by definition, price information is centralized and publicly available. Such observed differences help also in in understanding how individual learning and adaptation take place under different market architectures, how markets adjust to disequilibria, and to what extent collective rationality is rooted in individual rationality. The research questions covered by the selected papers include, first, the impact of decentralized pair-wise bargaining versus centralized auctions on the statistical properties of fish prices and traded volumes; and second, the ways information-processing, decision-making capabilities and behavioral rules are deployed by agents and influenced by market set-ups and market size.

Keywords: Fish markets, market institutions, aggregation, learning.

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The economic analysis of fish markets has a long history. In the nineteenth century, the fish market inspired an active debate over the correct definition of the demand for a commodity, as well as over the

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very notion of an equilibrium price. Celebrated economists, such as John Stuart Mill (1869) and Thornton (1870), were involved in discussions that have had echoes until recently, as testified by the analysis of Mill's and Thornton's positions in Negishi (1985, 1986, 1989) and Ekelund and Thommesen (1989). Marshall (1890) is often described as having used the fish market in order to illustrate the workings of supply and demand in his *Principles of Economics*. However, he actually described the corn market as one which functioned according to the basic principle of equilibrating supply and demand. He only cites fish markets, and this is important for this special issue, because they have a special feature. On each day the buyers consider the supply as fixed and on the day and, as Marshall said, on such markets it is only demand that adjusts.

The analysis of fish markets has a respectable pedigree also in terms of the description of how they function. Indeed, there is a substantial historical literature describing their functioning and institutions, which starts with detailed studies of the Roman fish market (see De Ruyt, 1983). Anthropologists have also made exhaustive studies of particular fish markets, and perhaps the most noteworthy is that of the Tokyo fish market by Bestor (2004). In economics, the most recent literature on fish markets includes some detailed accounts based on field observation and data collection. Worth mentioning are the contributions of Wilson (1980), Kirman and Vignes (1991), and Graddy (1995, 2006) on the New England, Marseille, and Fulton fish markets, respectively. A major advantage of the analysis of fish markets in this literature is that it often gathers and exploits information that is typically not available in official market statistics. A full understanding of market dynamics, for example, is easier to obtain if one can observe not only the final outcomes of bilateral transactions which are not observed by other market participants, but also the so-called "transactions that did not happen", i.e. offers and counteroffers that were refused by the trading parties (see Kirman, Schultz, Härdle and Werwatz 2005 on the wholesale fruit and vegetables market). Considering sales as the outcome of a bargaining process rather than simple observations of transactions gives a much better understanding of the evolution of prices.

Fish markets exhibit two features that make their analysis appealing for economists. On the one hand, fish is a perishable good, and because stocks cannot be carried over from one day to the next, the formal analysis of this market is simpler. Indeed, with no inventories, successive market sessions can be thought of as independent, at least approximately (Härdle and Kirman 1995) - and indeed, this is what Marshall was referring to for buyers. This is quite an attractive feature given the repeated nature of interaction in this market, where buyers and sellers often participate over many years. But the second and perhaps more intriguing feature is that the organization of fish markets varies from location to

location with little obvious reason. Perhaps the main division is that between markets with pair-wise trading, where prices are not posted, as in Marseille and at the Fulton market, as opposed to those based on auctions, e.g. in Tokyo, Sydney and in the Adriatic cities of Ancona, Pescara and Giulianova (Italy), where, by definition, price information is centralized and publicly available. In turn, one finds differences between the types of auction, sometimes even in the same country. For instance, Dutch and English auctions coexist in Iceland (see Graham 1998). In Norway, pelagic fish are sold by intranet sealed-bid auction, while demersal species are sold through intranet open English auctions (Armstrong 2001). Fish auctions also differ depending on whether the fish is available for viewing or, as it is the case with electronic auctions, it is not. In a similar vein, the way in which fish markets are organised does change over time. Shout auctions have often given way to electronic auctions (Graham 1998, Guillotreau and Jiménez-Toribio 2006), and , in some cases,auctions have replaced bilateral trading. There are even subtle differences in electronic auctions. In some markets such as that at Looe in Cornwall, the clock for the auction is moved from lot to lot, giving buyers time to examine the fish, whilst in Ancona each lot of fish passes rapidly on a belt and buyers have much less time to inspect the fish. The rationale behind the choice of specific market organizational forms is a research topic which has not received enough attention to date.

Following the lead of the early economic thinkers mentioned above, we contend that some of the insights yielded by the analysis of fish markets may be carried over to other real markets, possibly carrying more general implications as to how the dynamics of interactive market processes unfold. In particular, we are most interested in understanding how individual learning and adaptation take place under different market architectures, how markets adjust to disequilibria, and to what extent collective rationality is rooted in individual rationality. With respect to the latter issues, fish markets provide a relevant test bed. For instance, the available evidence (e.g. Härdle and Kirman 1995 on the Marseille fish market) shows that the fact that aggregate "demand" for fish is well-behaved does not reflect similar behaviour of the individual demand patterns of the buyers, i.e. processors, restaurant owners, or retailers. Analyzing fish markets can also yield insights as to the determinants of price dispersion, which is observed on fish markets and can, for example, be due to price discrimination (Graddy 1995) or to the loyalty of buyers to sellers (see e.g. Wilson 1980, Kirman and Vignes 1991).

With all of this in mind, the purpose of this special issue is to make some progress towards answering some crucial questions about the emergence of the institutional aspects of markets and their impact on market outcomes. The research questions covered by the selected papers include, first, the impact of decentralized pair-wise bargaining versus centralized auctions on the statistical properties of

fish prices and traded volumes; and second, the ways information-processing, decision-making capabilities and behavioral rules are deployed by agents and influenced by market set-ups and market size. More specifically, as far as behaviour is concerned one would like to know whether: loyalty is still observed in auctions, despite the lack of interpersonal buyer-seller contacts? How do buyers' behaviour change after the move to a non-viewing (i.e. electronic) trading set-up? To what extent does rationality as opposed to path dependent adaptation drive the observed pricing strategies (such as price discrimination) and the choice of particular forms of market organization?

The papers offer a thorough and detailed description of the trading mechanisms adopted by fish markets in different countries (United States, France, Italy), and of their evolution over time. Moreover, they provide convincing accounts of how changes in protocols have been driven by, or at least affected by, market participants themselves. For this, the papers draw on an interdisciplinary blend of economics, statistics, and sociology. The research issues are addressed with a wide array of research methods – from auction theory to price discrimination analysis, from probability theory to panel data econometrics, all the way to calibration. The papers included in this special issue yield valuable insights which may lead to further advances in the economic modeling of market evolution and dynamics, well beyond the confines of the fish market.

Synopsis of the articles.

The first article, by Kathryn Graddy and George Hall, uses data collected on the Fulton fish market to quantify the advantages for sellers, in profit terms, of engaging in third-degree price discrimination versus posting a single price to all retailers. The market is organized as a take-it-or-leave-it price-setting mechanism, and ethnicity is an observable trait that can be used to discriminate among buyers. Indeed, since Asians cannot pass price increases on to their low-income final customers, they need to bargain very hard and search extensively for better deals. Quite the contrary holds for white retailers.

Graddy and Hall set up a model in which the total market supply is drawn from a random process driven by weather conditions, retailers show up in a Poisson fashion, and wholesalers are able to perfectly observe the retailers' types (white or Asian). Based upon these pieces of information wholesalers optimally solve two problems: price discrimination and inventory management. The predictions of the price discrimination model are thus compared with a uniform-price counterfactual. The model is calibrated, setting the values of some parameters (e.g. intra-day discount factor, depreciation rate, transition probabilities between weather states) to match the observed characteristics of the market, and estimating the others. The findings of the article indicate that by posting a single

price, a wholesaler would receive only about $6 per day less (about 15/100 of one percent of total revenue) compared to price discriminating. This raises the question: why do wholesalers continue to price discriminate despite the lack of economically significant advantages? This is puzzling, since price discrimination may diminish the demand by consumers with low search costs who could rather shop around, gives rise to negotiation costs related to bargaining, and can impose psychological costs on buyers that can be detrimental to wholesalers' profits in the long run. Graddy and Hall point out that there are possible difficulties with their model, but conjecture that given the length of time that many participants have been on the market, sheer inertia may provide a large part of the answer.

Patrice Guillotreau and Ramòn Jiménez-Toribio provide a twofold - economic and sociological - approach to study the impact of the shift to electronic auctions and remote bidding on the level and volatility of wholesale fish prices. The authors provide a thorough review of the several instances of electronic fish markets in France and focus on two Breton locations, namely Le Guilvinec and Lorient, where electronic bidding was introduced approximately at the same time in 2002. In Le Guilvinec a shout English auction was replaced with an intranet English auction, while at Lorient market managers replaced a pairwise bargaining system by a Dutch electronic auction. The authors test for structural change in univariate and vector-autoregressive time series models, finding that prices in both markets experienced an upward shift after the introduction of electronic bidding. Further evidence reveals that volatility, too, increased after the change.. Such increases in fish prices and in their volatility are not due to market enlargement per se, since electronic bidding seems to have affected the asymmetry among bidders as well as their exposure to risk. In the authors' view, however, the introduction of electronic auctions should be seen as a step towards a fully non-viewing procurement system, presumably to the advantage of the wholesalers. While no evidence is yet available as to the effects of remote bidding, an interesting conjecture by the authors is that non-viewing procurement would break the social relationships between buyers - and their affiliation of values - as well as waste their competence at assessing the quality of fish, which is an essential though often neglected source of a fish buyer's strategic advantage.

The article by Mauro Gallegati, Gianfranco Giulioni, Alan Kirman and Antonio Palestrini tackles a number of stylized facts on the fish market, using transaction-level data collected at the Ancona fish market. The questions dealt with in the paper can be roughly summarized as follows. First, do stylized facts (e.g. loyalty and the "declining price paradox") relative to markets with pair-wise bargaining survive under a Dutch auction set-up? A second question concerns the empirical relevance of some tenets of neoclassical microeconomics, such as market efficiency and the isomorphism

between individual and aggregate demand functions. The authors find that even in a Dutch auction market, patterns of loyalty are observed – not loyalty to sellers, with whom buyers have no direct contact, but rather to a fishing vessel. It appears that positive past experience with the fish bought from a vessel leads to reinforcement learning. Interestingly, in contrast to the Marseille fish market, based on pair-wise trading, loyal buyers obtain lower prices on average. This is seemingly related to market inefficiency: indeed, the paper finds that there are buyers (as well as sellers) that get systematically better deals in terms of prices paid (or received). Further evidence in the paper reveals that the fish price declines over the trading day, but increases slightly in the last transactions, and this is most pronounced on days when the catch was rather limited. As explained by the authors, it takes a number of transactions before the uncertainty about the size of the catch is resolved; then, buyers realize that they need to purchase, even at high prices, if they wish to satisfy the demand by final consumers. Hence, buying at higher prices in the last transactions can be an optimal strategy. Finally, the empirical examination of individual demand patterns reveals that there is no correspondence between individual and aggregate demand properties. One cannot reject the hypothesis that the aggregate "demand" (quantities purchased as a function of price), for a certain fish species is downward-sloping, while this is not the case for individual demand. A simple explanation, originally proposed by Cournot, is that the aggregate relations are not derived from rational optimization at the individual level but simply come from the fact that reservation prices are heterogeneous across buyers.

In their article, Gianfranco Giulioni and Edgardo Bucciarelli start from the presumption that markets of different size impose different informational burdens on their participants. In particular, in larger markets the greater amount of information to be processed makes it harder for traders even to try to optimize. Complexity, in the sense of Hodgson (1997), appears relevant in this context. With this as the basic idea, the authors compare the agents' behaviors on two nearby Italian fish markets, Pescara and Giulianova, the former being larger. In both markets, fish is sold through Dutch auctions, with minor procedural differences. Fish cases are displayed on conveyor belts, their quality is observed by the buyers, and cases are sold one at a time. Giulioni and Bucciarelli abstain from analyzing fish prices, owing to difficulties in controlling for quality differences within species, and rather deal with the order of fish presentations and with loyalty. The first question is: are there preferred orderings of fish cases by sellers, or do they put cases on the conveyor belts in random order? The finding is that cheap fish is presented before higher quality (and more expensive) fish. What the authors conjecture is that buyers' arrival times are such that early in the trading day competition between buyers is very low. Therefore sellers are better off delaying the presentation of expensive fish until more customers show up and raise

the price. As to the second question, loyalty, the findings are in accordance with the evidence shown by Gallegati et al. on the Ancona fish market (this issue): buyers develop loyalty to certain vessels which have guaranteed better fish quality in the past.

Finally, the paper by Annick Vignes and Jean-Michel Etienne analyzes data from the Marseille fish market with the aim of measuring the respective importance of market-based and social interactions in driving fish prices in a take-it-or-leave-it price system. Market interactions are captured by correlation between the prices of transactions involving the same buyers and sellers in a given trading day. Arbitrage and bargaining by buyers characterized by different reservation values underlie such correlations, that the authors estimate by means of panel data methods. In addition, the authors build a seller-seller network, where two sellers are linked if they share at least one buyer. Sellers who are more central in the network are also those who share more buyers with their competitors, i.e. greater centrality means stronger competition between sellers. Vignes and Etienne show that the explanatory performance of the econometric model improves once a measure of network centrality is included among the explanatory variables, and that the point estimate of the centrality coefficient is positive. The latter result shows, quite paradoxically, that stronger competition between wholesalers is associated with higher prices. The paradox is solved by noting that the less central sellers are likely to entertain loyalty relationships with particular buyers. Loyalty, therefore, proves essential in explaining price dispersion.

Implications for the theory and for future research.

It has been said that good research raises as many new questions as it answers. The articles in this issue, indeed, suggest promising interpretative conjectures together with, questions on which to focus new research.

First, in the articles in this special issue one finds an unresolved tension between the explanations of the empirical regularities derived from standard economic theory and those derived from alternative approaches. Certainly, robust behavioral patterns seem to be quite at odds with the most naïve versions of optimizing behaviors. Some of the evidence can be relatively easily rationalized in terms of (more sophisticated) maximizing rules, while other features seem to be better explained by the assumption of boundedly rational, heterogeneous agents selecting their strategies by means of adaptive (possibly reinforcement-driven) learning of some kind. Thus, the appropriate theoretical basis for the interpretation of the empirical regularities is still open. For instance: to what extent can one rationalize e.g inertia in pricing strategies, and the creation of social ties, in term of a standard

decision making model? Or, conversely, to what extent are they "boundedly rational" but robust ways to cope with environmental complexity? All of this raises a more subtle methodological question, namely, is the rational choice paradigm "uniformly" inferior to an evolutionary one in fitting the evidence (in this case from the fish markets, but the issue is much more general), or can one "parametrize" a threshold – related to uncertainty, problem complexity and computational capacity of the agents - below which standard economics provides a reasonably adequate and possibly more parsimonious approximation?

Second, the evidence from fish markets vividly illustrates the lack of isomorphism between individual behaviors - including the prices-quantities profiles of individual buyers - and the aggregate price-quantity patterns emerging in the market. Of course such property further vindicates the notion that it is analytically misleading to try to account for aggregate dynamics in terms decisions of a purported "representative agent" (Kirman, 1989, 1992, 2010). Rather, aggregate dynamics - starting from those of prices and quantities – ought to be properly understood as an emergent outcome of the interaction of multiple heterogeneous budget-constrained agents.

Third, the papers that follow add evidence for the proposition that the institutional architecture of a market (e.g. whether based on pair-wise interaction vs. auctions of different types) influences the revealed outcomes - in terms of price levels, dispersion, volatility etc. – even when holding unchanged the characteristics of the object traded and plausibly the "ecology of behavioral rules" of market participants (similar results have been found for the stock markets by Bottazzi, Dosi and Rebesco, 2005). However, if this is generally the case, the challenge ahead, well beyond the confines of the fish markets, is to undertake taxonomic exercises mapping different market "types" into different statistical properties of the ensuing profiles of prices and quantities.

Fourth, the architectures of fish market themselves have changed in recent years. It would be interesting to understand the extent to which standard economic theory has shaped the choice of fish markets' organizational forms. Has consultancy by mechanism design theorists been as influential in the adoption of new fish market architectures, as it has been, say, in the design of the FCC spectrum auctions in the United States (see Milgrom 2004)? And, conversely, what has been the role of local learning and history dependence?

These are but some of the many interesting questions suggested by the results of the articles selected for this special issue. More research on the dynamics of trading in commodity and other markets is likely to be stimulated. In turn, as further pieces of evidence are collected, at last, this should significantly enhance our understanding of the emergence and impact of market institutions.

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