

Markets

The Fulton Fish Market

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This feature explores the operation of individual markets. Patterns of behavior in markets for specific goods and services offer lessons about the determinants and effects of supply and demand, market structure, strategic behavior, and government regulation. Suggestions for future columns and comments on past ones should be sent to James R. Hines Jr., c/o *Journal of Economic Perspectives*, Department of Economics, University of Michigan, 611 Tappan Street, Ann Arbor, MI 48109–1220.

Introduction

The Fulton Fish Market was a colorful part of the New York City landscape that operated on Fulton Street in Manhattan for over 150 years. In November 2005 the market moved from the South Street Seaport in lower Manhattan to a large facility built for the market at Hunts Point in the South Bronx. The Fulton Fish Market—now called The New Fulton Fish Market—is one of the world's largest fish markets, second in size only to Tsukiji, the famous fish market in Tokyo.

To economists, it may seem that a large centralized market with well-informed buyers and sellers should also be a very competitive market. But fish is a highly differentiated product. From 100 to 300 varieties of fish are sold at the Fulton market—with 15 to 20 different varieties of shrimp alone. Within each variety, there are large fish, small fish, fish that were just caught, and fish that have been around awhile (sometimes longer than they should be). Restaurateurs, retailers and even consumers often wish to examine fish themselves or to have their agents do so. The

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centralized market performs a matching function—matching fish to buyers of fish—and large centralized markets make this matching easier and more efficient for everyone. Indeed, the heterogeneity of fish explains why centralized fish markets have tended to survive, whereas methods of supplying other goods have often become decentralized with time. Unlike, say, many agricultural and industrial products, fresh fish is not easily treated as a well-defined commodity. Fish is more perishable, supply is more unpredictable, and individual fish are more heterogeneous than most agricultural products.

The high level of product differentiation and the institutional structure in the Fulton fish market can lead to patterns of behavior that suggest imperfect competition and a segmented market. Buyers at the fish market act as agents for customers with very different elasticities of demand, from restaurants selling fishballs in Chinatown, to expensive East Side restaurants, to fry shops serving fish sandwiches in Harlem, to suburban fish retail outlets. At times in the past, the repeated nature of price setting and extensive knowledge of the sellers may have created the basis for tacit collusion and allowed the dealers to gather economic rents by exploiting the different elasticities and buying patterns. Additional economic rents at the market were created by subsidized rents, and lax regulation created fertile ground for organized crime to operate.

History

The Fulton market was historically located in lower Manhattan, near the Brooklyn Bridge, just a few blocks from Wall Street. The market first opened on that site in 1807 on land donated to New York City, and at first was a general market for both fish and goods other than fish. In 1822 the fish merchants occupied a new Fulton market building, located on South Street between Fulton and Beekman Streets. Prior to 1850, housekeepers from Brooklyn and nearby areas would purchase fish directly from the market. However, since that time, wholesale customers have been the primary buyers (Slanetz, 1986). The market gradually gained in importance, and in 1924 the market sold 384 million pounds of fish, 25 percent of all seafood sold in the United States (Miller, 1991).

However, the relative importance of the Fulton market declined in recent years because of competing geographic markets such as Philadelphia and the New Jersey docks, and also because of the increasing use of national or regional suppliers. Philadelphia's market, although much smaller in size, was more convenient for merchants located near the area. The New Jersey docks allowed buyers to purchase some types of fish directly from the fishermen. Based on estimates from the *New York Times* of Fulton fish market volume (Bowen, 2005) and estimates of U.S. fish consumption per capita from the National Oceanographic and Atmospheric Administration (NOAA, 2005), about 5 percent of U.S. seafood sales flows through the Fulton market. Restaurants and merchants outside coastal areas usually use national seafood brokers to supply their fresh fish, bypassing a centralized

Table 1
Yearly Volumes at Selected Fish Markets

<i>Market</i>	<i>Yearly volume in 2004 (tons)</i>
Tsukiji (Tokyo, Japan)	614,409
Fulton Street (New York, NY)	115,000
Billingsgate (London, UK)	25,000
Sydney (Sydney, Australia)	15,000
Portland Fish Exchange (Portland, Maine)	11,000
Boston (Boston, MA)	10,000

Source: Data on all markets except for Fulton was taken from official websites for the markets. Data on Fulton is an approximation taken from the *New York Times* (Bowen, 2005).

Notes: Some major regional markets for which volumes were not readily available include Pike's Peak in Seattle, the Marseille fish market, the Newquay fish auction in Cornwall in the United Kingdom and numerous markets throughout India and Southeast Asia.

market completely. Without doubt, overnight shippers have increased the market for seafood brokers. This option is available to merchants in the New York area, but many merchants prefer to choose their fresh fish themselves, given the quality and variety that is available at the Fulton market.

For comparison, Table 1 shows volumes at various well-known fish markets. Tsukiji is by far the largest, with a volume of 615,409 tons per year, the Fulton fish market is second, at around 115,000 tons per year, and Billingsgate in London is a distant third at around 25,000 tons per year. All of these markets are located in coastal cities. With modern transportation, having a fish market in a coastal city is not strictly necessary. However, some coastal cities have built up a group of buyers with the taste and appreciation for fish that allows them to sustain large fish markets.

The Fulton market was primarily located in two open air structures, the "Tin Building" and the "New Building," in which various dealers rented stalls from the Port Authority of New York with closed offices at the back of the stalls. The New Building was opened in 1939 by Mayor La Guardia, after pilings of the old market building gave way in 1936 and the entire building slid into the river.

Not only was the marketplace old and established, but many of the wholesalers at the Fulton market were well-established firms. For example, the grandfather of Robert Samuels, an owner of Blue Ribbon Seafood which supplies New York restaurants such as La Bernardin and Bouley, started his business in the very early part of the twentieth century. The traders also had established histories and family ties to the business. For example, Martin (Buddy) Brady, a "halibut man," comes from a distinguished history of workers. "I've been here 38 years," he said, "since I was 17. My father did it before me, and my granddad before him." Mr. Brady worked as a loader for 15 years before graduating to selling (Blau, 1985). Most of

the wholesalers and traders have moved to the New Fulton Fish Market in the Bronx.

How the Market Worked at Fulton Street

Fish began arriving at the market around midnight. Historically, fish was received at the port of New York City by boat, but subsequently, all fish was brought in by truck or air from other areas. The market was open from three to nine in the morning on Monday and Thursday and from four to nine on Tuesday, Wednesday, and Friday. Teams of loaders transported the fish from the trucks to the stalls by hand trucks and small motorized pallet trucks. Once the buyers chose their fish, the loaders reloaded the fish onto the customers' trucks. Many of the market details are similar at the New Fulton Fish Market in the Bronx. However, some details have changed. For example, the loading and unloading of fish is done very differently, primarily because of better access to the dealers' stalls.

The market had three main sets of players: the buyers who purchased on behalf of retail fish stores and markets, the wholesalers or dealers at the market, and the suppliers who caught the fish in the first place. A common sight at the market was buyers of tuna for sushi going around and sampling different tuna. The buyers would take a sample, look at the color, rub the sample between their fingers to determine the oiliness and taste it. Buyers who were interested in different varieties of high-quality fish for their restaurant or retail shop were not inclined to leave the purchasing decision to an agent. Conversely, some buyers were happy with fish of a lower quality (primarily fish that were not quite so fresh), if the quality was at least acceptable and they could get the boxes cheaply. To determine acceptable quality and negotiate a good price, these owners or their agents would inspect the fish and negotiate the price themselves.

Before the move to the Bronx, there were 60 registered dealers in the market. The number seemed to be rising over time, since when I spent time at the market in the early 1990s, I counted a total of 35 wholesalers actively operating in the market. However, not all dealers carried all types of fish. In the early 1990s, there were only six major dealers in whiting.

The supply arrangements for the different types of fish differed. I am most familiar with the supply arrangements for whiting, since I observed the situation of a particular whiting dealer.¹ The whiting was supplied by fishermen's cooperatives, packing houses, and smaller fishing boats in New Jersey, Long Island, and Connecticut each day before the market opened. However, the price that a dealer would pay a supplier for a particular day's supply of whiting was determined at the end of the day by the prices the dealer had received for the whiting on that

¹ I chose to study whiting for three main reasons. First, at the time that I was at the market, more transactions took place in whiting than in any other fish. Second, whiting do not vary as much in size and quality as other fish. Finally, the dealer from whom I collected the data suggested that the whiting salesman would be the only salesman amenable to having an observer.

particular day. Each supplier serviced multiple dealers. A supplier would refuse to deliver fish to a dealer from whom he continually received a poor price relative to other dealers. In this way, according to my dealer, dealers competed with each other for fish supplied in the future by the amount they paid the suppliers for fish on a particular day. The dealer stated that he kept 5–15 cents on each pound of whiting sold (although this margin could not be independently verified).

Due to custom and the practicalities of loading and unloading fish, the quantity of whiting received for a particular day was received in its entirety before the market opened. The quantity that each of the dealers received was readily observable by all dealers. If one dealer did not receive what he perceived to be enough whiting, another dealer would sell him whiting before the market opened. The price was set not at the time of sale, but was determined toward the end of the trading day.

A dealer often had a good idea before the market's close of the quantity that would be available the next day. Quantity supplied was primarily determined by weather conditions. Wind and waves are the greatest determinant of the quantity of fish likely to be caught. Other determinants of supply in the Fulton market were prices in other places such as Philadelphia and the New Jersey docks, and the price received for whiting relative to the prices received for other fish on days in the recent past. If the price of whiting was relatively low, fishermen would seek other types of fish.

Anyone can purchase fish at the Fulton fish market, but small quantities were not sold. For whiting, the minimum quantity that was sold was one box, approximately 60 pounds (except as favors to regular customers). Most of the customers were repeat buyers, but buyer–seller relationships varied. Some buyers regularly purchased from one seller, and other buyers purchased from various sellers.

Most buyers followed distinct purchasing patterns. Monday, Thursday and Friday were big days, but Tuesday and Wednesday were relatively quiet. Whiting stays sufficiently fresh to sell for at most four days after it is received. However, it was usually sold from the market either the day it was received or the day after. About half of the time, total sales were less than total quantity received. As would be expected, there was a small amount of oversupply as some inventory loss is inevitable in the selling process, especially given the perishable nature of fish. Over 111 days in late 1991 and early 1992, the total quantity received exceeded the total quantity sold by 11,237 pounds, which amounts to about 1.6 percent of total sales. The bulk of this difference consisted of fish not sufficiently fresh to sell; the surplus was literally thrown out.

Most buyers purchased their fish on credit, with charges payable the following week. It does not appear that there was a premium for credit purchases. Interest rate effects were minimal and defaults were generally rare, as buyers were generally repeat customers.

Pricing

The Fulton fish market had no posted prices and each dealer was free to charge a different price to each customer. If a customer wished to buy a particular

quantity of fish, he would ask a seller for the price. The seller would quote a price and the customer would usually either buy the fish or walk away. Prices were generally quoted in five-cent increments, which can seem quite large, considering the average price was about 85 cents per pound. While sometimes the customer would respond with a price that was five cents lower and back and forth bargaining would take place (.65, .70, .65, .70—and so on), overt bargaining generally only occurred with a very few large customers. Sellers were discreet when naming a price. A particular price was for a particular customer. When I was observing, sometimes a salesman and a regular purchaser would walk away, arm in arm, discussing price very quietly.

My price data on whiting come from two sources. First, from April 13 to May 8, 1992, I spent everyday at the market collecting data on whiting prices from one dealer. If I did not hear the final price, the salesman would report it back to me. The dealer also gave me his inventory sheets for the period December 2, 1991, through May 8, 1992. Each transaction is recorded on the inventory sheet, along with a customer number for repeat customers. The inventory sheets matched up well with the hand-collected data (Graddy, 1995).

Prices varied tremendously. For example, the average price in a whiting transaction on Friday, May 1, 1992, was \$.33/lb., and the average price on Friday, May 8, was \$1.75/lb., an increase of almost six-fold. Figure 1 is a high-low price chart, where the bottom of the vertical line shows the low price for that day and the top of the vertical line shows the high price for that day. The high intraday volatility was primarily due to changes in price throughout the day, but some of the volatility can be attributed to differences in qualities of fish. There was often a large decline in price after 7:00 a.m., but the pattern before 7:00 a.m. was not easily predictable. There was a higher intraday volatility on Friday than on other days.

Figure 2 indicates total daily sales, which varied considerably. Daily supply shocks, primarily caused by weather, were largely responsible for the high volatility in day-to-day prices. The simple correlation between total daily sales and average daily price is $-.32$.

Fish of the same variety at the same point in time can also differ tremendously in price because of differences in quality. While I was collecting the data about whiting, I placed the available whiting into one of five categories ranging from very poor quality to very good quality, based on sight, feel and smell. I did not find that the quality of whiting sold declined throughout the morning—although this may have been partly because during my study, the temperature outside was near freezing, and the fish were well preserved by ice. Average price certainly differed by quality; for the month that I spent at the market, fish of medium or better quality averaged 83 cents per pound whereas fish of poor or very poor quality averaged 46 cents per pound. This price differential helps to explain why most fish merchants wish to choose the fish themselves, matching the quality of whiting to the eventual use.

About 60 percent of the purchasers at the market were Asian. I noticed that sellers were quoting lower prices to Asian customers for the same box of fish. The

Figure 1
Daily Prices for Whiting

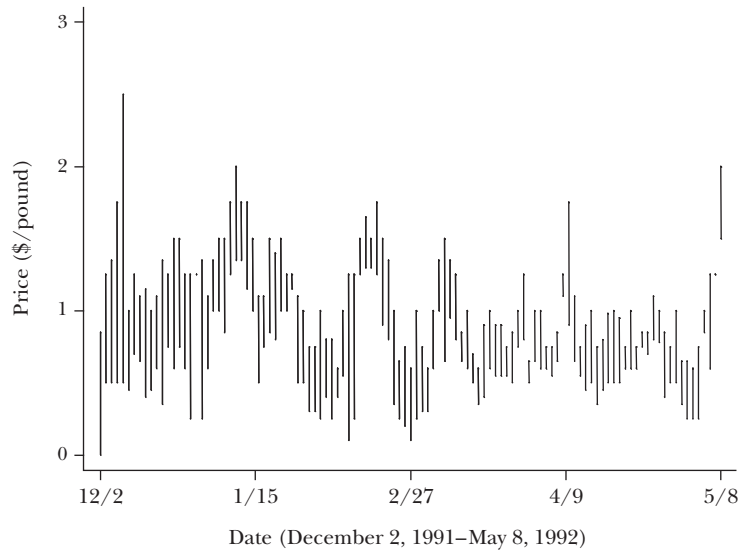
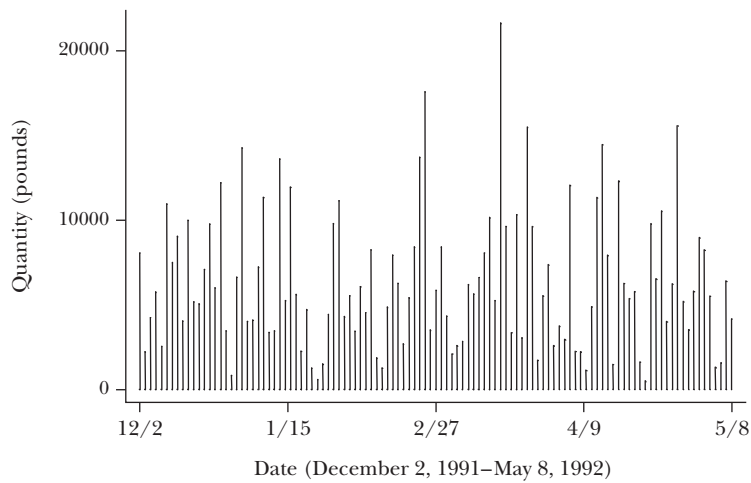


Figure 2
Daily Volumes of Whiting



price difference would usually be about 5 cents, though it could go to as large as 10 cents. Regressions that carefully control for other variables, including time of sale and quality, indicated that whites pay on average 6.3 cents per pound more on each transaction for the same type and quality of fish than do Asian buyers (Graddy, 1995). While quality controls could naturally be imperfect, these

regressions were consistent with my observations. Why and how can such a price difference occur?

On the demand side, there was strong anecdotal evidence that Asian buyers were more elastic than white buyers. Asians buyers would resell their whiting as whole fish in retail shops, fish sandwiches in fry shops, and would make them into fish balls. Most of these establishments were located in very poor neighborhoods. Resellers had little scope to raise the price of whiting for their ultimate customers. Consequently, they would bargain very hard at the market. A *New York Times* article described how one dealer named Donald Julich Sr. spent a half hour haggling over a box of lobster tails with John Kim, the owner of a fish store in Queens. Kim left, but came back an hour later, and paid the \$17.50 (Ackman, 2000). Furthermore, some of the Asian buyers purchased their fish at the Fulton market, and then resold it in Chinatown. Chinatown has a reputation as the cheapest place to buy seafood in New York City. Store owners claimed they must keep their prices low due to fierce competition and the fact that “most of their customers—blue-collar workers—simply cannot pay more” (Lii, 1995).

Asian buyers appeared to be more organized than white buyers. The Korean buyers had an active retailers’ organization. Shortly before my time at the market, the association organized a boycott of one of the dealers because he was allegedly shortchanging the pounds of fish included in a box. The dealers at Fulton Street may have recognized that this organized group had more options, like purchasing from fishing boats or intermediate wholesalers that supply the dealers at Fulton Street.

In contrast, many white buyers (though not all) had more scope to pass on prices to customers. For example, for the local fish dealer in Princeton, New Jersey, whiting was a very small part of his purchase; he would spend no time shopping around for price on whiting. If prices were especially high at the market, he could explain to his customers that fish were expensive at Fulton Street and his customers would often be willing to absorb costs by paying higher prices.

Why didn’t the Asian buyers arbitrage the market, buying low and then reselling to other customers? In all likelihood, it is very unlikely that either white buyers or Asian buyers actually knew this was happening. Prices were quoted discretely for particular customers. White buyers rarely socialized with Asian buyers and hence communication between the two groups was limited.

These conditions establish why price discrimination might have been profitable on the demand side. However, why weren’t any extraordinary profits competed away? The structure of the Fulton market for sales of whiting, at least in the early 1990s, appeared conducive to tacit collusion, rather than perfect competition. Remember that only a small number of dealers at the market (six at the time) carried whiting. Many of the dealers at the market had been operating for many years. Dealers would trade with each other before the market opened. The dealers would price fish on a daily and sometimes hourly basis and would receive feedback from the buyers on other dealers’ prices. Dealers in such a situation could easily become very good at tacit communication. Moreover, entry into this market may

well have been limited because suppliers provided the whiting on credit to established dealers—and it is not clear they would be willing to provide fish on credit to a new entrant. The presence of organized crime in the market may also have discouraged entry.

Wind and Waves

The quantity of fish brought to market is determined by many factors, but the weather is an important determinant of supply because strong winds and high waves make it difficult to catch fish. Quantities fall and prices rise when there are storms, and quantities rise and prices fall in good weather. Without centralization, it is unclear whether the price response could have been as effective in allowing demand to match supply as buyers might have suspected gouging on the part of the sellers if prices were not easily comparable.

As a demonstration of the price and quantity response to weather, in my price and quantity data on the whiting market in 1991–1992, I classified the weather as stormy when wave heights are greater than 4.5 feet and wind speed is greater than 18 knots. Wind speed and wave height are moving averages of the last three days' wind speed and wave height before the trading day, as measured off the coast of Long Island and reported in the *New York Times* boating forecast. Holding day of the week constant, the average quantity on a clear day was 2,371 pounds more than on a stormy day. Conversely, the average price was 32 cents less per pound than on a clear day. Average price on all days was 88 cents per pound and average quantity was 6,335 pounds.

Variations in weather offer a way to use price and quantity data to estimate a demand curve. The problem in estimating demand curves, of course, is that different observations of price and quantity may be affected by shifts in either supply and demand. However, both theory and evidence suggest that weather only affects the supply of fish caught.² For example, the consistent and significant price reactions to stormy weather also suggest that the availability of close substitutes, or at least those that are unaffected by the same storms, is limited. Fish restaurants and retailers feel a need to offer fresh fish, even if the weather has not been ideal. The data exhibit no price rigidities, and no excess supply and demand. Because of the strong effect that weather has on supply and the price response allowed by a centralized market, the price and quantity data from the Fulton fish market allow a researcher to estimate a market demand curve and the elasticity of demand (Angrist, Graddy and Imbens, 2000; Lee, 2004).

Table 2 shows estimates of elasticities—that is, the percentage change in

² As noted in Angrist and Krueger (2001) and Stock and Trebbi (2003), P.G. Wright (1928) suggested using yield per acre as an instrumental variable for estimating the demand elasticities of butter and flaxseed, because yield per acre is primarily determined by the weather. This is one of the first known solutions to the identification problem.

Table 2

Ordinary Least Squares and Instrumental Variable Estimates of Demand Functions with Stormy Weather as an Instrument

<i>Variable</i>	<i>Ordinary least squares (dependent variable: log quantity)</i>		<i>Instrumental variable</i>	
	(1)	(2)	(3)	(4)
Log price	-0.54 (0.18)	-0.54 (0.18)	-1.08 (0.48)	-1.22 (0.55)
Monday		0.03 (0.21)		-0.03 (0.17)
Tuesday		-0.49 (0.20)		-0.53 (0.18)
Wednesday		-0.54 (0.21)		0.58 (0.20)
Thursday		0.09 (0.20)		0.12 (0.18)
Weather on shore		-0.06 (0.13)		0.07 (0.16)
Rain on shore		0.07 (0.18)		0.07 (0.16)
R^2	0.08	0.23		
No. of Obs.	111	111	111	111

Source: The data used in these regressions are available by contacting the author.

Note: Standard errors are reported in parentheses.

quantity demanded in response to a percentage change in price—first using ordinary least squares and then using instrumental variables with stormy weather as an instrument. In the regressions, fish has been treated as an approximately homogeneous product. The first column is an ordinary least squares regression with log quantity as the dependent variable and log price as the independent variable. The quantity is the total amount sold on a day and the price is the average price for that day.³ A higher price has a negative effect on quantity. The second column shows that this estimate is unchanged by including dummy variables for the day of the week (Friday is the omitted day), and for measures of the weather on shore.

The third column then uses an instrumental variables approach. That is, first a regression is run with log price as the dependent variable and the storminess of the weather as the explanatory variable. This regression seeks to measure the variation in price that is attributable to stormy weather. The coefficients from this regression are then used to predict log price on each day, and these predicted values for price are inserted back into the regression. The third column shows that the impact of these predicted values of price on quantity are double the ordinary

³ There does not appear to be any correlation between stormy weather and the quality of whiting sold.

least squares estimates. Adjusting for the day of the week, as is done in the fourth column, increases the coefficient on the price still further. As would be expected, the ordinary least squares estimates of the impact of price on quantity are much smaller than the instrumental variables estimates.

In addition, it is interesting that the point estimates of the average elasticities in the third and fourth columns are both about -1 . This finding has several interesting implications. First, it is consistent with pricing power on the part of the fish dealers. A price-setting firm will raise price to the point where the percentage change in the quantity demanded is at least as large as the percentage change in price; otherwise, it would make sense to raise the price even more. Second, when demand has a unitary elasticity, it means that the percentage change in quantity would always equal the percentage change in price, and the weather would therefore not have much effect on a seller's revenue, keeping fishermen's incomes relatively constant. If demand were not approximately unit elastic, then sellers would be subject to widely varying revenues with price swings. In such a setting, market organization might well be different, with the sellers less willing to have prices change on a regular basis. Third, unit elasticities could also result from budget constraints on the part of some buyers. Undoubtedly, some buyers go to the fish market expecting to spend a certain amount. If the weather has been terrible, resulting in lower quantities and higher prices, they will be forced to buy less fish. Prices may rise and quantities may fall to the point where buyers are spending approximately the same amount at the market, regardless of the weather.

Crime at the Fish Market

Crime and the mafia have had a long history at the Fulton fish market. Law enforcement experts point out that the mafia may find it easier to gain a foothold when a relatively small number of people and businesses operate in a single location. At one point in the early 1900s, oystermen and fishermen refused to enter the harbor without police guard (Slanetz, 1986). Since then, there were continued reports of extortion, "tapping"—(that is, stealing fish), income tax evasion and obtaining false loans. All transporting of fish at the market was done by the loading teams, a system which evolved over 75 years ago (Raab, 1996), and these loading companies formed a monopoly over the loading and unloading of fish. Loading companies also controlled parking in city streets adjacent to the market, partially through extortionate measures (Raab, 1995b). Effectively, one could not park on city parking spaces near the market without paying.⁴

The involvement of the mafia was openly admitted in the early 1990s. At about that time, the city gave the dealers at the market a vastly subsidized rental deal. A

⁴ In 1992, I paid \$5.00 to park my car in a city space that should have been free parking. I would arrive at the market at about 3:00 a.m., and I was happy to pay the money as I felt relatively safe walking from my car to the market, which was not true of most parts of New York City at that time of the morning.

federal study in 1992 estimated the subsidy to be about \$2.7 million per year (Editorial Desk, 1995). From 1982 to 1995, rents were virtually unchanged for dealers at the market. City officials claimed that part of the problem was that previous city administrations had not wanted to sign long-term leases with dealers who might later be found to have mafia ties (Raab, 1994). Of course, this argument could be completely circular. The low rents in effect subsidized the presence of the mafia as the lower cost base allowed excess profits. In 1995, with Rudolph Guiliani as mayor, the administration began negotiations to raise rents for 40 dealers who currently paid about \$270,000 a year. They were able to force an agreement with the wholesalers that would bring the city's intake on rents up to about \$2 million by 1998 (Raab, 1995a).

It is likely that organized crime chose to operate at the Fulton market not only because of economic rents that were present, but also because it was relatively unregulated. This situation changed in the mid-1990s. In the early 1990s, about ten loading teams shared the market. However, as part of Rudolph Guiliani's move against organized crime, in 1995 the Guiliani administration held a sealed-bid auction to award unloading licenses to companies. The six incumbent unloading companies bid the exact same amount—\$1.35 per 100-pound crate. One cleaning company, the Laro Maintenance Corporation, that had no ties to the market or experience in unloading fish, bid \$1.10 per 100-pound crate and Laro won the entire loading contract (Van Natta, 1995). Since this crackdown on the market in 1995 and the increase in rents, there were few reports of continued mafia involvement and by 1998, the Guiliani administration claimed to have cleared the mafia out of the market.

Conclusion

Fish markets and the demand for fish have long been a favorite example and subject of academic economists. Alfred Marshall used fresh fish for a variety of examples in his *Principles of Economics* (1890 [1930]). More recently, Bell (1968) examined the effect on the price of fish of the Papal-Bishops decree in 1966 that Catholics no longer had to abstain from meat on Fridays, except during Lent. Kirman and Vignes (1991) and Hardle and Kirman (1995) investigated the price dynamics of the Marseille fish market and find significant instances of price dispersion.

This article has suggested that the Fulton fish market is a centralized market that exists because of the heterogeneity of fish and the differing tastes and needs of customers. This heterogeneity has led to market imperfections. However, caution is indicated before generalizing the patterns here to other fish markets. Any large centralized fish market will have the property that it will allow different suppliers with different types and qualities of fish to gather in one location, thus facilitating the matching of fish to customers. But issues like price discrimination and the involvement of organized crime are likely to depend on the institutional

structure and on how the market is regulated. Many fish markets, such as those listed in Table 1, are more organized and regulated than Fulton, which operated with little or no regulation for many years. Many other major fish markets, including Tsukiji, Sydney, Portland and Boston are auction markets, and price discrimination in an auction market is extremely difficult. With a different institutional structure for buying and selling, as well as more attentive law enforcement, many of the failings of the Fulton fish market would diminish or disappear. Yet the benefit of centralization, making an excellent variety of fish available to customers with different needs, would continue as it has for many years.

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References

- Ackman, Dan.** 2000. "New Yorkers and Co.: The Big Man in Shrimp." *New York Times*. July 2, Sec. 14, p. 4.
- Angrist, Joshua, Kathryn Graddy and Guido Imbens.** 2000. "The Interpretation of Instrumental Variables Estimators in Simultaneous Equations Models with an Application to the Demand for Fish." *Review of Economic Studies*. 67:3, pp. 499–527.
- Angrist, Joshua and Alan Krueger.** 2001. "Instrumental Variables and the Search for Identification: From Supply and Demand to Natural Experiments." *Journal of Economic Perspectives*. Fall, 15:4, pp. 69–85.
- Bell, Frederick.** 1968. "The Pope and the Price of Fish." *American Economic Review*, 58:5, pp. 1346–1350.
- Bowen, Dana.** 2005. "Fulton Market Looks Forward to Bronx Dawns." *New York Times*, March 23, Sec. F, p. 1.
- Blau, Eleanor.** 1985. "Fresh Fish Sold Old Way at Fulton Market." *New York Times*, May 28, Sec. B, p. 1.
- Editorial Desk.** 1995. "Tackling the Fish Market Mess." *New York Times*, February 3, Sec. A, p. 18.
- Graddy, Kathryn.** 1995. "Testing for Imperfect Competition at the Fulton Fish Market." *RAND Journal of Economics*. Spring, 26, pp. 75–92.
- Hardle, Wolfgang and Alan Kirman.** 1995. "Nonclassical Demand: A Model-free Examination of Price-Quantity Relations in the Marseille Fish Market." *Journal of Econometrics*. 67:1, pp. 227–257.
- Kirman, Alan P. and Annick Vignes.** 1991. "Price Dispersion: Theoretical Considerations and Empirical Evidence from the Marseilles Fish Market," in Kenneth J. Arrow, ed., *Issues in Contemporary Economics: Proceedings of the Ninth World Congress of the International Economic Association, Athens, Greece. Volume 1: Markets and Welfare*. New York: New York University Press, pp. 160–185.
- Lee, Sokbae.** 2004. "Endogeneity in Quantile Regression Models: A Control Function Approach." Unpublished paper. University College London.
- Li, Jane H.** 1995. "Chinatown, Where Fish are Cheaper." *New York Times*, November 29, Sec. C, p. 1.
- Marshall, Alfred.** 1930. *Principles of Economics, 8th Edition*. London: McMillan and Co.
- Miller, Bryan.** 1991. "Historic Fulton Market's King of Facts About Fish." *New York Times*. October 9, Sec. C, p. 1.
- National Oceanic and Atmospheric Administration.** 2005. "Fact Sheet: 2004 Seafood Consumption Statistics." *Fisheries of the United States, 2004*. Washington, D.C.: NOAA.
- Raab, Selwyn.** 1994. "Fish Market's Problems Revert to New York City." *New York Times*, March 27, Sec. 1, p. 1.
- Raab, Selwyn.** 1995a. "Merchant Feud Sheds Light on Fish Market's Workings." *New York Times*, August 21, Sec. B., p. 3.

Raab, Selwyn. 1995b. "Two Loaders Evicted from the Fulton Market." *New York Times*, December 31, Sec. 1, p. 29.

Raab, Selwyn. 1996. "Loaders are New Front in Fulton Market Conflict." *New York Times*, January 7, Sec. 1, p. 25.

Slanetz, Priscilla Jennings. 1986. "A History of the Fulton Fish Market." *The Log of Mystic Seaport*. 38:1, p. 14–25.

Stock, James H. and Francesco Trebbi. 2003. "Who Invented Instrumental Variable Regression?" *Journal of Economic Perspectives*, Summer, 17:3, pp. 177–194.

Van Natta, Don. 1995. "Tough Rookie Sees a Future Handling Fish." *New York Times*, October 22, Sec. 1, p. 35.

Wright, Phillip G. 1928. *The Tariff on Animal and Vegetable Oils*. New York: Macmillan.

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1. Cecilia Hammarlund, Johan Blomquist, Staffan Waldo. 2022. The Way the Wind Blows: Tracing Out the Demand for Norwegian Lobster Using Instrumental Variables. *Marine Resource Economics* **2018**, 000-000. [[Crossref](#)]
2. Joseph W. Watson, Angela Muench, Kieran Hyder, Richard Sibly. 2022. Factors affecting fisher decisions: The case of the inshore fishery for European sea bass (*Dicentrarchus labrax*). *PLOS ONE* **17**:3, e0266170. [[Crossref](#)]
3. Jan F. Kiviet. 2022. Instrument-free inference under confined regressor endogeneity and mild regularity. *Econometrics and Statistics* **10**. . [[Crossref](#)]
4. Amalendu Jyotishi, Joeri Scholtens, Gopakumar Viswanathan, Priya Gupta, Maarten Bavinck. 2021. A tale of fish in two cities: consumption patterns of low-income households in South India. *Journal of Social and Economic Development* **23**:2, 240-257. [[Crossref](#)]
5. Yonvitner, J Sartin. 2021. Precision Fishery Management Framework Based on Fisheries Management Area. *IOP Conference Series: Earth and Environmental Science* **912**:1, 012074. [[Crossref](#)]
6. Ho Geun Jang, Satoshi Yamazaki, Shoichi Kiyama, Keisaku Higashida, Dugald Tinch. 2021. Economic effects of sea surface temperature, aging population, and market distance on a small-scale fishery. *ICES Journal of Marine Science* **78**:3, 1038-1048. [[Crossref](#)]
7. Avi Herbon. 2021. Managing an expiring product under a market that is heterogeneous in the sensitivity to the retailer's reputation. *International Journal of Production Economics* **232**, 107990. [[Crossref](#)]
8. Tzu-Ming Lee, Pei-Yu Chi, Kuo-I Chang. 2020. Duration and determinants of fishery trade patterns: Evidence from OECD countries. *Marine Policy* **118**, 103977. [[Crossref](#)]
9. Alexander Dobeson, Sebastian Kohl. 2020. Why durability matters? Towards a Comparative Economic Sociology of Market Organization. *European Journal of Sociology* **61**:1, 33-64. [[Crossref](#)]
10. Matthew Elliott, Benjamin Golub, Matt V. Leduc. 2020. Supply Network Formation and Fragility. *SSRN Electronic Journal* **97**. . [[Crossref](#)]
11. Jonathan Mellon. 2020. Rain, Rain, Go Away: 137 Potential Exclusion-Restriction Violations for Studies Using Weather as an Instrumental Variable. *SSRN Electronic Journal* **14**. . [[Crossref](#)]
12. Geir Sogn-Grundvåg, Dengjun Zhang, Audun Iversen. 2019. Large buyers at a fish auction: The case of the Norwegian pelagic auction. *Marine Policy* **104**, 232-238. [[Crossref](#)]
13. Binlei Gong. 2019. Like father like son? Revisiting the role of parental education in estimating returns to education in China. *Review of Development Economics* **23**:1, 275-292. [[Crossref](#)]
14. Le-Yu Chen, Sokbae Lee. 2018. Exact computation of GMM estimators for instrumental variable quantile regression models. *Journal of Applied Econometrics* **33**:4, 553-567. [[Crossref](#)]
15. Mustafe Pillana, Saranda Tufa. 2018. Fish Market, Consumption and Consumer Behavior. *International Journal of Sustainable Economies Management* **7**:2, 25-35. [[Crossref](#)]
16. Kanae Tokunaga. 2018. Estimating Elasticity of Demand for Pacific Bluefin Tuna in Tsukiji Fish Market. *Marine Resource Economics* **33**:1, 27-60. [[Crossref](#)]
17. Jeremy Fisher. 2017. Gendering Markets, Gendering Food: Women, Law and Markets in the New York City Food System, 1800-1840. *Feminist Review* **117**:1, 97-112. [[Crossref](#)]
18. Carmen Pedroza-Gutiérrez, Juan M. Hernández. 2017. Social networks, market transactions, and reputation as a central resource. The Mercado del Mar, a fish market in central Mexico. *PLOS ONE* **12**:10, e0186063. [[Crossref](#)]
19. Xiangyu Hou, Rene Haijema, Dacheng Liu. 2017. Display, disposal, and order policies for fresh produce with a back storage at a wholesale market. *Computers & Industrial Engineering* **111**, 18-28. [[Crossref](#)]
20. David F. Hendry, Grayham E. Mizon. 2016. Improving the teaching of econometrics. *Cogent Economics & Finance* **4**:1, 1170096. [[Crossref](#)]

21. Simon Jennings, Grant D Stentiford, Ana M Leocadio, Keith R Jeffery, Julian D Metcalfe, Ioanna Katsiadaki, Neil A Auchterlonie, Stephen C Mangi, John K Pinnegar, Tim Ellis, Edmund J Peeler, Tiziana Luisetti, Craig Baker-Austin, Mary Brown, Thomas L Catchpole, Fiona J Clyne, Stephen R Dye, Nathan J Edmonds, Kieran Hyder, Janette Lee, David N Lees, Owen C Morgan, Carl M O'Brien, Birgit Oidtmann, Paulette E Posen, Ana Ribeiro Santos, Nick G H Taylor, Andrew D Turner, Bryony L Townhill, David W Verner-Jeffreys. 2016. Aquatic food security: insights into challenges and solutions from an analysis of interactions between fisheries, aquaculture, food safety, human health, fish and human welfare, economy and environment. *Fish and Fisheries* 17:4, 893-938. [[Crossref](#)]
22. Simon Board, Andrzej Skrzypacz. 2016. Revenue Management with Forward-Looking Buyers. *Journal of Political Economy* 124:4, 1046-1087. [[Crossref](#)]
23. Søren Johansen, Bent Nielsen. 2016. Asymptotic Theory of Outlier Detection Algorithms for Linear Time Series Regression Models. *Scandinavian Journal of Statistics* 43:2, 321-348. [[Crossref](#)]
24. Vikram Dayal. Supply and Demand 19-25. [[Crossref](#)]
25. E. Guerci, A. Kirman, S. Moulet. 2014. Learning to bid in sequential Dutch auctions. *Journal of Economic Dynamics and Control* 48, 374-393. [[Crossref](#)]
26. ROBERT G. HAMMOND, THAYER MORRILL. 2014. STRATEGIC EXCLUSION OF THE HIGHEST-VALUED BIDDERS IN WHOLESALE AUTOMOBILE AUCTIONS. *Economic Inquiry* 52:3, 1219-1230. [[Crossref](#)]
27. Soren Johansen, Bent Nielsen. 2014. Outlier Detection Algorithms for Least Squares Time Series Regression. *SSRN Electronic Journal* 15. . [[Crossref](#)]
28. Eric Guerci, Alan Kirman, Sonia Moulet. An agent-based model for sequential Dutch auctions 1707-1718. [[Crossref](#)]
29. Min-Yang Lee. 2012. Examining Bargaining Power in the Northeast Multispecies Days-at-Sea Market. *North American Journal of Fisheries Management* 32:5, 1017-1031. [[Crossref](#)]
30. Modest Fluvia, Anna Garriga, Ricard Rigall-I-Torrent, Ernesto Rodríguez-Carámbula, Albert Saló. 2012. Buyer and seller behavior in fish markets organized as Dutch auctions: Evidence from a wholesale fish market in Southern Europe. *Fisheries Research* 127-128, 18-25. [[Crossref](#)]
31. Robert G. Hammond, Thayer Morrill. 2012. Strategic Exclusion of the Highest-Valued Bidders in Wholesale Automobile Auctions. *SSRN Electronic Journal* 41. . [[Crossref](#)]
32. Kathryn Graddy, George Hall. 2011. A dynamic model of price discrimination and inventory management at the Fulton Fish Market. *Journal of Economic Behavior & Organization* 80:1, 6-19. [[Crossref](#)]
33. Gianfranco Giulioni, Edgardo Bucciarelli. 2011. Agents' ability to manage information in centralized markets: Comparing two wholesale fish markets. *Journal of Economic Behavior & Organization* 80:1, 34-49. [[Crossref](#)]
34. Sandro Sapio, Alan Kirman, Giovanni Dosi. 2011. The emergence and impact of market institutions: The wholesale market for fish and other perishable commodities. *Journal of Economic Behavior & Organization* 80:1, 1-5. [[Crossref](#)]
35. Annick Vignes, Jean-Michel Etienne. 2011. Price formation on the Marseille fish market: Evidence from a network analysis. *Journal of Economic Behavior & Organization* 80:1, 50-67. [[Crossref](#)]
36. Kathryn Graddy, Peter Kennedy. 2010. When Are Supply And Demand Determined Recursively Rather Than Simultaneously?. *Eastern Economic Journal* 36:2, 188-197. [[Crossref](#)]
37. Wayne Morra, Gail Hearn, Andrew J. Buck. 2009. The market for bushmeat: Colobus Satanas on Bioko Island. *Ecological Economics* 68:10, 2619-2626. [[Crossref](#)]
38. SIMON LOERTSCHER. 2008. MARKET MAKING OLIGOPOLY*. *The Journal of Industrial Economics* 56:2, 263-289. [[Crossref](#)]
39. Jean-François Bigot, Laurent Baranger, Patrice Guillotreau, Laurent Le Grel, Yves Perraudau, Alex Rubin, Arnaud Souffez. Chapitre 3. Criées et ports de pêche 103-138. [[Crossref](#)]

40. Simon Loertscher. 2007. Horizontally Differentiated Market Makers. *Journal of Economics & Management Strategy* **16**:4, 793-825. [[Crossref](#)]