Price Discrimination and Customer Behaviour: Empirical Evidence from Marseille

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Abstract

We analyse the interaction between a seller and customers in a shop on the fruits and vegetables wholesale market in Marseille using an unique data set. We find that customers' bargaining activity is correlated with the kind and location of the business. To determine how the interactions between the seller and the customers influence prices, we compare the price each customer pays for a given good with the daily average price. We find that a customer of the shop is more likely to pay a price higher than other customers for the same good if—ceteris paribus—the customer is unknown to the shop assistants, buys only a small quantity, or buys goods sold on commission. If the customer is known to the shop assistants, then loyalty and bargaining make it more likely that the customer gets better than average price.

Keywords: Face-to-face bargaining, customer loyalty

1 Introduction

The formation of prices in decentralized markets is an important issue in economics (Muthoo, 1999). In decentralized markets—such as wholesale markets for fish, meat, flowers, or fruits and vegetables—prices and quantities are negotiated bilaterally between the buyer and the seller. There is a substantial literature that studies the question of discrimination in markets; price discrimination occurs when the prices of similar products sold by the same seller show difference that cannot be attributed to differences in cost. While price discrimination has been extensively studied in theoretical economics, empirical studies are still rare, for an account see Verboven (2008).

In this paper, we study price discrimination using data from the wholesale fruit and vegetables market in Marseille. Our data base allows to consider buyers' behaviour and how it influences the likelihood of being discriminated against. We begin by describing the two classical definitions of price discrimination used in economics. We then describe our database and present the results of our empirical analysis. Lastly, we conclude by proposing a new classification that could be used to classify the different sorts of discrimination in repeated matches.

The paper is organized as follows. Section 2 summarizes the theory and provides empirical predictions, which are then tested at hand of the data. Section 3 presents the data and contains the empirical analysis. The last section concludes.

2 Theory and empirical predictions

The perishable markets captivate the economists (Bestor, 1998; Graddy, 2006; Kirman and Vignes, 1991; Kirman and Vriend, 2001; Rivaud-Danset and Vignes, 2004; Weisbuch et al., 2000) for two reasons: (1) they avoid all the problems due to the inventories and (2) due to the problem of perishability of the goods, buyers and sellers need to find quickly an arrangement. All the

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agents want to maximize their profit and use the available information to learn the limit prices of their opponents.

2.1 Definitions

Price discrimination occurs when the prices of similar products sold by the same firm show variation that cannot be attributed to variation in marginal costs.

Pigou's Classification Economists generally follow the taxonomy of Pigou, who used the term price discrimination to describe what we have been referring to as differential pricing. Pigou (1920) classifies price discrimination into three degrees:

First-degree price discrimination means that the producer sells different units of output for different prices and these prices may differ from person to person. This is sometimes known as the case of perfect price discrimination.

Second-degree price discrimination means that the producer sells different units of output for different prices, but every individual who buys the same amount of the good pays the same price. Thus prices depend on the amount of the good purchased, but not on who does the purchasing. A common example of this sort of pricing is volume discounts.

Third-degree price discrimination occurs when the producer sells output to different people for different prices, but every unit of output sold to a given person sells for the same price. This is the most common form of price discrimination, and examples include senior citizens' discounts, student discounts, and so on.

Stole's Classification Stole (2007) classifies price discrimination as direct versus indirect.

Direct price discrimination is exercised on the basis of observable characteristics of the buyers such as localization or job.

Indirect price discrimination sorts consumers by offering menus of products that differ in quality or quantity.

These definitions and classifications are very wide and can be made more precise if we replace them in the context of interactions studied here. As noted by Lucas (1988) *"Applications of economic theory to market or group behaviour require assumptions about the mode of interaction among agents as well as individual behaviour"*. The network of individuals which governs who interacts with whom will have an important effect on the nature and extent of discrimination.

2.2   Price discrimination in an oligopoly

The literature on price discrimination covers a wide range of issues and in particular concerns three different cases depending on how much information is available about the characteristics of buyers. This can be summed up as: the homogeneous case, the observable heterogeneity case and the unobservable heterogeneity case. In all cases, certain futures are necessary for price discrimination to work. Essentially, there are two conditions required for discriminatory pricing. First, the seller must have the ability to sort customers. There must be a different price elasticity of demand for each group of consumers. Secondly, the seller must prevent resale. Buyers who have purchased a good or services at a lower price must not be able to resell them to consumers who would normally have paid the expensive price.

The efficiency of price discrimination (first, second or third degree) and its consequences have been extensively studied in theoretical economics. There have been since Robinson (1933) a number of contributions examining the efficiency consequences of imperfect price discrimination in the context of a monopoly.[1]

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[1]For a survey see Varian (1989).

Theoretically, under conditions of perfect competition, price discrimination could not exist even if the market could be easily divided into separate parts. As Robinson (1933, p. 179) emphasizes, the demand would be perfectly elastic in each section of the market and, every seller would prefer to sell his whole output in the section of the market where he could obtain the highest price. The attempt to do so would drive the price down to the competitive level and there would be only one price across the whole market. As long as the market is perfect, sellers can take advantage of the barrier between one part of a market and another to charge different prices for the same thing if and only if all sellers are combined or are acting in agreement. If there is some degree of market imperfection there can be some degree of discrimination. The market is imperfect because customers will not move willingly from one seller to another, and if it is possible for an individual seller to divide his market into separate parts, price discrimination is practiced. Robinson (1933, p. 180) points out that in a competitive market, sellers' demand curves are likely to be very elastic, and price discrimination will not usually lead to very great differences in the prices charged to different buyers by any seller. When a single seller is not subject to direct competition, or when there is an agreement between rival sellers, price discrimination is more likely to occur. Even when there is no natural barrier between groups of customers there are various devices by which the market may be divided so as to make price discrimination possible. Various brands of a certain article which in fact are almost identical may be sold as different qualities under names or labels which induce subdivision between buyers.

In a recent study about in competitive price discrimination, Borenstein (1985) used simulations to analyze third-degree discrimination, Lederer and Hurter (1986) examined on spatial pricing. Katz (1984) and Stole (1995) analyzed second-degree price discrimination and Holmes (1989) extended the traditional literature's analytical approach to third- degree price discrimination in environments of imperfect competition. Holmes (1989) demonstrates that in a symmetric oligopoly model the effects of price discrimination are quite similar to its effects in the monopoly case; in particular, the uniform price necessarily

lies between the discriminatory prices, so that permitting price discrimination leads to higher prices for some consumers and lower prices for others. Katz (1984) demonstrates a similar result in a model that, while developed in terms of second-degree (quantity-dependent) price discrimination, amounts to a model of third- degree discrimination because he assumes that there are two types of consumers that are perfectly separated.

2.3 Price discrimination in a non-anonymous and repeated market

Sellers' and buyers' relationships are long-term relations embedded in a social context. This context evokes such notions as contractual incompleteness, repeated interactions and social relationships. Those notions are potentially of important economic significance and play an important role in explaining the existence of price discrimination.

Non-anonymous interactions and personal characteristics   The relationships between sellers and buyers take place in a social context. Agents are recognizable by their partners and we cannot consider that a representative buyer exists (Kirman, 1992; Gallegati and Kirman, 1999). We must consider each buyer as an agent characterized by a vector of intrinsic characteristics having his personal story and knowledge about the market. The social part of interactions have to be taken into account to understand how prices are formed (Granovetter, 2001). Kuhn (2005) notices that *"Markets are not self-operating, objective mechanical objects. They are, rather, a complex set of constraints, rules, rights, regulations, and laws, guiding human participants in making their multiple, various trades, purchases, and exchanges. The motivating force that generates benign market outcomes is the willingness of all to obey the guidelines and deal openly transparently with each other. Invisible to the naked eye are the common social bonds of trust among all, strangers and acquaintances alike. The bonds of trust are what create and sustain truly efficient, effective markets."* Depending on several parameters (e.g, outside

markets, limit value), agents can have different willingness to pay. Due to the perishability of goods, sellers have to adapt their behaviour to the buyers to minimize the quantity of unsold goods. As a very simple example, we can take as an example the case in which buyers have either a given low or a high price limit value. We can expect that buyers with a high limit value pay a higher price than buyers with a low limit value.

Repeated interactions and strategic behavior In most decentralized markets, there is no contract between the agents that guarantees the exact term of trade. They are rather decided through daily matches. The fact that their relationships are characterized by long term or repeated interactions can involve strategic incentives beyond social norms. Agents use their experience and act strategically in order to obtain better profits with their counter-parts. A basic lesson from game theory is that repeated interactions may create incentives that are absent in one-shot interactions (Rubinstein, 1998; Falk et al., 1999). For example, buyers can try to develop a reciprocal reputation because this may elicit lower prices from the seller. Kreps et al. (1982) shows that, due to the existence of plausible reciprocal obligations, incomplete information about one or both players' options, motivation or behavior can explain the observed cooperation in repeated games (for example in terms of loyalty). Repeated interactions give information about agents' strategies. For example, a seller can adapt his negotiation strategy (for example by adjusting his offers) in order to insure the same price faced with a buyer used to bargain and a buyer who is not used to. Seller can also adapt prices to the quantity that the buyer is used to buy if he is faced with a buyer used to buy from him. We will develop some of those intuitions later on.

2.4   Predictions

Correlation between loyalty, bargaining behaviour, and prices The combination of repeated and non-anonymous interactions make agents behave strategically. Recall that there are here the two conditions required for dis-

criminatory pricing. First, the seller has to have the ability to sort customers and second, the seller must prevent resale. Buyers who have purchased a good or services at a lower price must not be able to resell them to consumers who would have normally paid the expensive price. In the environment previously described, we are interested in the effect of loyal and bargaining behaviour. By choosing their loyalty and bargaining behaviour strategically, we show that buyers will influence the level of the prices that they pay and we show three relationships (1) walk-in customers will be more likely to be discriminated against (pay a higher price on average), (2) the quantity bought plays a role, i.e., customers who buy large quantities have more "market power" and can bargain for a lower price than average. (3) Bargaining, perhaps with the threat of never coming back, has a lowering effect on the price. The first and third concepts are the most studied in the context of decentralized and repeated negotiations. The points are frequently analysed in the management literature but only few economic studies address this issue (see Verboven (2008) for an exception). The next two subsections examine the evidence which helps to explain the phenomena we document.

Bargaining and prices   Generally, the bargaining process can be seen in 2 different ways: (1) it is a way to exchange information about the global state of the market and (2) it is a way to exchange quantitative information about the prices that the parties are willing to pay. We adopt the second point of view and we consider that bargaining is primarily driven by parties attempting to learn about others' limit values by analysing the sequence of offers that they observe.

Bargaining is an important part of the price formation process for perishable goods. Markets for such goods are unstable (over time) and consequently there is no equilibrium value of the good which can be readily estimated. Under these conditions, the final transaction price is correlated both with the characteristics of the good and with the bargaining skills and power of the buyer and seller. The impact of bargaining on prices is far from being completely determined. Raskovich (2007) shows that the combination of competition among sellers

and bargaining leads to low prices. When buyers choose the order in which they bargain with suppliers of known characteristics, prices are determined jointly by bargaining power and competitive intensity (the outside option to bargain with rival suppliers). Bargaining power becomes less important to the outcome as competition intensifies and prices fall to marginal cost in the limit. Davis and Holt (1994) show that bargaining does not involve necessarily lower prices. By using laboratory experiments to compare posted price and bargaining situations, they find that, in the bargaining situations, sellers' prices are higher, and prices are stickier under haggle than under posted offer. Sellers anticipate that buyers bargain and hence increase their offers during the bargaining to conclude a transaction at the same price than when the prices are posted.

Loyalty and prices   An aspect of the market that is stressed in our research is the fact that people tend to have regular relations with each other. Using the same vocabulary as Hirschman (1970), "Exit" (leave a seller to another) is a viable solution for the customers as long as there are some outside options available to them. This is frequently observed in bilateral bargaining situations and has led to the construction of many models. In a decentralized market, the existence of loyalty is a direct consequence of repeated interactions and the existence of switching cost. Considering that loyalty is endogenous, Stole (2007) argues that sellers apply high reduction to insure the loyalty of their customers. Buyers are faced with several sellers and can use the existence of competition between sellers to obtain lower prices. Suppose a buyer has to choose between two sellers a and b. In addition suppose that, due to the purchase history, the buyer prefers the seller a to the seller b. Weisbuch et al. (2000) show that seller b must make a large reduction to change the preferences of the buyer and attract him away from seller a. On the same lines, Stole (2007) argues that purchase history is useful because ex post heterogeneity between goods can emerge. An otherwise homogeneous good becomes differentiated ex post due to exogenous switching costs. It follows that the buyer who prefers to buy the good at the seller a at current prices is precisely the person to

whom seller b would like to offer a price reduction. In this case, purchase history operates through a different conduit of differentiation. Nevertheless, the strategies of "paying customers to switch" (Chen, 1997) or "consumer poaching" (Fudenberg and Tirole, 2000) can be profitable and purchase history provides a variable which can be used as the basis of dynamic third-degree price discrimination. On the other hand, Weisbuch et al. (2000) study empirical data from the Marseille Fish market and show that loyal buyers actually pay higher prices than opportunistic ones. Several agent-based models try to reproduce these stylized facts.

There are two types of models: (1) the first type considers that being loyal or not is an endogenous decision. Usually, the loyalty that emerges is due to learning by agents, who discover which interaction gives them the highest profit and choose to interact with those agents that provide the highest gains. In this case, the emergence of loyalty is shown to occur for certain values of learning parameters (Weisbuch et al., 2000). If buyers can also learn which prices to accept and sellers which prices to offer, the emergence of loyalty also generates price dispersion (Kirman and Vriend, 2001). In their process, buyers learn to become loyal as sellers learn to offer higher utility to loyal buyers, while these sellers, in turn, learn to offer higher utility to loyal buyers as they happen to realize higher gross revenues from loyal buyers. In some cases loyalty is not the main focus, but is the first step for agents to stabilizing some negotiation patterns, and these can be compared to recorded micro-behaviour on the real market (Moulet and Rouchier, 2008). In these cases, the emergence of loyalty is always due to the buyers'attraction to the highest profit. (2) The second type of study considers that loyalty is exogenous. As an example, Rouchier and Mazaud (2004) consider it to be a sign of different motivations: the pleasure of interacting with well-known persons rather than strangers, moral norms, or an anticipation of the risk that searching for low price leads to delays in decision making and the danger that no goods are left when the decision is finally taken. Lastly, in the case where several qualities exist, the seller can secure the loyalty of his buyer by keeping the higher quality for loyal buyers. There is hence no direct link between price and loyalty. Gans (2002) studies the

effect of quality on customer loyalty. He provides 3 arguments that consumers use to choose a supplier based on quality. (1) There are increasing returns in customer loyalty in exchange for a suppliers improvements in quality. (2) The expected duration of a customers loyalty increases with the consumers prior belief that a given supplier is good. Conversely, the probability that a customer will defect to a competitor increases with the consumers prior belief that the suppliers competition is better. (3) The optimal action for suppliers, then, is to choose a quality level for which the marginal revenue from a quality improvement equals the marginal cost of the change.

We now turn to the empirical evidence on which we base our conclusions.

3 Empirical analysis

3.1 Data

The data comes from a single shop on the site of the fruit and vegetable wholesale market MIN in Marseille (Marché d'Intérêt National). The MIN is jointly owned by the city of Marseille and private shareholders and leases shops on its site to wholesalers. The MIN adminstration allows that only eligible professional customers to enter the market site and purchase goods there.[2] Registered customers are often retailers, who sell fruits and vegetables in their own shop or on farmers' markets, but customers also include food producers and restaurant owners. The MIN is open six days a week and is closed on Sundays. In 2006, 50 shops were leased to wholesalers, 905 people were working on the market, and 1733 customers were registered.

The data cover all the transactions that took place in the shop during the eleven opening days between October 14 and October 26 in 2006. The information on individual transactions comes mainly from the electronic billing and bookkeeping system of the shop. Further information was provided in

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[2]Would-be customers have to apply to the MIN adminstration, providing evidence that they are listed in the commercial register. Further, customers pay a fee to use the market.

the form of copies of the checked daily print-outs of the system, often with additional hand-written information. Information on customer characteristics was obtained by interviewing the shop assistants and the owner of the shop.

A transaction is characterized by the type of good, its country of origin, the price paid per unit of the good, the total quantity bought, and the day the transaction took place.[3] A good is defined and classified according to the official Ctifl classification, which is very detailed, taking variety and quality of the good into account.[4] For example, different varieties of apples such as Golden Delicious or Granny Smith count as separate goods. The units of quantity in which the goods are sold vary and can be the number of packs, kilograms, or pieces.

Goods are sold either by the shop on its own account or on commission for an external supplier. In more than half of the transactions, the goods are sold by the shop on its own account. Because the goods are perishable, any such good not sold at the end of the day may be worthless, incurring a loss to the shop. In the remaining transactions, the goods are sold on commission for an external supplier. For these transactions, the shop earns the difference between the price agreed with the customer and the supply price arranged with the external supplier. Because the shop does not own the goods, it is not exposed to a loss if some of these goods are unsold at the end of the day.

The 2454 transactions can be classified into four different types. Type 1 are transactions where the customer buys the good in the shop, often after bargaining over the price and quantity. Type 2 are transactions where the customer pre-orders the good via phone on the previous day, but picks up the goods himself in the shop. The customer might then bargain over the price of the prepared order. Type 3 are transactions where the customer pre-orders the

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[3]Transactions that took place on the two Saturdays during the sample period were recorded jointly with transactions taking place on the respective following Monday. Saturday and Monday transactions cannot be identified separately in the data set, leaving us in effect with nine trading days.

[4]The individual items of a good, such as individual Golden Delicious apples, are nearly identical and very homogeneous.

good via phone on the previous day and the shop delivers the goods to customer's address on the next day. The price is usually pre-arranged and billed directly to the customer, so that no face-to-face bargaining takes place. Type 4 are transactions where the good was given to the customer for free as replacement for a poor quality good bought on the previous day. There is no bargaining in this case. Our analysis focuses on the 2111 transactions of Type 1 and 2, for which face-to-face bargaining can take place.[5]

Shop's customers are of two different types. The first type visits the shop regularly and is known personally to the shop assistants. Regular customers are often registered with the shop to allow them to purchase on account and to facilitate the billing process. Some regular customers have more than one buying agent visiting the shop on consecutive days or even the same day. Visiting the shop on a regular basis does not necessarily mean, however, that the customer is a loyal buyer. He may well buy elsewhere also. The second type are walk-in customers, who visit the shop only occasionally. We know for regular customers if they are loyal buyers, i.e., if they not only visit the shop regularly but also buy their goods there; if they haggle over the unit price and the quantity regularly, occasionally, or never; and if they are disciplined payers if they do not pay cash. For walk-in customers, we only know that they pay in cash and do not pre-order.

The interaction between shop assistant and customer is usually very short and at any stage the customer may walk away. The bargaining process starts with the shop assistant announcing an offer price per unit. The customer can accept or decline the offer. The declining customer might then make a counteroffer, often combined with mentioning the quantity she is prepared to buy at the counteroffer price. The shop assistant will either accept directly or make a final offer, which the customer then either accepts or declines.[6] Regarding the bargaining behavior of regular customers, we know for each customer if he

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[5]Of all transactions, 9 are of Type 4 and 334 of Type 3.

[6]This is the standard professional interaction on the MIN, as we corroborated by interviewing other shopkeepers. See also Kirman et al. (2005), who analyse detailed bargaining process information from a different shop at the MIN.

bargains (i) never, (ii) occasionally, or (iii) regularly.

3.2   Buyer characteristics and bargaining strategy

We next analyse the correlation between buyers' characteristics and their bargaining strategies. To do so, we resort to *Correspondance Analysis* as developed by Benzécri et al. (1973), see also Greenacre (1984) and Lebart et al. (1984). Correspondence analysis is a descriptive/exploratory technique designed to analyze simple two-way and multi-way tables containing some measure of correspondence between the rows and columns. The results provide information which is similar in nature to those produced by Factor Analysis techniques, and they allow one to explore the structure of categorical variables included in the table.

Correspondence analysis is a multivariate method that applies for positive numerical data tables and overall qualitative data. Rows of such tables are the "observations" or "cases" and columns the "variables". It allows the construction of an orthogonal system of axes (called factors and denoted F1, F2, etc...) where observations and variables can be jointly displayed. The factors are constructed according to the information they represent and therefore are presented in a decreasing order of importance. A maximum of $n-1$ such factors can be determined, where n is the lowest of the two numbers of observations and of variables. The information included in a subspace of dimension p $(p \leq n-1)$ equals the sum of information included in the p factors. In this system proximity between observations or between variables are interpreted as strong similarity. Proximity between observations and variables are interpreted as strong relationship. The ability of displaying simultaneously observations and variables on the same factorial space makes it easy to discover the salient information included in a given data table.

To test if the personal and the behavioural characteristics are correlated, we do an independency test. The results are presented in the Table 1. We test the two hypothesis:

H0: The personal and the behavioural characteristics are independent.

Ha: The personal and the behavioural characteristics are dependent.

We have done the test for all the possible line-column combinations. The tests shed light on only four relationships (see Table 1): the bargaining behaviour is correlated to the location of buyer's business, the business and the characterization of buyer's clientele. The payment behaviour is correlated to the characterization of buyer's clientele. The test does not show any correlation between the other variables.

[Table 1 about here.]

To be more precise, we use Goodman and Kruskal's τ.[7] It indicates in which proportion the behavioural factors are dependant on the personal factors. If is interpreted as follows: Suppose that $\tau = x$, this means that the personal factors explain $100x\%$ of the variations in the behavioural factors. We can also say that the error ratio goes down to $100x\%$ if the choice was done randomly. The values of τ are presented in the Table 2.

[Table 2 about here.]

Buyer's business and bargaining behaviour Figure 1 presents a separation into clusters between three groups of buyers. The clusters appear in three planes: The north east plane gathers buyers that transform the goods (manufactures or caterers) and indicates that they do not bargain. The north west plane gathers buyers with general food stand and wholesaler. For these two categories the purchases on the whole market are a quite small part of their activity and buyers bargain occasionally. The south west plane indicates that buyers who sell the fruits and vegetables on a retail market (either on a local market or a retail market) bargain more often.

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[7]It is considered as the best measure of the relationship between nominal variables.

An explanation of this division can be given by making a link between bargaining and time. If we consider that bargaining is time consuming, then only buyers that spend more time in the market can bargain, others do not have any time. We can also justify this by saying that the higher is the importance of those purchases (in term of time), the higher is the tendency to bargain. Buyers bargain only if the profit that can be generated is higher than the cost to bargain.

[Figure 1 about here.]

Characterization of buyer's clientele and bargaining behaviour   Figure 2 presents a separation into clusters between three groups of buyers. The clusters appear in the following planes: The north east plane indicates that buyers that buy goods for themselves have a tendency to not bargain. The north west plane indicates that buyers with customers from high quality price segment have a tendency to bargain occasionally. The south west plane indicates that buyers with customers from low quality price segment have a tendency to bargain regularly. Lastly, we cannot infer from the graph concerning the bargaining behaviour of the buyers with customers from medium quality price segment. It seems that they either bargain regularly or not at all. The first intuition seems to be that all the professional buyers bargain. If retail market customers are not willing to pay higher price to have access to the quality, the buyer always tries to obtain low prices and hence regularly bargains. If retail customers are willing to pay more for quality, buyers bargain still occasionally. It is better for him to have low prices, but even if the prices are not so low, he can sell the goods on the retail market.

[Figure 2 about here.]

Characterization of buyer's clientele and payment behaviour   Figure 3 presents a separation into clusters between 4 groups of buyers. The clusters appear in each plane: The north east plane indicates that buyers that buy

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goods for themselves have a tendency to pay cash. The north west plane indicates that buyers with customers from high quality price segment have a tendency to have the variable payment equal to 1 and hence pay with short time credit. The south west plane indicates that buyers with customers from low quality price segment have a tendency to have the variable payment equal to 4 and hence pay with very long time credit. The south east plane indicates that buyers with customers from medium quality price segment have a tendency to have the variable payment equal to 2 and 3. Those clusters clearly indicate that the payment behaviour of the buyers on the whole market depends on the retail market[8]. The first intuition seems to be that if retail prices are too low, the buyer cannot cover all his fees and pays the wholesaler with delay. If the characterization of buyer's clientele is low, the stand owner applies low prices. The profit generated is hence low and the stand owner has hence more difficulty to pay (in time) the wholesaler.

[Figure 3 about here.]

Buyer's location and bargaining behaviour We first test the link between the area and the bargaining behaviour. Nevertheless, the obtained graph does not give rich information (Most of the points are close to the origin). We cannot deduce anything for areas 13 and 84. This can be due to the division of the area. Those two areas are quite large and there can be an important heterogeneity between the buyers in the area. Areas 4 and 26 are separated by the first axis. This fact indicates that buyers from those two areas do not have the same bargaining behaviour. To know more about the buyers from areas 13 and 84, we could use the ZIP code. Nevertheless, the high number of classes causes the frequencies to be too low.

3.3   Analysis of face-to-face bargaining

For the analysis of face-to-face bargaining between the seller and his customers, we group the individual transactions on a same day and same good basis. This

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[8]We consider here that the characterization of the buyer's clientele is a personal factor

grouping ensures that the goods are homogeneous between the transactions, because they are taken from the same daily stock. Further, the daily grouping ensures that other circumstances on the market and day, which are not observed by us, can be assumed to be constant between transactions.

Of the 815 day-good groups, 340 consist only of one transaction and are excluded from further analysis.[9] The remaining 475 day-good groups have at least two transactions and cover 161 different goods. Table 3 provides information on the transactions of the day-good groups.

[Table 3 about here.]

Two-thirds of the day-good groups show price variation between transactions during the day, see Panel A. The average number of transactions per day-good group is five, see Panel B. Groups with price variation during the day contain slightly more transactions on average because more transactions give the shop assistants more opportunities to adjust the price. Such price adjustments are not inevitable, however, as the maximum of transactions for day-groups without price variation shows. The quantity variable in Panel C is measured as the turnover of the individual transaction relative to the turnover of all transactions in the day-good group.[10] There is no discernible difference between the quantities bought by regular and walk-in customers. The median quantity is 0.2, which corresponds to the share one would expect if the quantity were the same for each of the average five transactions per day. The deviations of the quantities from the median is right skewed and positive deviations are larger on average than (absolute) negative deviations. To measure negative price discrimination, we compute the average price per unit of a good for each day-good group and compare the average price with the price paid in the individual transaction. Adverse price discrimination exists if the customer pays a price above the average. This is the case for 34.5% of all transactions, see Panel D. A test using the z-Statistic indicates that discrimination against walk-in

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[9]For instance, only one customer bought red apples on the 26th.

[10]We measure 'quantity' as turnover share to allow comparison between goods sold in different units such as number of packs or in kilograms.

customers is significantly more likely than discrimination against regular customers (using the usual significance levels).

To examine if walk-in customers are more likely to be discriminated against per se or because of their behaviour, we fit binary probit regressions with the discrimination indicator as the dependent variable.[11] The explanatory variables considered are the quantity bought in the transaction, the method of payment, and if the good bought was on commission of the external supplier or buyer (controlling for Type 2 transactions). Table 4 presents the regression results.

[Table 4 about here.]

Panel A reports the result for the regression when only the quantity and the customer type is considered; Panel B reports the results when the other variables are included. The cash payment and the buyer commission indicators are excluded from the final regressions because both had insignificant coefficients when included.[12] The significant coefficients of the estimated probit models in Table 4 show that customer behaviour plays a role in price discrimination.

Next to evaluate the effect of the purchased quantity on the likelihood of discrimination, we plot the predicted probability in Figure 4.[13]

[Figure 4 about here.]

As the Figure shows, quantity matters. The more the customer buys, the less likely it is that will she be discriminated against and have to pay a higher

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[11]Using a logit instead of a probit link function does not alter the qualitative results. This also applies to the other regressions presented below.

[12]Further, because the supplier commission information is missing for one day, using this variable leads to a loss of observations.

[13]The plots of the predicted probability as function of the quantity based on the other fitted models are very similar to Figure 4 and are not reported.

than average unit price.[14] The significant negative coefficients for regular customers in both regressions in Table 4 show that walk-in customers have a higher probability of being discriminated against. Whereas the probability of being discriminated against for a regular customer buying the median quantity is 31.6%, it is substantially higher for a walk-in customer buying the same quantity and has a probability of 41.7%.

Panel B of Table 4 considers additionally if a good is sold on commission for the supplier. As was discussed above, in this case, the risk of not selling the perishable good is borne by the supplier, not the shop. Because we do not observe information on commissioned goods for one day in our sample, the number of observations in the second probit regression reported is smaller than in the first. The regression results show that the probability of a buyer being discriminated against increases by about 13% if the good is sold on commission. The economic argument is that the shop gains from high prices from successful transactions, while the loss from keeping the goods and letting them perish after an unsuccessful transaction is removed.

We now turn to the effect of bargaining behaviour. Table 5 presents the probit regressions for regular customers, taking their bargaining behaviour into account.

[Table 5 about here.]

As expected, bargaining has a significantly negative impact on the probability of being discriminated against. The probability for being discriminated against of a customer who bargains occasionally is about 13% lower than for a customer who does not bargain. The probability is lower by 17% if the customer haggles regularly. The coefficient for the loyalty variable indicates that loyalty pays off. Loyal customers have a 7% smaller likelihood of being discriminated against than disloyal, but regular, customers.

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[14]This assumes that the quantity is under the full control of the customer. The Appendix presents results of an IV regression, where the actual quantity purchased is instrumented. The hypothesis that the quantity is exogenously set by the customer cannot be rejected at the usual significance levels.

We further conducted some robustness checks of these results. The probit regression results are qualitatively similar if only those cases are considered where at least two *different* customers purchased a good on a given day. If transactions recorded on Mondays are excluded, because they consist in effect of Monday and Saturday transactions, then all but the loyalty coefficient remain qualitatively the same. The loyalty coefficient is still negative, but no longer significantly different from zero at the usual significance levels. This stays unchanged if the Monday and Saturday and goods with only one customer are excluded. The general results are thus fairly robust.[15]

3.4 Summary

We find considerable second degree price discrimination in our data set because different customers pay different prices for the same good on the same day. The statistical analysis shows that customers' behaviour impacts on the likelihood of being discriminated. We find that it pays off for customers to set up a relationship with a given shop and to stay loyal to the shop. Further, the larger the quantity the customer wants to buy, the more can improve the price per unit. Bargaining tendencies also improve the price paid.

4 Conclusion

We have looked at the problem of price discrimination by analysing the data from a single shop on the Marseille wholesale fruit and vegetable market. As is usually the case in empirical work, the classification of price discrimination into different types is far from clear-cut.

We first show that buyers' bargaining behaviour is correlated with their characteristics. We use Correspondence Analysis to show that some buyers characteristics have an impact on their behaviour. We hence show that (1) the bargaining behaviour of buyers is determined by their business, the location

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[15]The results of these regressions are not reported here.

of the business and the characterization of their clientele and (2) the payment reliability of the buyer depend on the characterization of the buyers' clientele.

Regarding the interaction between buyers and the seller, we do find a significant relation between three features and the probability of paying a higher price. First, customers who are loyal tend to pay lower than average prices, in contradiction to certain other studies such as that of Weisbuch et al. (2000). There are subtle elements at work here. Charging a loyal customer more may result in better service. The obvious candidate for this would be the quality of the goods received or reserving goods for such customers. In our case the quality element did not play a role, according to the evidence provided by the shopkeeper, and no goods were reserved except for those explicitly ordered by telephone. However, a loyal customer will implicitly receive better treatment as the quantities provided by the seller are a function of his previous sales and these are mainly determined by what the loyal customers buy. Whether or not the loyal customer will get a higher price depends on the implicit cost of selling to a walk-in customer. Selling to such a customer may reduce the goods available for the loyal customers and if the latter do not find what they want, this may reduce their probability of remaining loyal. This effect would tend to drive the price charged to casual buyers up. Second, customers who bargain obtain better prices. At first sight this is obvious but if the seller knows that he is faced with a bargainer he might propose a higher price initially as game theory would suggest. However, the empirical evidence shows no such strategic effect. Third, goods sold on commission fetch higher prices as a result of the lower risk involved for the seller.

This contribution of our paper could be thought of as providing an empirical justification for all the papers that simplify the agents' representation but model the markets as situations where agents co-evolve by adapting their behaviour to the behaviours of their opponents and justify the attraction of economists to the impact of bargaining and loyalty behaviour. We have shown here that buyers are discriminated and that this discrimination is correlated directly with the behaviour of the buyers and indirectly with their personal characteristics.

In this paper we simply take the fact that buyers face different demands as given but in future work we would like to explore the nature of the relationship between the types of buyer and the demand that they face when they resell their goods.

Appendix

The Appendix presents the results of a two-stage IV regression, which tests if the quantity purchased is endogenous (Wooldridge, 2002, 15.7.2). The first-stage regression explains the actual quantity bought with the exogenous customer characteristics loyalty and bargaining behaviour plus the quantity of the same variety of good bought by the same customer on the most recent previous day. We have only 666 observations available because not all customers bought the same variety of good at least twice over the sample period. Panel A of Table 6 presents the results of the first stage regression. Although the overall explanatory power is rather low with a coefficient of determination of 4%, the actual and the previous quantity have a significant positive relationship.

[Table 6 about here.]

Panel B shows the results of a probit regression where the actual quantity is replaced by the quantity predicted from the first stage regression. All estimated coefficients have the same signs as before, but the coefficient for the (predicted) quantity is not significant.[16] Panel C shows, however, that the test of exogeneity cannot be rejected at the usual levels of significance. In that case, the probit regressions given in the main text are more efficient and the interpretation should be based on these.

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[16]Because the Newey coefficient estimators are standardized, the magnitudes of the estimates are not directly comparable to the estimates of the probit models presented above.

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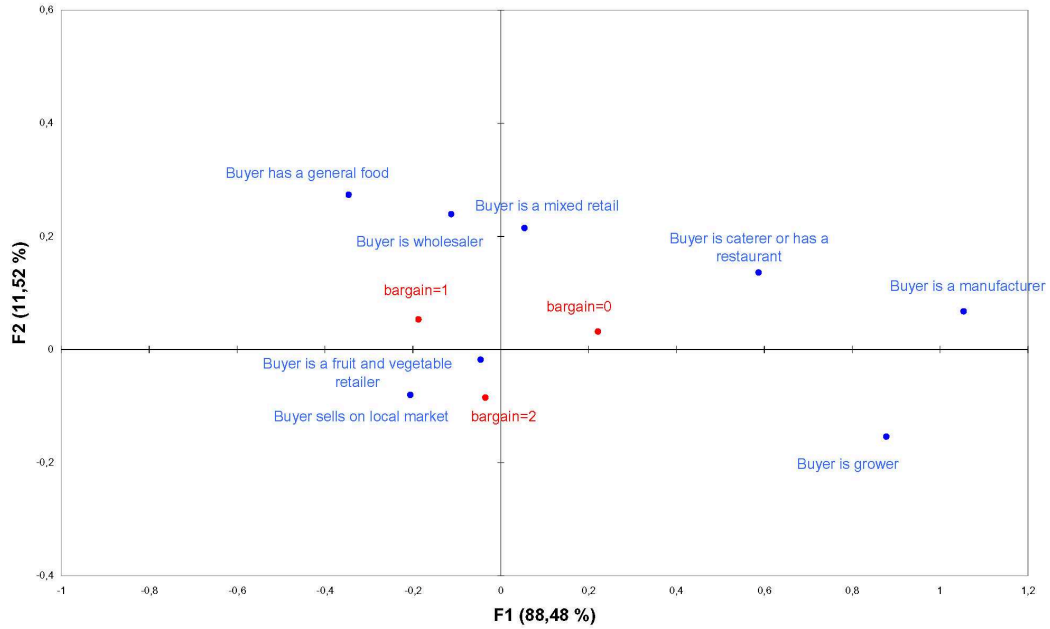
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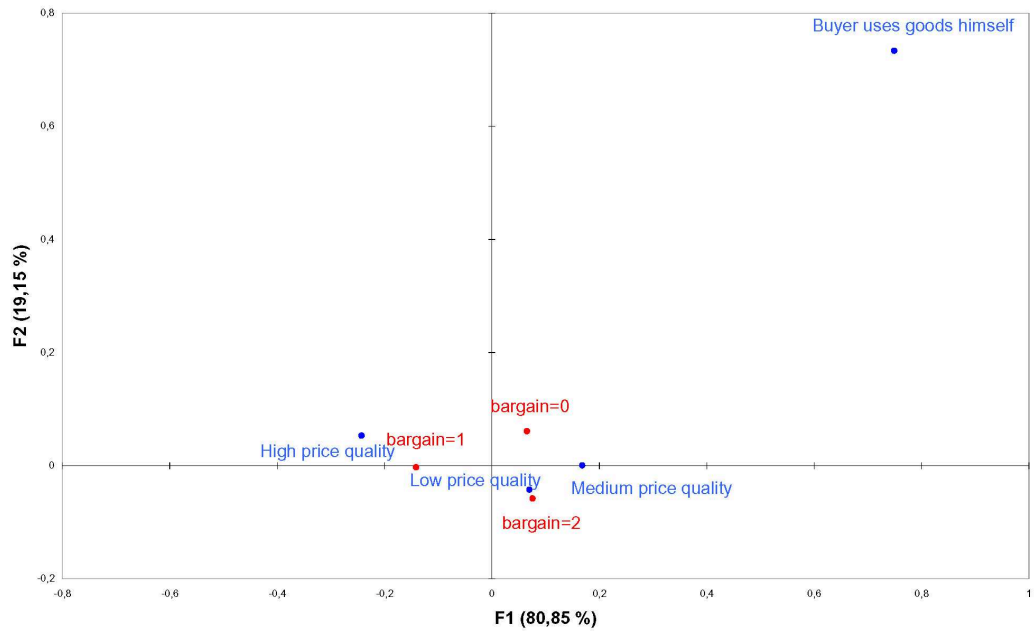
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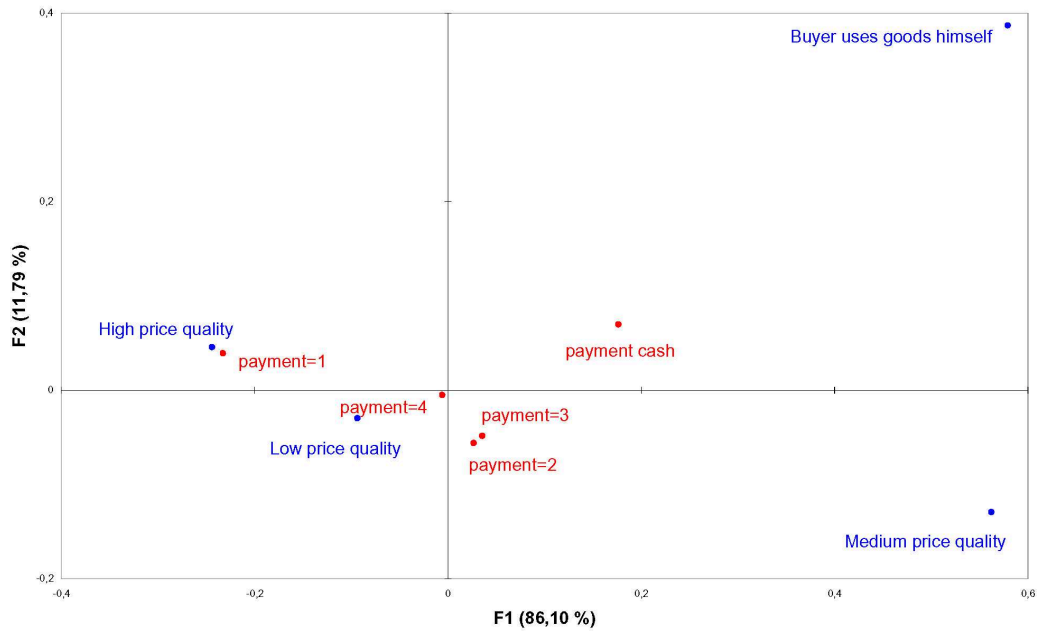
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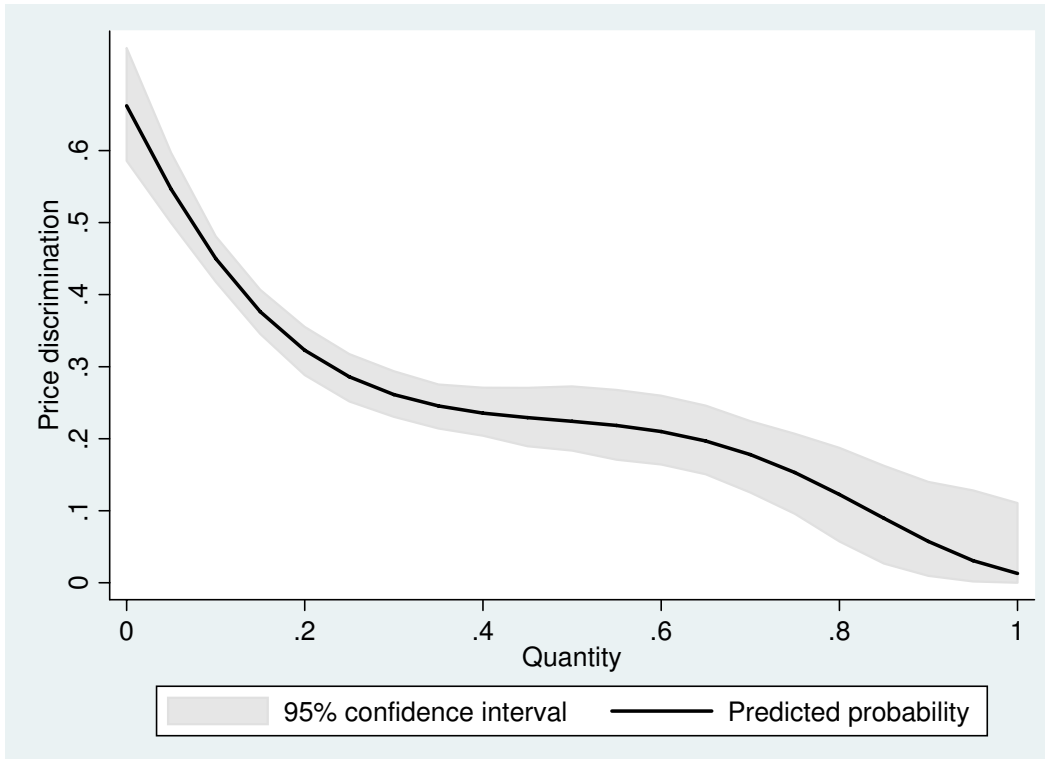
Figure 4: Predicted probability $\Phi(x\beta)$ of being price discriminated as a function of the quantity purchased. The probability is computed using the estimated coefficients given in Table 4 Panel A by varying the quantity variable. The share of regular customers is fixed at its sample mean. The 95% confidence interval for the predicted probabilities are based on 1000 bootstrap replications per grid point.

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Table 1: Risk to reject the assumption of independency between the variables.

| Variables	Risk
Location of buyer's business and bargaining behaviour	3.38%
Business and bargaining behaviour	0.04%
Characterization of buyer's clientele and bargaining behaviour	4.61%
Characterization of buyer's clientele and payment behaviour	0.01%

Notes: Results of the independency test between the personal and behavioural factors. The tests shed light on only four relationships: the bargaining behaviour is correlated to the location of buyer's business, the business and the characterization of buyer's clientele. The payment behaviour is correlated to the characterization of buyer's clientele.

Table 2: Test of Goodman and Kruskal

Test	τ
Area explains bargaining behaviour	0.096
Business explains bargaining behaviour	0.183
Buyer's customers explains bargaining behaviour	0.070
Buyer's customers explains payment behaviour	0.151

Notes: Goodman and Kruskal's τ to calculate in which proportions the behavioural factors are dependant on the personal factors

Table 3: Summary statistics for day-good groups and price discrimination.

			Panel A: Day-good groups			
	With	Without	All			
Daily price variation	296	179	475			
		Panel B: Transactions per day-good group				
	Mean	Median	Std. Dev.	Min	Max	Total
With price variation	5.1	5	2.5	2	12	1188
Without price variation	4.3	3	2.6	2	14	583
All	4.8	4	2.5	2	14	1771
		Panel C: Quantity per transaction				
	Mean	Median	Std. Dev.	Min	Max	Total
Regular customer	27.2%	20.2%	21.4%	0.6%	93.9%	1641
Walk-in customer	22.4%	16.7%	19.8%	1.8%	85.7%	130
All	26.8%	20.0%	21.3%	0.6%	93.9%	1771
		Panel D: Transactions with price discrimination				
		Transactions		Proportion		z-Statistic
Regular customer		1641		33.5%		3.05***
Walk-in customer		130		46.9%		

Notes: Price variation in Panels A and B indicates if the sales price per unit varies between transactions on a day. Quantity in Panel C is transaction's share relative to the turnover of a transactions in the same day-good group. Proportion in Panel D indicates the share of transactions in which a customer paid more than the daily average price. The z-Statistic is the square root of a Wald-Statistic based on a bootstrapped covariance matrix estimator using 500 replications. The one-sided hypothesis 'Proportion for walk-in customers is at most as large as the proportion for regular customers' can be rejected at the 1% significance level (***). The z-Statistic is asymptotically standard normal distributed and the critical value is 2.33.

Table 4: Probit models for price discrimination of regular and walk-in customers.

			Panel A		
Variable			Coefficient	z-Statistic	P-Value
Quantity			-6.671	-5.04	0.000
Quantity squared			13.247	3.24	0.001
Quantity cubed			-9.220	-2.67	0.008
Regular customer			-0.270	-2.36	0.018
Constant			0.668	4.60	0.000
Observations	1771		Wald-Statistic		129.88
Pseudo R^2	0.063		P-Value(Wald-Stat.)		0.000
			Panel B		
Variable			Coefficient	z-Statistic	P-Value
Quantity			-6.576	-5.10	0.000
Quantity squared			12.861	3.32	0.001
Quantity cubed			-9.121	-2.81	0.005
Regular customer			-0.276	-2.32	0.021
Commissioned good			0.282	4.02	0.000
Constant			0.522	3.35	0.001
Observations	1674		Wald-Statistic		148.05
Pseudo R^2	0.076		P-Value(Wald-Stat.)		0.000

Notes: Dependent variable is the price discrimination indicator. The indicator is 1 if the customer pays a price above the daily average in the same day-good group; the indicator is 0 otherwise. The probability of the indicator is modeled as $\Phi(x\beta)$. Φ is the distribution function of a standard normal variable, x contains the explanatory variables, and the coefficients are estimates for β. z-Statistics are computed using bootstrapped standard errors with 500 replications. Panel B includes additionally a dummy that is 1 if the good bought in the transaction was sold on commission for an external supplier. This variable is missing for one day, which leads to less observations.

Table 5: Probit models for price discrimination of regular customers taking their behaviour into account.

		Panel A		
Variable		Coefficient	z-Statistic	P-Value
Quantity		-5.751	-4.18	0.000
Quantity squared		10.927	2.69	0.007
Quantity cubed		-7.505	-2.24	0.025
Occasional bargaining		-0.336	-2.28	0.023
Regular bargaining		-0.498	-2.58	0.010
Loyal buyer		-0.183	-1.77	0.076
Constant		0.736	3.14	0.002
Observations	1641	Wald-Statistic		86.17
Pseudo R^2	0.067	P-Value(Wald-Stat.)		0.000
		Panel B		
Variable		Coefficient	z-Statistic	P-Value
Quantity		-5.433	-3.63	0.000
Quantity squared		9.720	2.22	0.027
Quantity cubed		-6.661	-1.86	0.063
Occasional bargaining		-0.354	-2.23	0.026
Regular bargaining		-0.535	-2.62	0.009
Loyal buyer		-0.193	-1.73	0.084
Commissioned good		0.332	4.57	0.000
Constant		0.567	2.39	0.017
Observations	1548	Wald-Statistic		124.72
Pseudo R^2	0.081	P-Value(Wald-Stat.)		0.000

Notes: Dependent variable is the price discrimination indicator. The indicator is 1 if the customer pays a price above the daily average in the same day-good group; the indicator is 0 otherwise. The probability of the indicator is modeled as $\Phi(x\beta)$. Φ is the distribution function of a standard normal variable, x contains the explanatory variables, and the coefficients are estimates for β. z-Statistics are computed with bootstrapped standard errors with 500 replications and clustered with respect to the buyers. Panel B includes additionally a dummy that is 1 if the good bought in the transaction was sold on commission for an external supplier. This variable is missing for one day, which leads to less observations.

Table 6: IV Probit regression where the actual quantity is instrumented using Newey's efficient two-step estimator.

Panel A: First Stage Regression			
Variable	Coefficient	z-Statistic	P-Value
Previous quantity	0.272	4.11	0.000
Occasional bargaining	0.058	2.97	0.003
Regular bargaining	0.048	1.64	0.101
Loyal buyer	0.030	1.34	0.182
Constant	0.172	6.25	0.000
Observations	666	R^2	0.040
Panel B: Second Stage Probit Regression			
Variable	Coefficient	z-Statistic	P-Value
Quantity	-0.056	-0.03	0.974
Occasional bargaining	-0.668	-4.07	0.000
Regular bargaining	-1.118	-4.82	0.000
Loyal buyer	-0.284	-1.76	0.079
Constant	0.336	0.91	0.363
Observations	666	Wald-Statistic	38.08
		P-Value(Wald-Stat.)	0.000
Panel C: Wald Test of Exogeneity			
Test Statistic	1.30	P-Value(Wald-Stat.)	0.254

Notes: Dependent variable in the first stage regression is the quantity bought. Previous quantity is the amount of good of the same variety bought by the same customer in the most recent transaction. Second stage probit regression has the discrimination indicator as dependent variable. Quantity in the second stage regression is the predicted quantity of the first stage regression.