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MODELLING TRANSACTIONS WITH ULTIMATUM GAMES: AN EXPERIMENT ON CERTIFICATION

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Modelling transactions with ultimatum games: An experiment on certification

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ABSTRACT

Ultimatum games have been extensively used in experimental studies. By studying the consequences that restrictions shared by ultimatum games have in subject's behaviour, this paper argues that some results are falsified by design constraints. This paper also presents a taxonomy of certification, and provides experimental evidence supporting the commonly observed use of rankings in certificates, as well as the restriction of awareness by certifiers to increase revenue. Regulatory implications are discussed.

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Introduction

Ultimatum games are probably the most commonly analysed games in experimental studies. Ever since the first systematic study of ultimatum games by Güth, Schmittberger and Schwarze (1982) numerous experiments have been designed around the basic ultimatum game. A commonly reported result in ultimatum experiments is some form of "fairness" concern by which proposers deviate from purely selfish behaviour. It has been demonstrated that fairness considerations decrease when the symmetric information constraint is lifted (see for example Mitzkewitz and Nagel, 1993, Rapoport, Sundali and Seale, 1996, and Croson, 1996). By lifting two common constraints in ultimatum experiments to create an ultimatum game with a twist, this paper obtains results where fairness concerns are significatively weaker than those of typical ultimatum games. This paper then proposes that commonly observed fairness concerns in experiments is largely a product of design constraints.

In our daily life we are presented with numerous settings where asymmetric information is present: the purchase of a used car, the selection of a financial instrument, the choice of a restaurant or a hotel, shopping on the internet, etc. The uninformed party in these situations can in some cases use a trusted third party (such as a certifier) to eliminate or diminish the uncertainty. One can consult a friend or a restaurant guide (like the Michelin guide) when choosing a restaurant. Investors buying debt instruments can consult bond-rating agencies (like Standard and Poors or Moody's). An internet consumer may be presented with a certificate from a third party (like VeriSign) stating that the site he is consulting complies with certain criteria, which may be helpful in removing some (or all) the uncertainty. However, what does the absence of a certificate signal? Amazon, one of the best known e-tailers, does not display e-certificates as those offered by VeriSign or e-trust, that are commonplace among other e-tailers. Should the visitor be wary of this absence of a certificate? Or is it the case that reputation makes certification redundant? The present study provides a taxonomy of certification to help answering these questions. It identifies five interrelated issues present in certification environments. It also tests experimentally the effects of certification in asymmetric information situations, and test the effect of two of the issues on a certification experiment.

Certification

Certification is an activity whose objective is to dissipate market frictions that impede the direct exchange of information among agents. Asymmetric information is therefore a necessary condition for certification to arise. If a party is better informed than another in an exchange situation, the less informed party may have an incentive

to acquire costly information from a certifier. Diverse frictions may obstruct the informed party from disclosing its information credibly to the uninformed party, or the uninformed party from reliably accessing this information. Examples of these frictions are: doubts that consumers may have in sellers' claims if the sellers have incentives to lie, difficulties in assessing the attributes of a product by a consumer, etc. Certification can therefore help both buyers and sellers in an economy when there is uncertainty about the qualities of suppliers or products (see Akerlof, 1970, Viscusi, 1978 and Guerra, 2001).

Certification has been present in the real world almost since the first transaction with unknown parties took place: it was not unusual for ancient merchants to ask for references when they did not know a supplier or a buyer. Certification has enhanced trade and developed trust among those involved in transactions. Every day examples of certification include bond ratings, hotel rankings, equity research reports, restaurant guides, and electronic certificates for e-commerce. The importance of certification has increased enormously during the past thirty years, not in small part as a consequence of the information revolution, which has facilitated anonymity, reduced the cost of mimicry and contributed to increase the information variance among agents. Akerlof (1970) demonstrates that information asymmetry can unravel a market, with low quality goods pushing out high quality goods thus causing a market breakdown. Viscusi (1978) presented certification as an alternative to exit for high quality providers. Certification thus offers several benefits to the market: it can be used to eliminate (or reduce) informational asymmetries that can lead to undesirable monopolistic rather than competitive markets, it can alleviate adverse selection and moral hazard that may impede markets from developing, it can prevent hidden information from skewing competition towards observable attributes instead of desirable attributes (e.g. appearance instead of quality), etc. These are just some of the problems that can be solved through certification.

Certification Issues

As we discussed above, certification is a very powerful tool, but an understanding of its mechanisms and their effect in the response to certification is necessary. Drawing on Guerra (2001), this paper delineates a taxonomy of certification by defining the five most important issues faced by the three parties involved in certification (certifier, certificate user and certified party). These five issues are: payee, price, participant, partition, and publication.

Payee refers to *who* should be charged for the certificate. A certificate is a public good, as its use by one agent does not prevent other agents from using it. As Beales, Craswell and Salop (1981) point out, information markets present imperfections due

to their natural monopoly features (there is a low marginal cost for distributing information once it has been produced), and their free rider problems (buyers can resell or give away acquired information to others). These problems are alleviated if the party being certified pays for the certificate, as it happens in the bond ratings industry. Coestier (1998) proposes public financing of certification, given its public good characteristics, as otherwise there could be too little supply of certificates. The user of the certificate can also be charged; for example in the UK, the Automobile Association charges the potential buyer for a certificate on used cars, instead of charging the car owner for it. Unfortunately there is no easy way to determine who should pay for a certificate. Sometimes there are no efficient ways to compensate a certifier. For example, if a certificate benefits a consumer more that a supplier, why should the supplier have to pay for it? One could argue that the supplier can pass the certificate's cost to the consumer, but if not all consumers require the certificate then some consumers would be (unfairly) subsidizing this cost for others.

Price focuses in *how much* to charge for the certificate, and it depends in no small part on who the payee is. If the seller pays for the certificate (which, given its public-good nature, is the sensible thing to do), setting the price could induce moral hazard: if the certifier charges a higher price for a better certificate (as a seller attaches higher value to a good certificate), he has an incentive to distort the truth and increase the rating of all his clients to increase revenue. One way to overcome this moral hazard problem is to charge a fixed price for certification regardless of the quality of the party being certified. Still there is a chance of certifier's moral hazard if the sellers expect to receive a favourable treatment by simply applying for a certificate. Reputation for the certifying party can help overcome this difficulty as noted in Guerra (2001).

Participant denotes *whom* to certify. When there exist several certifiers in a market, those being certified could go "shopping" for the best certificate they can obtain therefore diminishing the informative value of the certificate. To avoid this problem all those that can be certified should be subject to certification. This explains the phenomena of unsolicited ratings in the bond rating industry. Unsolicited certification can present a problem when pricing certificates, as some sellers could try to free raid and wait to receive an unsolicited certificate instead of paying for a solicited one. Random assignment of unsolicited certification could assist in this problem. Universal certification can also help users in interpreting certificates: a rating of *A+*, or three stars may not provide enough information to a consumer, but finding known companies in a certain rating group could help assessing unknown companies. As some companies would rather not certificate themselves at a given price, when this price is greater than the expected benefits of certification, an unsolicited certificate could bring them to these comparison groups for the benefit of the consumer.

Partition refers to *where* to set boundaries. A certificate should cover those characteristics that matter to the user, and provide accurate and useful information. This may seem obvious, but it is not always the case. For example, consider the star rating system for holiday resorts. Even though it is helpful in establishing quality within a market, it is extremely noisy across markets. A 4 star hotel in Paris is quite different from a 4 star hotel in America, and both are very different from a 4 star hotel in Singapore. Guerra (2001) shows that rank-orderings (as the hotel star system or bond rating notches) develop naturally in a monopolistic certification market. Once a partition is defined it is likely to evolve once the users of the certificate require a finer discrimination. This is exemplified in the bond rating industry, in which agencies had to append + and – signs to their ratings, and have further added 'outlooks' to their ratings to indicate the likely change of a given rating. Against increasing the depth of the certificate, Faulhaber and Yao (1989) point out to the "user cost" of understanding and remembering certificates. They claim that a simple "OK/not OK" rating such as the Good Housekeeping Seal may dominate complex systems under some circumstances.

Publication addresses *when* to release. To avoid noise in the market a certifying party should disclose the result of its enquiry regardless of its result, for otherwise companies with bad certificates would choose not to display them and this would bias certificates upwards. This is because if companies can decide when to disclose a certificate, they will choose to disclose it only when it is valuable for them to do so, which may be when the certificate is either accurate or positively biased (but not necessarily, as a company may want to disclose even a negatively biased certificate if it improves the expectation of consumers from an uninformed situation). The bias in certificates could induce a revision by its users about the informativeness of the certificates, introducing unnecessary uncertainty and noise to the market.

In the experiment presented in this paper partition and publication are varied, while payee, price, participant are fixed with the suggestions presented in Guerra (2001), as it will be explained latter.

Modelling market transactions with Ultimatum Games.

An ultimatum game is a two person game in which one player (the proposer) suggests a division of a resource between the two. The other player (the responder) can then accept or reject the offer. If the responder accepts both get the allocation suggested by the proposer, and if he rejects, both get nothing. The sub-game perfect equilibrium predicts the proposer suggesting getting all (or almost all) the resource and a zero (or insignificant proportion for the receiver), and the receiver accepting it. Ultimatum games have been studied extensively since the first systematic study of ultimatum

games by Güth, Schmittberger and Schwarze (1982) (for surveys of the literature see Thaler, 1988, Güth and Tiez, 1990, Roth, 1995, and Güth, 1995). Typical results show modal proposal of fifty-fifty split, with mean choices giving proposers higher proportions (between 60% and 70%). This paper presents evidence suggesting that these results are a product of experimental constraints, and not necessarily due to fairness concerns, as it has been often hypothesized.

Ultimatum games have often been used to describe bargaining situations, but their use in modelling commercial transactions have been neglected, even though they provide a powerful framework for the task (Croson, 1996 suggests ultimatum bargaining as a model for transactions. Hoffman, McCabe, Shachat and Smith, 1994 model different buyer-seller transactions using ultimatum games). To understand how an ultimatum game can model a standard operation let us begin with the simplest transaction of all: a seller offering a good to a buyer. When the seller sets a price p for his good, he becomes a proposer. The buyer who must decide whether to buy or not is then put in the receiver place (a purchase will give the seller a profit π and the buyer will receive her utility u from the good minus the disutility of the price p). One limitation of ultimatum games is the requirement of a fixed amount to be shared among two agents, and both of them getting nothing in the case of a disagreement. If keeping the good provided value to the seller, it would still be possible to analyse the transaction as an ultimatum game by normalizing the gains over this value.

For the purposes of this paper, the ultimatum game will be enhanced with one side uncertainty and the possibility of negative payoffs, to reflect typical real life situations in which the seller is better informed about the attributes of the good than the buyer, and where the buyer may end up paying more than she would be willing to under perfect information.

One Side Uncertainty

Several experiments have used uncertainty in the form of one-sided private information in which the size of the cake is determined by nature: Forsythe, Keenan and Sopher (1991), Mitzkewitz and Nagel (1993), Straub and Murnighan (1995), Kagel, Kim and Moser (1996), Rapoport, Sundali and Seale (1996), Rapoport and Sundali (1996) and Croson (1996). The typical model is that of Mitzkewitz and Nagel (1993) and in which the proposer knows the pie size but the receiver knows only the probability distribution of the value of the pie (the pie size in this case varies from 1 to 6 according to the throw of a die). The paper distinguishes two types of games with asymmetric information, demand and offer games. In demand games the proposer announces the share of the pie he request for himself, while in offer games it informs of the possible share of the receiver. This study will use the demand game to

model the simple buyer-seller situation: the seller sets a price (demands an amount for him) and it is up to the buyer to accept or reject it. As a result of introducing one-sided uncertainty the notion of "fairness" becomes ambiguous, and makes difficult for the buyer to expect (or measure) equality. Mitzkewitz and Nagel (1993) find that by introducing this enhancement, proposers demanded a higher share (from 83% to 61%, depending on pie size). In a closely related piece of research Harrison and McCabe (1996) show that differences in common knowledge of the rationality, beliefs and motives of other players are better predictors for variations in proposed distributions than fairness considerations.

Negative Payoffs

As exposed above, there is abundant experimental evidence that lifting the perfect information constraint reduces "fairness" considerations. This paper argues that lifting a second constraint further diminishes these considerations, and consequently proposes that fairness is mainly a product of experimental constraints. The second constraint to be lifted to complete the Ultimatum Game for Transactions is the non-negativity of payoffs. In regular ultimatum experiments a seller cannot ask from a buyer more than the totality of the pie. This prevents experimenters from modelling situations where the buyer is made worst off by transacting with the seller. One can get rid of this artificial constraint when one-side uncertainty is present, without affecting the basic structure of the game. For this it suffices to allow sellers to demand as much as the highest possible pie, regardless of the actual pie being divided. The pie size can still be considered fixed, as the appropriation by the seller is equal to the extraction from the buyer. By allowing sellers to offer negative utility to buyers we can extend the ecological validity of ultimatum games when modelling transactions, leaving most of the analysis intact.

At this point it is convenient to define two different measures of pie size. The first one, *Maximum Pie*, will identify the maximum possible pie in the setting (or alternatively, the maximum amount that a seller can receive at any given point). The second measure, *True Pie*, refers to the actual pie being divided (or the maximum value that a buyer could obtain at a given point). In Mitzkewitz and Nagel (1993) both measures were equal given the constraint of non-negative payoffs, i.e. a seller could receive at most the value indicated by the die throw, which was the upper limit of what a buyer could obtain. If we were to lift the non-negativity constraint in Mitzkewitz and Nagel's (1993) design, the maximum pie would be 6 (as the proposer could in theory ask for the maximum possible value and the responder could concede without necessarily breaking the individually rationality constraint, under a well defined set of beliefs). Clearly the maximum pie would differ from the true pie whenever the die outcome was not 6.

Experimental Setting

Design.

In this experiment, the effect of two certification issues (partition and publication) on both buyers and sellers behaviour is tested, while holding the other three issues (price, payee and participation) constant. The price of the certificate is fixed at 25 pence, the payee is defined as the seller, and participation is voluntary. Two variants are allowed for both partition and publication. The experiment also tests on whether awareness of certification affects buying behaviour on buyers or willingness to apply for a certificate on sellers. A benchmark treatment with no certification (***n*** variant) is included. These variants resulted in a 2x2x2 + 1 factorial design run in 12 sessions (the twelve session with factorial design allow 4 session for each of the nine treatments). To test the theoretical work presented by Guerra (2001) imperfect certification was introduced. Each session consisted of 8 subjects, 4 for each role (randomly assigned), the experiment was computer assisted, and was run in the Experimental Laboratory of the Department of Economics, University of Oxford during the autumn of 2001.

Partition variant

The pie size was determined by the quality of the product being offered. This quality was exogenously given (determined by nature) through a random draw from a uniform distribution in [0..100]. A discrete partition was used in the form of a 5 stars system (***5*** variant) or a semi-continuous value (***v*** treatment with the certificate taking an integer value in [0..100]).

Imperfect Certification.

Guerra (2001) demonstrated that the ordered ranking of levels frequently observed in real markets could be explained by introducing noisy estimates of quality in buyers. Previous to that certification literature had not being able to explain the ranking phenomena: Lizzieri (1999) demonstrated that buyers' lack of information caused certifiers to disclose only whether the seller was of the lowest type, which under the assumption of a continuum of quality types is a zero probability event. De & Nabar (1991) modelled certification as binary (as a result of binary product quality), limiting the size of the partition.

Providing or generating a noisy estimate in the minds of the buyers experimentally is plagued with undesirable issues such as lack of control over the degree of noisiness and also it can have demand effects. These problems were reduced through the use of imperfect certification, which leads to similar results to those of Guerra (2001), and allows better experimental control.

The imperfect certificate was obtained in the ***v*** treatment by taking the real value of the quality of the good (q), and drawing a number from a uniform distribution in [q-10, q+10]. If the resulting value was higher than (lower than) the upper (lower) limit of 100 (0) the certificate showed the limit value of 100 (0). For the ***5*** variant, the certificate was obtained by taking the integer part of $q/20$ and adding it one to assign the corresponding number of stars (except in the case q=100, which was assigned a 5 star certificate). 80% of the time the number of stars thus defined was shown, 10% of the time it would fall in the partition immediately below, and 10% of the time in the partition immediately above; again, if the resulting certificate was 0 (or 6) the certificate was set to 1 (or 5) stars.

Publication variants.

Two variants to the type of publication were defined: immediate (***i***) and seller defined (***s***). In the ***i*** variant the result of the certification process is passed to the buyers regardless of the result, while in the ***s*** treatment the seller has a chance to see the type of certificate being awarded, and then decide whether to display it or not. The absence of a certificate in the ***s*** variant, therefore, does not provide information about whether or not the seller applied for a certificate.

Awareness variant

Two conditions, aware (***a***) and unaware (***u***) were given for the certification cases. In the ***a*** condition buyers were informed that sellers had the opportunity to apply for a certificate, and the conditions of certification. In the ***u*** condition this information was withheld from the buyers, and it was provided to them the first time they were presented with a certificate. Therefore, in the unawareness condition, a buyer will be ignorant about the existence of certificates until he encounters a seller with a certificate.

An additional condition with no certification (***n***), to which none of the above mentioned variants apply, was included as a benchmark.

Subjects' payoffs were given in points. At the end of the experiment these points were paid at a rate of 1 penny (0.01 GBP) per point. When the experiment was conducted the exchange rate was 1.46 USD per GBP.

The extensive form of the modified Demand Game is given below (see the appendix for a transcript of the instructions given to subjects). The steps that are to be included only in specific variants are preceded by the codes ***c***, ***i***, ***s***, **5**, ***v***, ***a***, ***u*** in brackets for the variants *certification*, *instantaneous*, *seller*, *5 star*, *value*, *aware* and *unaware* respectively.

Procedure

1. Each player is assigned a role: Buyer or Seller.
2. Nature assigns each seller a quality level $q \in [0..100]$.
3. Each seller is informed of his quality level, and is asked to set a price $p \in [0..250]$.

[***c***] 3.1. The seller decides whether to certify or not at a cost of 25.

[***c***] 3.2. Nature decides the outcome of the certificate (imperfect certification).

[***cs***] 3.3. The seller observes the certificate and chooses whether to display it or not.

[***cs***] 3.3.a. If the seller chose to display the certificate, it is shown to the buyer.

[***ci***] 3.3.b. The certificate is shown to the buyer.

4. The buyer observes the price and decides whether to buy the good or not.

The process is repeated three more times from 3.3a onwards so that all four sellers are matched with all four buyers. To finish the game one of the matches is chosen at random. If the buyer chose to buy in that match the seller receives p from the buyer, and the buyer receives 2.5 units for each quality unit of the seller's good. If she decided not to buy, both receive nothing.

The sellers used a semi circular dial calibrated in integers from 0 to 250 to choose price. The certificates where shown in graphic form (1 to 5 stars in the ***5*** variant, and an horizontal bar filling a box containing the numeric value in the ***v*** variant).

Results

Table 1 shows some summary statistics. From the certification data we can observe that the partition treatments (***5*** and ***v***) do have an effect on certification. Sellers were more inclined to certify under the 5 star variant than under the value regime. Guerra (2001) predicts this result, with an ordered ranking of levels maximizing revenue for certifiers, under a fixed price scheme. In the ***5*** variant 69% of the sellers chose to buy a certificate, while only 38% chose to do so in the ***v*** case. This difference is significant at the 5% level (p value 0.000). An alternative explanation to that of Guerra (2001) is complexity aversion: sellers are more comfortable with simple certificates. Against this theory one should consider that a seller trying to inform buyers of his characteristics would do so with the resources available to him, regardless of complexity. In any case, the important result is that the ordered ranking of levels, frequently observed in real life, was preferred over the continuous ranking in the laboratory. Similarly awareness reduced certification, with 75% certification rate in the ***u*** variant against a 31% in the ***a*** variant (p-value 0.000). This may explain why certifiers do not put more emphasis in education consumers about their rankings.

Table 1. Means and Standard Deviations of Observed Variables

	n	***5***	***v***	***s***	***i***	***a***	***u***	***all***
Certify	-	68.8%	37.5%	50.0%	56.3%	31.3%	75.0%	53.1%
	-	(0.467)	(0.488)	(0.504)	(0.500)	(0.467)	(0.436)	(0.501)
Buy	43.8%	42.2%	40.6%	39.1%	43.8%	43.8%	39.1%	42.2%
	(0.500)	(0.498)	(0.495)	(0.492)	(0.500)	(0.500)	(0.492)	(0.495)
Price	119.1	133.4	135.3	121.8	146.8	134.6	134.0)	129.3
	(57.098)	(43.768)	(40.995)	(44.527)	(36.027)	(42.99)	(41.834)	(48.100)
Offered Profit	-6.63	-2.59	-4.63	-8.06	0.84	-11.97	4.75	-4.61
	(34.717)	(53.430)	(45.701)	(43.221)	(55.110)	(49.242)	(48.772)	45.064

One striking result is the Offered Profit. Offered Profit is defined as the potential profit from a buyer offered by a seller, and is given by 2.5 x $q - p$. where q is the seller's quality and p is the price chosen by him. A typical result in ultimatum games is the fairness result, with typical offers of 50:50. This result is reduced in ultimatum games with asymmetric information (Mitzkewitz and Nagel, 1993, report required demands from 83% to 61% depending on cake size). From the offered profit we can see that sellers are demanding on average more than 100% of the true pie. This result confronts typical "fairness" results of ultimatum experiments, and its likely cause is the liberation of the complete information and non-negative payoff constraints. An additional source for reduction of fairness concerns could be the transaction frame used in this experiment: if the seller perceives that he owns the good, he may ask for his entitlement (which may be higher than 50%). Hoffman, McCabe, Shachat and Smith (1994) use a similar buyer-seller frame (which they call "exchange frame"), and find a significant reduction in fairness, with modal demands in the 60% to 70% range, but with no demand exceeding 80% in the comparable case (they have an additional treatment with entitlement in which a small number of observations have demands of 90%). The frame alone cannot therefore account for the striking average demands of more than 100% of the true pie. This result is also not a consequence of certification as we can see from table 2: in ***n***, the benchmark case with no certification, which is comparable with ultimatum demand games like the one in Mitzkewitz and Nagel (1993), the median demand is 110% of the true pie, above 100% even without certification.

Table 2. Median required true pie proportions by sellers across variants

	N	***5***	***v***	***S***	***I***	***a***	***u***	***all***
Median	109.8%	97.1%	104.9%	119.8%	93.9%	108.4%	99.1%	105.5%
Minimum	73.2%	52.4%	52.4%	57.0%	52.4%	57.0%	52.4%	52.4%
Maximum	1600.0%	714.3%	4400.0%	266.0%	4400.0%	4400.0%	266.0%	4400.0%
Std. Dev.	369.8%	155.3%	754.2%	53.4%	1051.4%	1048.3%	55.0%	650.8%

These results raise a very important methodological issue. We must analyse the effect that (commonly used) experimental constraints put on subjects. Lifting two small

constraints in this experiment challenge one of the most replicated experimental results in economics. This may indicate that fairness does not come naturally to subjects, but it is induced through experimental constraints. Harrison (2001) argues that price controls in the form of ceilings affect subjects' behaviour. It seems that if we let subjects exhibit a truly selfish behaviour they will opt to do so. Figure 1 shows sellers' demanded proportion of true pie with respect to true pie size. Mitzkewitz and Nagel (1993) obtain a similar shape with a limited number cake sizes, using the non-negative restriction. Their graph decreases from 83% for the smaller pie to 60.8% for the larger one. It seems that the non-negative restriction shifts the curve down.

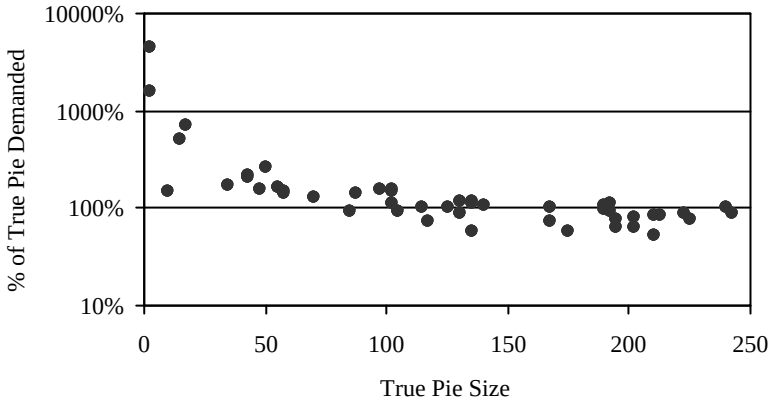


Figure 1. Sellers' Demands of True Pie (log scale)

It can be argued that sellers were focusing in the maximum pie, and not in the true pie. In fact, the summary statistics of such assumption (see table 3) would initially suggest that this was indeed the case, and then the results would seem similar to the typical ultimatum games results.

Table 3. Median required maximum pie proportions by sellers across variants

	n	***5***	***v***	***s***	***i***	***a***	***u***	***all***
Median	46.0%	50.0%	50.2%	50.0%	59.6%	50.0%	51.2%	50.0%
Min	6.0%	30.8%	30.0%	30.0%	39.6%	30.0%	32.0%	6.0%
Max	88.0%	96.0%	96.0%	96.0%	87.2%	96.0%	87.2%	96.0%
Std Dev	22.8%	17.5%	16.9%	17.8%	14.4%	17.2%	16.7%	19.2%

A closer look to the data shows that the results are not typical. Figure 2 shows sellers' demands of maximum pie with respect to true pie size (or quality assigned). The proportion of maximum pie demanded is increasing in true pie size, which is generally the opposite for typical demand games. Mitzkewitz and Nagel (1993) show an inverse relation where the maximum demand correspond to the lowest true pie, and the smaller demand to the largest pie. An even if sellers were concentrating in maximum pie size, this would be further evidence that fairness consideration were not present, as this produced negative mean offered profits.

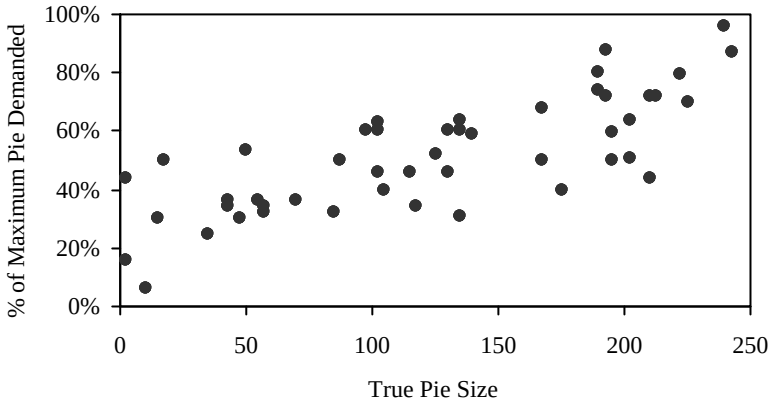


Figure 2. Sellers' Demands of Maximum Pie (log scale)

The strength of this result should not disappoint those of us that believe in the integrity of people. As we can observe in figure 3 there were some sellers that did offer buyers' positive payoffs. This is especially true in those sellers endowed with a higher quality level (larger true pie). In all, 44% of all sellers suggested demands that offered non-negative payoff to buyers (90% of which offered a strictly positive payoff).

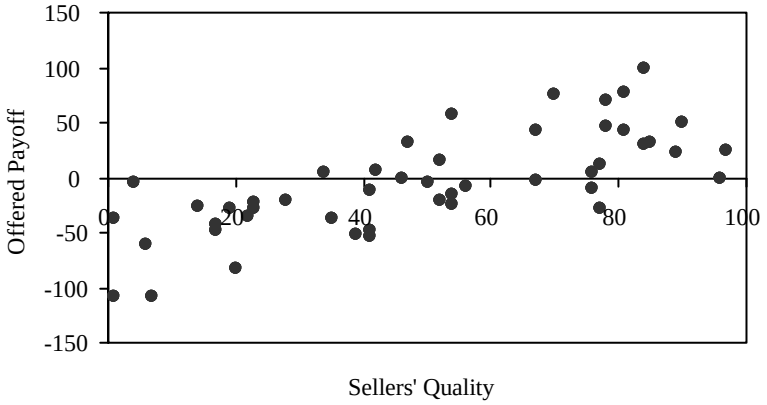


Figure 3. Profit offered by sellers

Table 4 shows the raw data for sellers. One curious relationship from this data is the one of price to quality. Without certification (our benchmark ***n*** case) the sub-game perfect Nash equilibrium prediction for rational, risk-neutral sellers would be to set the price at 125[1], with all buyers purchasing at this price. This is not the case. Figure 4 shows a similar relation for the ***n*** variant to that of the other variants. Under the theory that people are selfish, and without certification to discover deception, why would their choice of price be correlated to the quality assigned to them by nature? Two explanations may be that they are bounded rational, and have a strategy of taking

[1] The expected quality of any given seller is 50 points, as quality is uniformly distributed in [0..100]. In order to extract the maximum value from buyers, would therefore choose a price of 2.5 x 50 = 125.

all the pie, without realizing that they can take even more than that by deceiving buyers. A second explanation is that they have some "fairness" concern, and even though they prefer all the pie for themselves, they do not want to steal from buyers.

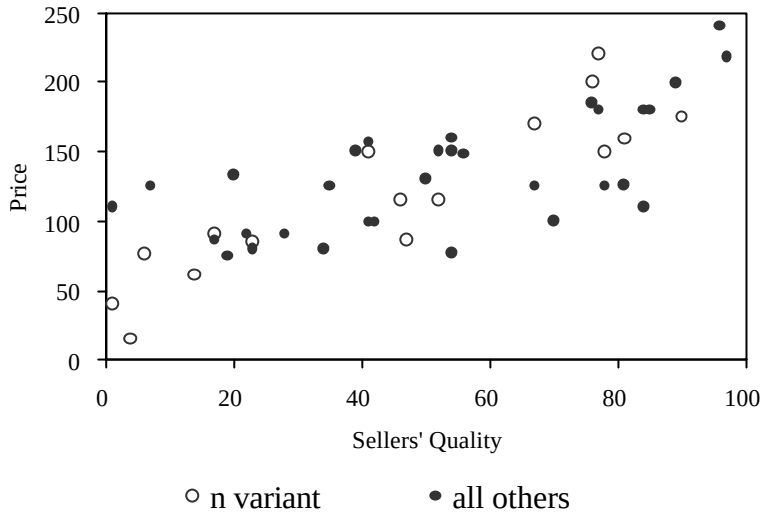


Figure 4. Price-Quality relation

Given the linear relation between price and quality, it would be valid to question whether the observed relation of figure 3 is not in caused different sellers with diverse satisfaction levels: a satisficing seller would choose a price high enough for his satisfaction level resulting, given the random assignation of quality, in a linear price-payoff relation merely by design, not by fairness consideration. From figure 5 we can see that this is not the case. A simple linear regression for the relation depicted in figure 3 can explain 54.5% of the variance, while a linear regression for the data in figure 5 can explain only 2.2%. We can then discard the spurious effect hypothesis.

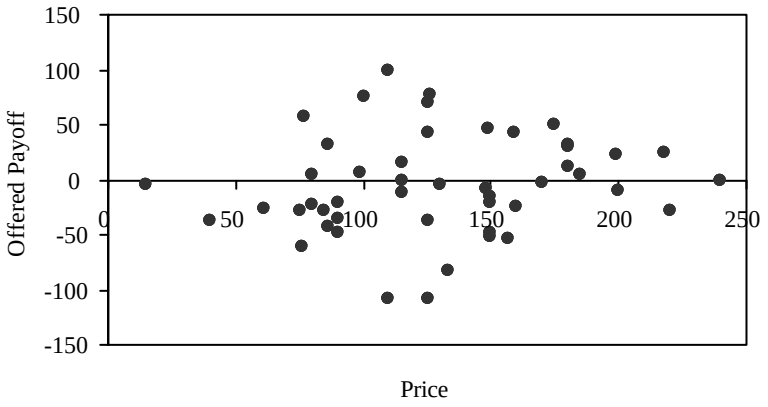


Figure 5. Profit Offered by Sellers

Table 4. Sellers' Raw data

Ses	Subj	Variant	Qual	Prie	Cert	C	Dis	Sold
1	S1	***n***	17	90	-	-	-	3
	S2	***n***	1	40	-	-	-	4
	S3	***n***	81	159	-	-	-	1
	S4	***n***	47	86	-	-	-	2
2	S1	***n***	78	149	-	-	-	1
	S2	***n***	52	115	-	-	-	0
	S3	***n***	77	220	-	-	-	0
	S4	***n***	23	85	-	-	-	3
3	S1	***n***	41	150	-	-	-	1
	S2	***n***	6	76	-	-	-	2
	S3	***n***	4	15	-	-	-	3
	S4	***n***	14	61	-	-	-	3
4	S1	***n***	76	200	-	-	-	0
	S2	***n***	90	175	-	-	-	1
	S3	***n***	67	170	-	-	-	1
	S4	***n***	46	115	-	-	-	3
5	S1	***c5ia***	42	99	N	-	-	3
	S2	***c5ia***	7	125	N	-	-	2
	S3	***c5ia***	39	150	Y	2	-	0
	S4	***c5ia***	84	180	Y	5	-	4
6	S1	***c5iu***	85	180	Y	5	-	3
	S2	***c5iu***	52	150	Y	3	-	0
	S3	***c5iu***	77	180	Y	4	-	0
	S4	***c5iu***	84	110	Y	5	-	3
7	S1	***c5sa***	54	77	Y	2	N	2
	S2	***c5sa***	78	125	N	-	-	0
	S3	***c5sa***	35	125	N	-	-	1
	S4	***c5sa***	96	240	Y	5	Y	2
8	S1	***c5su***	34	80	Y	2	N	2
	S2	***c5su***	22	90	Y	3	Y	2
	S3	***c5su***	20	133	N	-	-	2
	S4	***c5su***	28	90	Y	2	N	1
9	S1	***cvia***	56	148	Y	63	-	1
	S2	***cvia***	67	125	N	-	-	3
	S3	***cvia***	54	160	N	-	-	0
	S4	***cvia***	1	110	N	-	-	1
10	S1	***cviu***	41	99	N	-	-	2
	S2	***cviu***	70	100	N	-	-	0
	S3	***cviu***	97	218	Y	95	-	2
	S4	***cviu***	89	199	Y	93	-	4
11	S1	***cvsa***	23	80	N	-	-	3
	S2	***cvsa***	54	150	N	-	-	2
	S3	***cvsa***	76	185	N	-	-	2
	S4	***cvsa***	19	75	N	-	-	2
12	S1	***cvsu***	50	130	Y	48	Y	1
	S2	***cvsu***	17	86	Y	26	Y	0
	S3	***cvsu***	81	126	Y	88	Y	3
	S4	***cvsu***	41	157	N	-	-	0

Table 6 shows the raw data for buyers. Buyer behaviour is analysed using the information available to buyers beyond the experimental variant. Subjects can be divided further into two additional categories: knowledgeable (***k***) and oblivious (***o***). The ***k*** category consists of those buyers that have been informed that certification is available; this is, subjects in the ***a*** variant and subjects in the ***u*** variant that are currently or have previously encountered a seller displaying a certificate. The ***o*** category encompasses the rest.

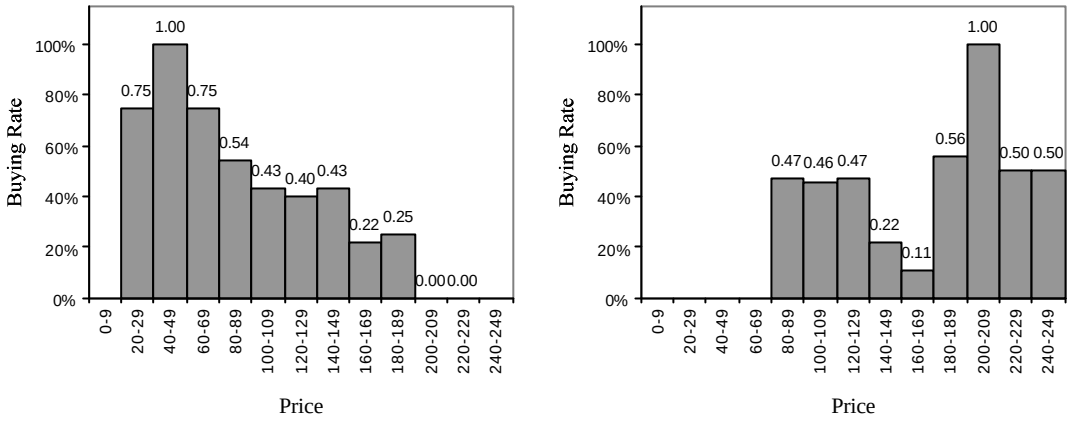
Figure 6 was obtained by grouping buying decision in classes according to observed price (the empty classes show no label for value, while classes with frequency equal to zero are indicated with a 0.00 label). Figure 6a shows the demand schedule of ***o*** buyers (74 observations) and figure 6b the one for ***k*** buyers (118 observations). Figure 6a can be construed as a common downward sloping demand curve; which is inconsistent with the sub-game perfect equilibrium for risk-neutral ***o*** buyers. The estimate of ***o*** buyers about a seller's quality level is given by the expected quality of that seller, i.e. 50 units, given that ***o*** buyers do not anticipate any additional information about a seller. All buyers then should accept any price no higher than 125, and reject any offer priced above 125. This is the equilibrium prediction, quite different from the result observed in figure 6a. Table 5 was obtained by classifying the data in three groups according to equally distanced prices ranges: 0 to 83, 84 to 166 and 167 to 250. The comparison of the mean willingness to buy in this group is significantly decreasing in price, as indicated in Table 5.

Table 5. Buying Behaviour for ***o*** buyers

				P-Value (one-tail)		
Class	*Mean*	*Std. Dev.*	*Obs.*	*0-83*	*84-166*	*167-250*
0-83	70.6%	0.4697	17	-	0.022	0.000
84-166	41.5%	0.4988	41	0.022	-	0.019
167-250	12.5%	0.3416	16	0.000	0.019	-

Figure 6b presents an (almost) inelastic demand curve, which is consistent with the sub-game perfect equilibrium prediction of all sellers but that of the lowest quality applying for a certificate, and all buyers buying at any price below cc*2.5, where cc is the certificate centre[2]. The fact that the willingness to buy is lower than 100 may be explained by a combination of risk aversion and the fact that some sellers may strategically choose not to apply for a certificate, or choose not to display it.

[2] The certificate centre is the expected value of a seller's quality level given the value of the certificate assigned by nature. In the ***5*** variant for the one, two, three, four and five star cases it is equal to 11, 30, 50, 70 and 88 respectively. In the ***v*** variant the certificate centre for a certificate of value $v \in [10..90]$ it is equal to v, for $v<10$ it is equal to $\frac{\sum_{i=1}^{v+10} i}{21}$ and for v>90 is given by $\frac{(v-90)*100+\sum_{i=v-10}^{100} i}{21}$.



Buying rate in relation to price

Figure 6a. ***o*** buyers Figure 6b. ***k*** buyers

The ***k*** class (buyers that know certification is available) can be further divided into two groups (as observed by the buyers): ***k*** buyers matched with sellers displaying a certificate (56 observations), and those matched with sellers not displaying a certificate (62 observation). Note that from a buyer's standpoint, it is impossible to distinguish sellers that applied for a certificate and decided not to display it, and those that did not apply for a certificate. We can analyse the behaviour of those buyers that were shown a certificate. Figure 7 shows the classification of the 56 observations according to the expected profit, defined as 2.5 times the certificate centre (see footnote 2) minus the price. The figure shows how a positive expected profit significantly increases willingness to buy, compared to a non-positive expected profit (mean buying rate is 75% for positive expected profit, 14% for non-positive, p value 0.000).

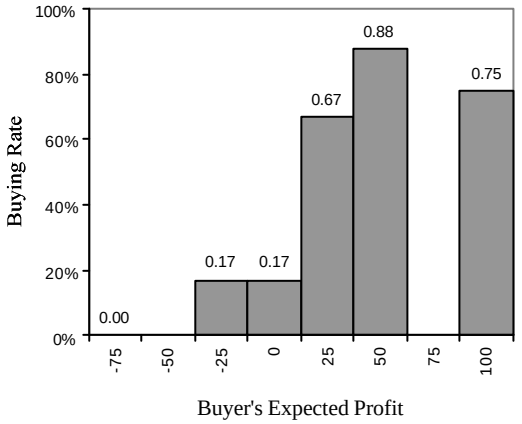


Figure 7. Buying Rate in relation to Expected Profit under Certification

The profit actually realized by buyers under certification (this is actual purchases, not offers) deserves further analysis, as it can be used to test the effectiveness of certification. Table 7 presents a summary of the buyer's actual profit in the different

Table 6. Buyers' Raw data

			Price Round				*Certificate Round*				*Buy Round*			
Ses	*Subj*	*Var*	*1*	*2*	*3*	*4*	*1*	*2*	*3*	*4*	*1*	*2*	*3*	*4*
1	B1	***n***	90	86	159	40	-	-	-	-	Y	N	Y	Y
	B2	***n***	40	90	86	159	-	-	-	-	Y	N	N	N
	B3	***n***	159	40	90	86	-	-	-	-	N	Y	Y	Y
	B4	***n***	86	159	40	90	-	-	-	-	Y	N	Y	Y
2	B1	***n***	149	85	220	115	-	-	-	-	N	N	N	N
	B2	***n***	115	149	85	220	-	-	-	-	N	N	Y	N
	B3	***n***	220	115	149	85	-	-	-	-	N	N	N	Y
	B4	***n***	85	220	115	149	-	-	-	-	Y	N	N	Y
3	B1	***n***	150	61	15	76	-	-	-	-	Y	Y	Y	N
	B2	***n***	76	150	61	15	-	-	-	-	Y	N	Y	N
	B3	***n***	15	76	150	61	-	-	-	-	Y	Y	N	Y
	B4	***n***	61	15	76	150	-	-	-	-	N	Y	N	N
4	B1	***n***	200	115	170	175	-	-	-	-	N	Y	Y	N
	B2	***n***	175	200	115	170	-	-	-	-	N	N	Y	N
	B3	***n***	170	175	200	115	-	-	-	-	N	Y	N	N
	B4	***n***	115	170	175	200	-	-	-	-	Y	N	N	N
5	B1	***c5ia***	99	180	150	125	-	5	2	-	N	Y	N	N
	B2	***c5ia***	125	99	180	150	-	-	5	2	Y	Y	Y	N
	B3	***c5ia***	150	125	99	180	2	-	-	5	N	Y	Y	Y
	B4	***c5ia***	180	150	125	99	5	2	-	-	Y	N	N	Y
6	B1	***c5iu***	180	110	180	150	5	5	4	3	N	N	N	N
	B2	***c5iu***	150	180	110	180	3	5	5	4	N	Y	Y	N
	B3	***c5iu***	180	150	180	110	4	3	5	5	N	N	Y	Y
	B4	***c5iu***	110	180	150	180	5	4	3	5	Y	N	N	Y
7	B1	***c5sa***	77	240	125	125	2	5	-	-	N	Y	N	N
	B2	***c5sa***	125	77	240	125	-	2	5	-	N	N	N	N
	B3	***c5sa***	125	125	77	240	-	-	2	5	N	N	Y	Y
	B4	***c5sa***	240	125	125	77	5	-	-	2	N	Y	N	Y
8	B1	***c5su***	80	90	133	90	-	2	-	3	N	N	Y	Y
	B2	***c5su***	90	80	90	133	3	-	2	-	N	N	N	N
	B3	***c5su***	133	90	80	90	-	3	-	2	N	N	Y	Y
	B4	***c5su***	90	133	90	80	2	-	3	-	N	Y	Y	Y
9	B1	***cvia***	148	110	160	125	63	-	-	-	N	Y	N	Y
	B2	***cvia***	125	148	110	160	-	63	-	-	Y	N	N	N
	B3	***cvia***	160	125	148	110	-	-	63	-	N	N	Y	N
	B4	***cvia***	110	160	125	148	-	-	-	63	N	N	Y	N
10	B1	***cviu***	115	199	218	100	-	93	95	-	Y	Y	N	N
	B2	***cviu***	100	115	199	218	-	-	93	95	N	N	Y	N
	B3	***cviu***	218	100	115	199	95	-	-	93	Y	N	N	Y
	B4	***cviu***	199	218	100	115	93	95	-	-	Y	Y	N	Y
11	B1	***cvsa***	80	75	185	150	-	-	-	-	Y	N	Y	N
	B2	***cvsa***	150	80	75	185	-	-	-	-	Y	N	N	Y
	B3	***cvsa***	185	150	80	75	-	-	-	-	N	N	Y	Y
	B4	***cvsa***	75	185	150	80	-	-	-	-	Y	N	Y	Y
12	B1	***cvsu***	130	157	126	86	48	-	88	26	Y	N	Y	N
	B2	***cvsu***	86	130	157	126	26	48	-	88	N	N	N	Y
	B3	***cvsu***	126	86	130	157	88	26	48	-	Y	N	N	N
	B4	***cvsu***	157	126	86	130	-	88	26	48	N	N	N	N

variants. Certification significantly increases buyers' profit from purchases (from –15.63 in ***n*** to 6.887 in ***c***, p-value 0.0155). Unawareness is also a factor that significantly increases buyers' profit (from –4.61 in the awareness case to 19.76 in the unawareness case, p-value 0.0345). The difference in profit caused by the disclosure of the certificate is significant only at the 10% level (-3.42 if seller decides vs. 16.09 in automatic, p-value 0.0745). The dept of certificate does not affect the profit significantly (p-value .4275)

Table 7. Buyer's realized profit in different experimental variants

	N	***5***	***v***	***s***	***i***	***A***	***u***	***all***
Profit	-15.63	5.67	8.15	-3.42	16.09	-4.61	19.76	-0.90
St. Dev.	32.276	56.818	40.073	43.605	52.176	45.105	50.576	44.941
Observations	28	27	26	25	28	28	25	81

Conclusion

The evidence presented in this paper suggests that the commonly observed fairness consideration in ultimatum games is a product of design constraints. This has serious consequences for experimentalists, as indicates that small design restriction can have an important impact in experimental results.

This study showed that the frequently used ranking system in certification is preferred by sellers, as suggested by the theoretical work of Guerra (2001). Similarly it showed that sellers prefer to certify when consumers are not aware that certification is present. This has important regulatory implications. When sellers are the purchasers of certificates (which as discussed in the paper is sensible to do given the public nature of certificates), certifiers may willingly fail to inform buyers that they are present in the market, to increase certification revenue from sellers. However, this paper also demonstrated that certificates benefit consumers by reducing uncertainty and the incidence of non-desirable purchases. Therefore, sellers and certifiers may collude (implicit or explicitly) to restrict the number of buyers that are aware of certification, extracting rents from consumers to their detriment. A regulator could enforce the mandatory disclosure of intent from all certifiers, so that all consumers could benefit from their presence in the market.

The analysis presented here demonstrated that when certification is present, certificates are displayed, and prices reflect consumers' knowledge, willingness to buy is significatively increased. It therefore follows that certification can be used to promote consumption in an economy. By introducing mandatory certification, consumers will become knowledgeable, and competitive sellers will have to price accordingly, with the consequent increase in consumption.

Appendix

The instructions are divided in three parts: Common, Seller and Buyer instructions. Common instructions were shown to all participants at the beginning of the experiment. A random assignment of roles followed, and then subjects were presented with Seller or Buyer instructions according to the role assigned to them.

[COMMON INSTRUCTIONS]

Welcome to the Department of Economics. You are about to take part in an experimental study of decision making.

You are not allowed to speak to other participants or communicate in any other way. If you want to ask a question, please put up your hand.

As of this moment, you have been credited with the sum of £3.00, your INITIAL AMOUNT. During the course of the experiment you may, through the decisions you make, either add to this, leave it unchanged, or lose some of it.

INTRODUCTION
In today's decisions there will be two roles: BUYERS and SELLERS. The decisions will be rewarded with points, that will be transformed, at the end, to money at the rate of 1 penny per point.

Some of you will be Buyers and some Sellers. Both Buyers and Sellers may win Points with their Decisions, but they may also in some circumstances lose Points.

SELLERS
Sellers will produce a good with quality level between 0 and 100 units (Sellers will be assigned a fixed quality level, they will not be able to chose it). Once a Seller knows his/her quality level, he/she will proceed to choose a price (between 0 and 250 points) at which to offer the good. The price will be shown, one at a time, to the buyers, who will decide whether to buy the good or not.

At the end of the experiment the decision of (only) one of the buyers will be chosen at random, and if he/she chose to buy the good from the seller, the seller will increase his/her Initial Amount with the points asked in the price, otherwise he/she will add nothing to his/her initial amount.

BUYERS
Buyers will decide whether to buy or not a good from a seller at a price chosen by that seller. Each buyer will be paired with all sellers, one at a time, to make these decisions.

At the end of the experiment (only) one of the pairings will be chosen at random, and if the buyer chose to buy the good from the seller in the chosen pairing, the buyer will receive 2.5 points for each quality unit of the good, otherwise he/she will receive nothing. Additionally, the buyer will have to pay the points asked in the price.

As a good's quality can be between 0 and 100 units a buyer can receive between 0 and 250 points from it. Note that if the price paid is greater than the benefit from the quality, the buyer will loose points from his/her Initial Amount.

[The following paragraphs (preceded by [*c*]) are for variants with certification only, and are shown at this stage only on the variants with awareness. In the variants without awareness

they are shown to sellers at the assignment stage, and to the buyers only at their first pairing with a seller displaying a certificate. The paragraphs preceded by ***5*** were shown in the variant with 5 stars certificates, the ones by ***v*** in the variant for value certificates, the ones by ***s*** in the variant with the seller deciding disclosure of certificate, and the ones by ***i*** in the variant for instantaneous disclosure of certificates.]

[***c***]CERTIFICATES
[***c***]To inform Buyers of the quality level of his/her goods, a Seller can apply for a Certificate, by paying 25 points.

[***cv***]A Certificate reflects quality within a rank of plus or minus 10 units. A product with 60 units of quality could receive a certificate of anywhere between 50 to 70 units, each with the same probability (However a certificate will never be above 100 or below 0 units).

[***c5***]A Certificate reflects quality in the form of stars: 1 star if the good has between 0 and 20 units of quality, 2 stars if it has between 21 and 40, and so on until 5 stars, if it has between 81 to 100 units of quality. The certificate will be correct 80 percent of the time. 10 percent of time it will overstate quality by one star, and 10 percent of the time it will understate quality by one star. However a certificate will never have more than 5 stars or less than one.

[***cs***]Once a certificate has been assigned, the Seller observes it and, if he so chooses, he can display it (the seller can also opt to not show the certificate, in which case the buyer will not know if the seller applied for a certificate or not).

[***ci***]Once the Seller applies for a certificate, the certificate will be showed to all buyers when they are paired with that seller.

ROLE ASSIGNMENT
As stated before, some of you will be Sellers and some Buyers.

Which role you play will be determined by your own choices in a lottery. We will now proceed to this lottery.

THE LOTTERY.
You will see a display of 10 `nonsense syllables'. The computer has assigned each of them, randomly, a different procedure to generate a number. No two procedures are the same. You will be asked to choose one syllable. When everyone has made a selection, the participants with the lowest numbers will be assigned the Seller's role and the others the Buyer's role. You will be shown immediately to which role you have been assigned. Please keep your role to yourself both during and after the experiment.

In each of your Decisions your will be paired will be a different person. You will not learn at any stage who you were paired with. Please choose one 'nonsense syllable'.

[END OF COMMON INSTRUCTIONS]

After choosing a syllable players were assigned their role (buyers or sellers), the computer chose a quality level x for sellers and subjects were presented with their corresponding instructions

[SELLER INSTRUCTIONS]

You have been assigned the Seller role. Your goods will have a quality level of [x] units. You will be paired with all the buyers, one at a time.

[In the unawareness treatments the paragraphs preceded by ***c*** in the common instructions were shown here.]

At the end of the experiment your total payment will be determined as follows. The computer programme will randomly choose one of the pairings. Your final payment will be one penny for each point. Your points will be the sum of:

• your Initial Amount of 300 points
• the price you set for your good, if the person you were paired with chose to buy it.
•[***c***] minus 25 points for the certificate, if you applied for one.

When everyone is ready, we will begin. You may have to wait one or two minutes for others to be ready. We ask you to be patient. Be sure you have understood the whole procedure, referring to Help if you wish to, before clicking on Continue. Put up your hand if you need any further help.

YOUR DECISION.
Please choose a price for your goods. You will receive that amount only if the person you are paired with decides to buy. Please Remember:

• The Buyer will receive 2.5 points for each unit of quality of your good.
• The Buyer does not know your quality level.
• You will have an opportunity to buy a Certificate for 25 points.

[Sellers proceeded to choose a price using a semi-circular dial calibrated with integers from 0 to 250 to choose a price *y*. In the ***c*** treatments they were presented the following choices:

[***c***]You have just chosen a price of [*y*] points. Do you want to apply for a Certificate or Not? Applying for a certificate costs 25 points.

[If a seller chose to certify he was assigned a certificate *z* (in the form of 5 stars or value, according to variant) and was presented the following message, otherwise, the procedure ended.]

[***c***]You have been assigned a [*z*] certificate.
[***cs***]Do you want to Display it or not?

[END OF SELLER INSTRUCTIONS]

At this stage sellers waited for the four encounters with buyers, one pairing was selected at random and the results of the chosen pairing were shown. Subjects were then paid according to the results obtained.

[BUYER INSTRUCTIONS]

You have been assigned the Buyer role. You will be paired with all the sellers, one at a time. At the end of the experiment your total payment will be determined as follows. The computer programme will randomly choose one of the pairings. Your final payment will be one penny for each point. Your points will be the sum of:

• your Initial Amount of 300 points
• 2.5 points per each quality unit of the good you bought (if you bought it) in the selected pairing.
• minus the price you paid for the good (if you bought it).

When everyone is ready, we will begin. You may have to wait one or two minutes for others to be ready. We ask you to be patient. Be sure you have understood the whole procedure, referring to Help if you wish to, before clicking on Continue. Put up your hand if you need any further help.

[The following paragraphs were presented four times to each buyer, with *n* being the counter for each time. The values of *x*, *y* and *z* (where applicable) came from those presented to or chosen by the corresponding sellers.]

The Seller in pairing [*n*] is offering his good at a price of z

[In the unawareness treatments the paragraphs preceded by ***c*** in the common instructions were shown here if the seller in this pairing was displaying a certificate and if they had not been shown in previous pairings.]

[***c5***]He's been issued a certificate of *z* stars by the computer.

[***cv***]He's been issued a certificate of *z* units by the computer.

[***cs***]After seeing his certificate he/she decided to display it.

Do you want to buy from him/her?

[Once the buyer made her decision she was told "You are ready for the next pairing. Please press <CONTINUE>" in the first three pairings, in the fourth pairing the procedure ended.]

[END OF BUYER INSTRUCTIONS]

At this stage buyers waited for all buyers to end their encounters. One pairing was selected at random and the results of the chosen pairing were shown. Subjects were then paid according to the results obtained.

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