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A note on fairness and personalised pricing

Nir Vulkan [a], Yotam Shem-Tov [b,*]

[a] Said Business School, Oxford University, United Kingdom
[b] UC Berkeley, United States

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ABSTRACT

Since the seminal papers of Fehr and Schmidt (1999) and Bolton and Ockenfels (2000), fairness has become an important discussion point in economics. Is it unfair that different people pay different prices for the same good or service? We provide what we believe to be a novel approach: We let normal everyday consumers play the role of sellers who have access to consumers' data (and willingness to pay). A strong finding of behaviour in this setup is that subjects charge a fixed percentage (approximately 64%) of the willingness to pay from each of their subjects, leading to a fair, whilst uneven, distribution of prices. Interesting, this 64% price level does not change when we vary the number of sellers competing in the market.

1. Introduction

Since the seminal papers of Fehr and Schmidt (1999) and Bolton and Ockenfels (2000), fairness has become an important (and sometimes controversial) discussion point in economics. There are now many experiments showing that economic agents behave as though they care about the payoffs of others, not just theirs (Cooper and Kagel, 2009 provide a good summary of this literature). A general feature of this literature is that members of the public seem to be averse to inequality and are willing to sacrifice some of their own payoffs to others to ensure a more equal overall distribution of payoffs.

While most of the original literature and many of the experiments that followed look at ultimatum games, an important economic scenario where fairness consideration could matter is pricing: In recent years, and especially with the advent of e-commerce, we are witnessing a significant increase in dynamic pricing, pricing based on location and postcode, and pricing based on historical data, sometimes even at an individual level (see e.g. Chapter 3 in Vulkan, 2003, or Montgomery et al., 2004a, and Montgomery et al., 2004b). Is it unfair that different people pay different prices for especially the same good or service? A number of recent papers (Huang et al., 2005; Englmaier et al., 2012) suggest that this may be the case.

In this paper we provide what we believe to be a novel approach: We let normal everyday consumers play the role of sellers who have access to consumers' data (and willingness to pay). We tell our subjects that consumers are "simple" in that they buy from the cheapest seller, and we see what kind of pricing decisions they make.

What would be fair here? A strong notion of fairness could be that sellers do no use of the information they have access to and simply charge everyone the same price. This does not happen in our experiment.

An alternative would be to charge different prices to different people, those with higher willingness will pay more, but do it in a fair way i.e. everyone pays a price that is same percentage of their willingness to pay. So that those willing to pay more do pay more but all buyers essentially pay the same percentage of their willingness to pay. We find strong support for this kind of behaviour. In fact, we show that this result is of first order importance and holds across different treatments.

When our subjects cannot personalise their prices they charge prices well over marginal costs. This is similar to previous similar experiments such as Dufwenberg and Gneezy (2000) and Abrams et al. (2000). As we increase the number of sellers in a market, prices decrease, once again consistent with previous findings. As Baye et al. (2004) and Dufwenberg and Gneezy (2000) show, this sort of behaviour is consistent with bounded rationality theories.

* Corresponding author.
E-mail addresses: nir.vulkan@sbs.ox.ac.uk (N. Vulkan), shemtov@berkeley.edu (Y. Shem-Tov).

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When sellers are allowed to use information about the willingness-to-pay of their buyers we find they do so, leading to increased competition and falling average prices. A strong finding of behaviour in this setup, as stated earlier, is that subjects charge a fixed percentage (approximately 64%) of the willingness to pay from each of their subjects, leading to a fair, whilst uneven, distribution of prices. Interestingly, this 64% price level does not change when we vary the number of sellers competing in the market.

Even more interesting, this 64% figure is consistent with what Fehr and his colleagues found as the percentage most people keep to their selves in the Ultimatum game (as opposed to nearly 100% which the pure rational theory would predict). Fischbacher et al. (2009), and Fehr et al. (2009) show that this figure persists even with fluctuation in excess supply or demand, which again is consistent with our finding of behaviour persisting with changing level of competition (number of sellers). This strongly suggests that fairness could indeed be the reason for our subjects' behaviour (*JEL*: *D*47, *L*26, *L*11).

2. Experiment design and implementation

2.1. Participants

Experiment 1 took place on April 12th 2013. One hundred and twenty eight people participated in the online experiment. Participants were recruited through a social science laboratory subject pool in a leading UK university. This lab was set up specifically to reflect the general population in England, not just students. The experiment took place in three sessions, which lasted on average about ten–fifteen minutes. At each session one participant was randomly chosen and received his payoffs from the experiment. The chosen participants earned an average of 45.6 Sterling pounds (proximally 73.8$ US, or 57 Euros). Experiment 2 took place on July 9th and 10th 2013. One hundred and twenty two people participated in the online experiment. Once again participants were recruited through the same database but excluding those who took place in the April experiment. The experiment took place in 4 sessions and lasted on average about ten–fifteen minutes. After the experiment was completed, five participants were randomly chosen and received their payoffs from the experiment, they earned an average of 39.2 Sterling pounds (proximally 63.7$ US, or 49 Euros). Table 2 shows the descriptive statistics of the participants in both experiments.

2.2. Experimental design and procedure

Experiment 1 was conducted online in three sessions, and all the subjects in each session participated simultaneously. The participants signed in using a special link they received in an email that was active only at the time the experiment was scheduled. They were then welcomed to the experiment and to receive the instructions. Each participant was instructed to act as the seller of a book and choose the most profitable price to sell it. The participant was told that he was paired with another seller who is also offering copies of the same book, and that they are both competing over a market of six buyers. The sellers were informed of their buyers' valuations, and that the buyers will never purchase the book for a price that is strictly higher than their valuation. The participants knew that the buyers will be able to see both prices before choosing whether and from whom to purchase.[1] Before starting the experiment they were presented with an example to illustrate how the game is played. They were told that at the end of the experiment session one participant would be chosen at random, and be paid his profits in the experiment multiplied by four, in Amazon vouchers sent to his email account. The experiment session is concluded with a questionnaire which gathers some demographic information (gender and age group). The participants do not have any information on their opponent; it can be any of the other participants in the experiment, on which they also have no information.

There is only one round in the experiment 1, all the subjects offer a pricing schedule one time and then the experiment ends, hence all the observations are independent of one another. For simplicity, sellers are presumed to have zero costs of production and produce identical books. Each buyer can only purchase one book. Each buyer can be considered as a separate market for the sellers, this is a Bertrand competition over multiple markets. Table 1 shows the distribution of buyers' valuations.

The purpose of the second experiment was solely as a robustness check in order to change a few of the designs in the first experiment. The design of the second experiment is similar to the first experiment, with two changes: (1) variation in the number of competing sellers in each group. (2) Different distribution of buyers' valuation.[2]

Table 1
Distribution of buyers valuations.

Experiment 1						
Buyer (market)	1	2	3	4	5	6
Valuation	2	2	3	3	17	18
Experiment 2						
Buyer (Market)	1	2	3	4	5	6
Valuation	6	7	8	9	22	23

Note, the table reports the valuation of the good for each buyer (market). The valuation is the highest amount the buyer will be willing to pay for the object.

Table 2
Descriptive statistics of covariates.

	Mean	SD	Min	Median	Max
Experiment 1					
Female	0.508	0.502	0	1	1
Age 18–24	0.211	0.410	0	0	1
Age 25–29	0.320	0.468	0	0	1
Age 30–39	0.281	0.451	0	0	1
Age 40–49	0.078	0.269	0	0	1
Age 50–65	0.078	0.269	0	0	1
Age 65+	0.016	0.125	0	0	1
Experiment 2					
Female	0.418	0.494	0	0	1
Age 18–24	0.180	0.385	0	0	1
Age 25–29	0.270	0.445	0	0	1
Age 30–39	0.320	0.467	0	0	1
Age 40–49	0.090	0.287	0	0	1
Age 50–65	0.098	0.298	0	0	1
Age 65+	0.025	0.155	0	0	1

Note, the table reports the descriptive statistics of the participants in each experiment.

[1] Participants were informed that price offer is separate and is allowed to be different. The exact instructions of the experiment are available by request from shemtov@berkeley.edu.

[2] There are two changes in the distribution of buyer valuations, the lower values of the distribution have been shifted to the right, and there are no two buyers with the same valuation of the good. Moving the lower valuations to the right was meant to make them more attractive to compete over, and give them a stronger effect on the seller's gains. We were concerned that in the previous experiment the lower valuations were too low, and wanted to check the robustness of the results when they are higher, and more attractive to compete over. The second change was to make the distribution less skewed, instead of two buyers with a valuation of "2" and two buyers with a valuation of "3", now each buyer has a different valuation.

Table 3
Offered prices adjusted by buyers' valuation Experiment 1.

	Market 1	Market 2	Market 3	Market 4	Market 5	Market 6
No controls						
Mean	0.629	0.641	0.640	0.646	0.651	0.651
Standard deviation	0.231	0.244	0.228	0.234	0.255	0.258
Controls for session						
Mean	0	0	0	0	0	0
Standard deviation	0.229	0.243	0.224	0.229	0.246	0.249

Table 4
Offered prices adjusted by buyers' valuation Experiment 2.

	Market 1	Market 2	Market 3	Market 4	Market 5	Market 6
No controls						
Mean	0.508	0.540	0.571	0.593	0.551	0.580
Standard deviation	0.234	0.225	0.222	0.222	0.236	0.247
Controls for session						
Mean	0	0	0	0	0	0
Standard deviation	0.216	0.208	0.205	0.208	0.230	0.238

Table 5
Kolmogorov–Smirnov tests for equality of adjusted prices between markets Experiment 1.

	Market 1	Market 2	Market 3	Market 4	Market 5	Market 6
No controls						
Market 1	1	0.948	0.571	0.435	0.225	0.103
Market 2	0.948	1	0.571	0.435	0.225	0.435
Market 3	0.571	0.571	1	1.000	0.154	0.435
Market 4	0.435	0.435	1.000	1	0.435	0.852
Market 5	0.225	0.225	0.154	0.435	1	0.717
Market 6	0.103	0.435	0.435	0.852	0.717	1
Controls for session						
Market 1	1	0.571	0.717	0.717	0.717	0.318
Market 2	0.571	1	0.717	0.717	0.318	0.318
Market 3	0.717	0.717	1	0.852	0.717	0.852
Market 4	0.717	0.717	0.852	1	0.948	0.717
Market 5	0.717	0.318	0.717	0.948	1	0.948
Market 6	0.318	0.318	0.852	0.717	0.948	1

Notes. Each cell reports the *P*-value of a Kolmogorov–Smirnov test.
The table reports all possible comparisons of adjusted prices between markets.

The participants played three rounds, in each round they were told they were in a group with a different number of sellers. Hence a total of two, three or four sellers are competing in the same group over a market of six buyers. The purpose of this change was to examine the interplay between pricing decisions and increase competition.

3. Results

Sellers' strategic behaviour is expressed in their choice of prices in each market (buyer type). Sellers' behaviour changes across different buyers' valuation, both with respect to the average price and the variance of offered prices. Fig. 3 shows the average offered prices and Fig. 1 the entire distribution of offered prices in experiment 1. We report a stylised fact on sellers strategic behaviour. They choose a price as a fraction of the buyers valuation,

$$p(v_i) = \alpha \cdot v_i, \tag{1}$$

where v_i is the valuation of buyer i, and $0 < \alpha < 1$. If this prediction is correct $p(v_i)/v_i$ should be the same across different buyer types (i.e., across different markets). We adjust the offered prices by the different buyer valuations in each market, and find this prediction holds. Tables 3 and 4 show the mean and standard deviation of the adjusted prices (with and without controlling for session[3]).

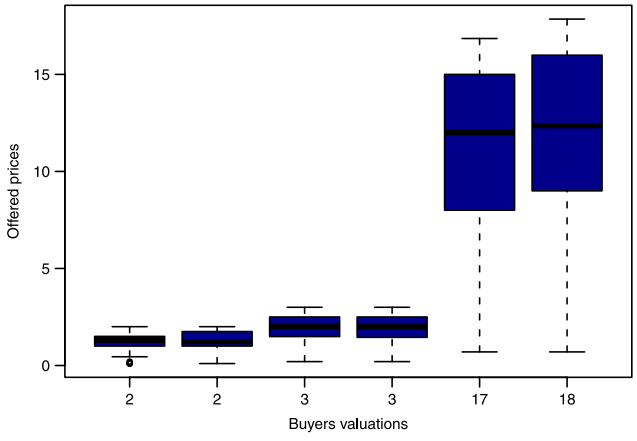

Fig. 1. Distribution of offered prices for each buyer's valuation.

This change makes the distribution of valuations less skewed, and increases the variation in the willingness to pay of the lower buyer types. We wanted to examine the hypothesis that this higher variation will increase the intensity of the seller's competition over the lower part of the distribution.

[3] We control for session using session fixed effects.

Table 6
Kolmogorov–Smirnov tests for equality of adjusted prices between markets Experiment 2.

	Market 1	Market 2	Market 3	Market 4	Market 5	Market 6
No controls						
Market 1	1	0.056	0.003	0.001	0.016	0.002
Market 2	0.056	1	0.031	0.001	0.203	0.031
Market 3	0.003	0.031	1	0.126	0.126	0.126
Market 4	0.001	0.001	0.126	1	0.023	0.161
Market 5	0.016	0.203	0.126	0.023	1	0.097
Market 6	0.002	0.031	0.126	0.161	0.097	1
Controls for session						
Market 1	1	0.254	0.381	0.254	0.381	0.097
Market 2	0.254	1	0.805	0.313	0.203	0.203
Market 3	0.381	0.805	1	0.541	0.313	0.203
Market 4	0.254	0.313	0.541	1	0.313	0.254
Market 5	0.381	0.203	0.313	0.313	1	0.880
Market 6	0.097	0.203	0.203	0.254	0.880	1

Notes. Each cell reports the *P*-value of a Kolmogorov–Smirnov test.
The table reports all possible comparisons of adjusted prices between markets.

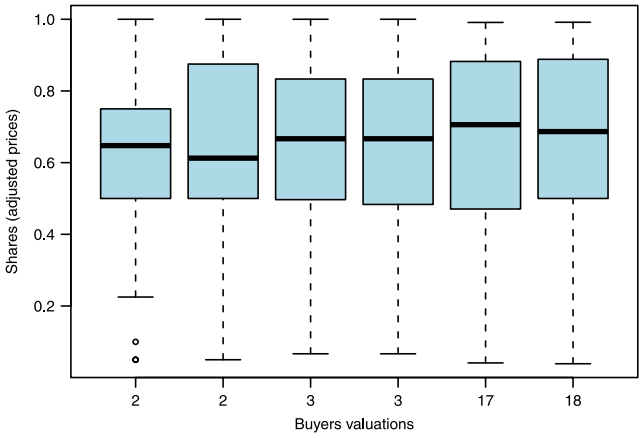

Fig. 2. Distribution of offered prices after adjustment for buyers' valuations.

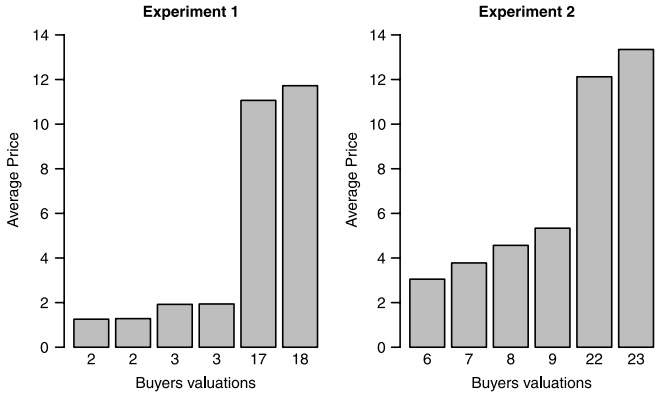

Fig. 3. Average offered prices for each buyer's valuation.

To test formally whether the entire distribution of offered prices is the same across markets we use the Kolmogorov–Smirnov test. Tables 5 and 6 show the results for experiments 1 and 2 respectively. We cannot reject the null hypothesis of equality between the distributions, for all possible comparisons.[4] We conclude that the distribution of adjusted prices is the same across markets. We find no evidence of a change in sellers behaviour when the number of competing sellers in the group increases. The stylised fact we report is robust in both experiment 1 and 2.

4. Conclusions

In recent years, retailers, especially e-commerce retailers, have the technology and data to personalise their websites and, if they so wish, their prices.

Whilst the technology has been around for some time, retailers have largely been unwilling to use it, fearing consumer backlash as in the well-publicised Amazon pricing experiment (the story was first reported in the Washington Post (Streitfeld, 2000)). Our study suggests another possible fair pricing mechanism for companies using personalised pricing, one where consumers pay a price that is a fixed percentage of their willingness to pay.

[4] In experiment 2 there is a session fixed effect and we argue the comparison should be done after controlling for session. In both experiments after controlling for session effects the Kolmogorov–Smirnov results show clear evidence in support of not rejecting the null hypothesis of equality between the distributions.

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Appendix

See Tables 2–6 and Figs. 1–3.

References

Abrams, Eric, Sefton, Martin, Yavas, Abdullah, 2000. An experimental comparison of two search models. Econom. Theory 16 (3), 735–749.
Baye, Michael R., Morgan, John, Scholten, Patrick, 2004. Price dispersion in the small and in the large: Evidence from an Internet price comparison site. J. Ind. Econ. 52 (4), 463–496.
Bolton, Gary, Ockenfels, Axel, 2000. ERC: A theory of equity, reciprocity, and competition. Amer. Econ. Rev. 90, 166–193.
Cooper, David, Kagel, John H., 2009. Other regarding preferences: a selective survey of experimental results. In: Handbook of Experimental Economics. p. 2.
Dufwenberg, Martin, Gneezy, Uri, 2000. Measuring beliefs in an experimental lost wallet game. Games Econom. Behav. 30 (2), 163–182.
Englmaier, Florian, Gratz, Linda, Reisinger, Markus, 2012. Price discrimination and fairness concerns. Available at SSRN 1999757.
Fehr, Ernst, Brown, Martin, Zehnder, Christian, 2009. On reputation: A micro-foundation of contract enforcement and price rigidity*. Econom. J. 119 (536), 333–353.
Fehr, Ernst, Schmidt, Klaus M., 1999. A theory of fairness, competition, and cooperation. Quart. J. Econ. 817–868.
Fischbacher, Urs, Fong, Christina M., Fehr, Ernst, 2009. Fairness, errors and the power of competition. J. Econ. Behav. Organ. 72 (1), 527–545.
Huang, Jen-Hung, Chang, Ching-Te, Chen, Cathy Yi-Hsuan, 2005. Perceived fairness of pricing on the Internet. J. Econ. Psychol. 343–361.

Montgomery, Alan, Hosanagar, Kartik, Krishnan, Ramayya, Clay, Karen, 2004a. Designing a better shopbot. Manage. Sci. 50 (2), 189–206.
Montgomery, Alan, Li, Shibo, Srinivasan, Kannan, Liechty, John, 2004b. Modeling online browsing and path analysis using click stream data. Mark. Sci. 23 (4), 579–595.
Streitfeld, David, 2000. On the web, price tags blur, Technical Report, Washington Post.
Vulkan, Nir, 2003. The Economics of E-commerce: A Strategic Guide to Understanding and Designing the Online Marketplace. Princeton UP, Princeton, NJ.