Product Ratings and Externalities

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Motivation

- "Green Nudges", in the form of labels or quality-marks increasingly prevalent. (Carlsson et al 2021, Gravert and Kurz 2021)
  - Fundamental problem: A sizable portion of consumers likely do not care about externality concerns the labels address.

- At the same time consumer-ratings systems on vendor platforms are an important driver of purchasing behavior. (e.g. Tadelis 2016, Vana and Lambrecht 2021)

- Moreover, a host of theoretical and experimental work on vendor reputation mechanisms suggest that consumer rating systems can be successfully be used to overcome information asymmetry problems in markets. (Mailath and Samuelson 2001, Board and Meyer 2013, Huck et al. 2016, Knutsen 2020, 2021)
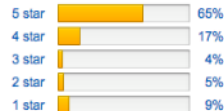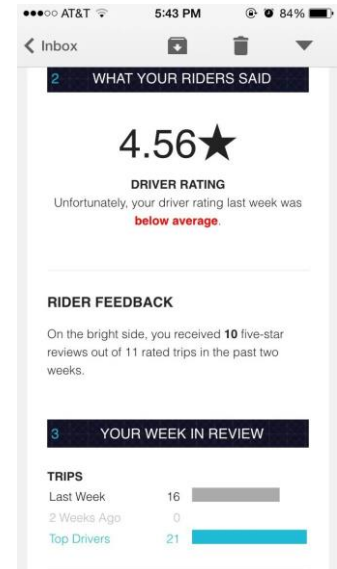
Research question

- Can product ratings for vendors/producers more effectively push markets towards trading lower-externalty experience goods, if product quality and externality performance are summarized in **one** product rating, rather than presented separately?
  - For example let the product rating be a weighted average of consumer feedback and a scoring by a qualified agency estimating externality effects

Model

- Each period, a producer is matched with a new consumer.

- The producer makes two investment decisions

  - Investing in product quality $I_{PQ} \in \{0,1\}$

  - Investing in damage reduction $I_{DR} \in \{0,1\}$

    - *Not* investing in damage reduction creates a negative externality in the background

- Consumers have a unit demand and choose whether to purchase $b \in \{0,1\}$ at an exogenously determined price p

Payoffs and types

- Consumer types:
  - *Regular* with utility $U_{CR} = b \cdot (I_{PQ} - p)$
  - *Green* with utility $U_{CR} = b \cdot (I_{PQ} - p - d \cdot (1 - I_{DR}))$

- Producer types:
  - Profit maximizers: $\pi = b \cdot p - c_{PQ} \cdot I_{PQ} - c_{DR} \cdot I_{DR}$
  - Commitment types: $\{Full\ Invest, PQ, DR, \}$

Reputation ratings

- Each producer will build up reputation ratings R_{PQ}^t, R_{DR}^t from their reported product quality and damage reduction investments I_{PQ}^t, I_{DR}^t of past periods t

  - $R_{PQ}^t = \frac{1}{t} \sum_{t'=0}^{t-1} I_{PQ}^{t'}$

  - $R_{DR}^t = \frac{1}{t} \sum_{t'=0}^{t-1} I_{DR}^{t'}$

  - Additionally, $R^t = \frac{R_{PQ}^t + R_{DR}^t}{2}$

- We refer to the case where consumers can observe R_{PQ}^t and R_{DR}^t before making a purchase decision as the *separate ratings* case

- And refer to the case where consumers observe only R^t as the *combined ratings* case

Theoretical Results

- Define a *full-investment equilibrium* as one where each round the producer chooses to both invest in product quality and damage (externality) reduction.

- With separate ratings this equilibrium only exists with a sufficient share of $Green$ consumers.

- With combined ratings this equilibrium exists *independent* of the share of $Green$ consumers.

- Moreover, with our cost structure, a *product quality only* investment strategy is only an equilibrium under separate ratings, not with the combined rating.

Experimental Design

- The experiment was run at the lab at BI Oslo in autumn 2022

- Participants are randomly assigned the role of producers and consumers

- Divided in matching groups of 6 (3 Producers, 3 Consumers)

- Randomly matched within their matching groups over approximately 48 rounds (stochastic horizon)

Experimental Design

- Each round a producer chooses:
  - Whether to invest in high product quality at a cost of 15 points
  - Whether to invest in damage reduction at a cost of 10

- Each round a consumer chooses:
  - Whether to buy the offered product in a round at a price of 60 points

Experimental design

- Consumers receive 100 points if they purchase a high-quality product

- Furthermore, each participant loses 0.25 points for each % of producers that did not invest in damage-reduction. (externality)

Experimental design

- Consumers are not aware of the round decisions by the producer they are matched with

- However, they observe ratings with average information on past investment decisions
  - These ratings will be reset three times during the experiment (so we have 4 'Super Games')

- Producers observe a graphical summary of how past purchasing decisions in the matching group depend on both quality and damage-reduction ratings

Experimental Design

- Two treatments
    - *Separate ratings*: Consumers observe separate product quality and damage reduction ratings
    - *Combined rating*: Consumers only observe one 'combined' reputation rating
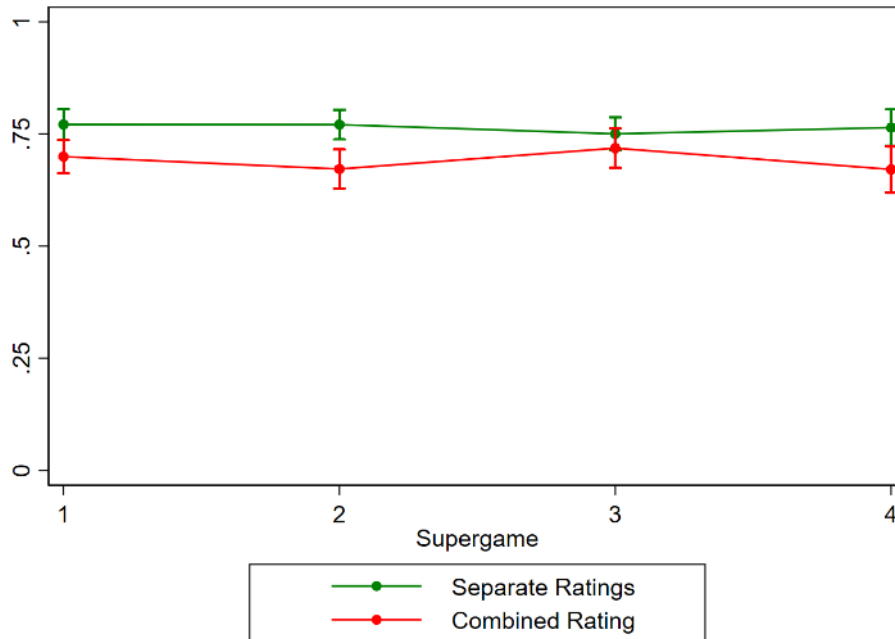
Results

# Do combined ratings still overcome the lemon market problem?

Investment in PQ

Investment in PQ	Two Ratings	One Rating	Mann-Whitney p	T-test p
All data	**76,40 %**	**69,01 %**	**0,2534**	**0,1538**
Supergame 1	77,09 %	69,94 %	0,1470	0,1636
Supergame 2	77,07 %	67,19 %	0,1220	0,0785
Supergame 3	75,03 %	71,84 %	0,6440	0,5803
Supergame 4	76,42 %	67,09 %	0,2181	0,1624
N=240	20 matching groups	20 matching groups		

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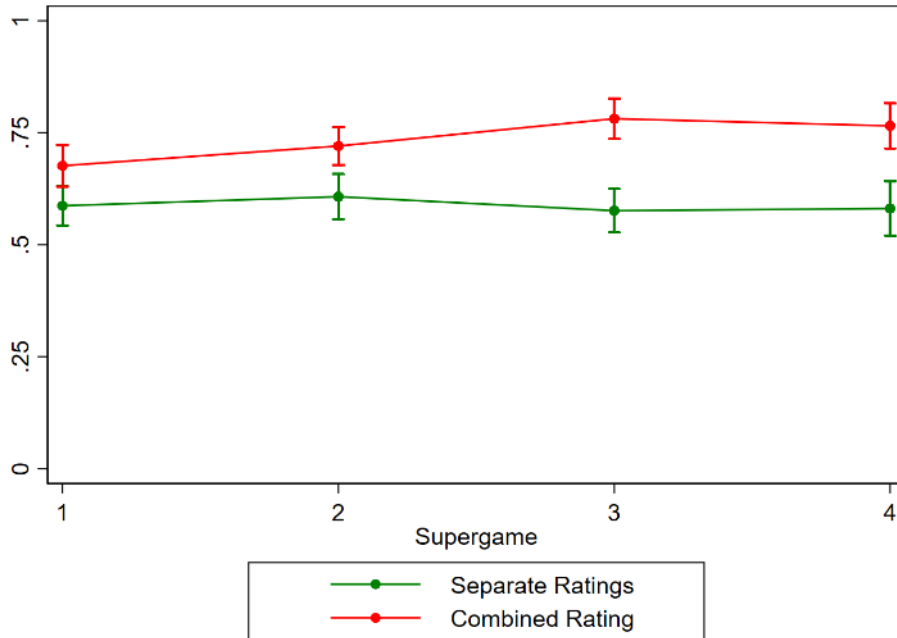
Purchases
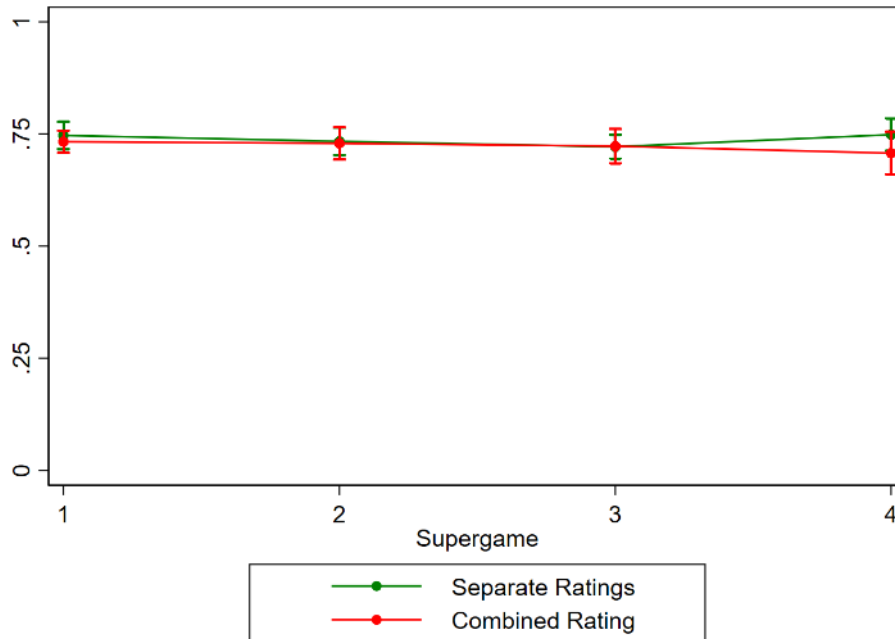
Purchase	Two Ratings	One Rating	Mann-Whitney p	T-test p
All data	**73,75 %**	**72,30 %**	**0,6065**	**0,7210**
Supergame 1	74,68 %	73,27 %	0,9626	0,7224
Supergame 2	73,35 %	72,91 %	0,8566	0,9268
Supergame 3	72,14 %	72,28 %	0,8881	0,9762
Supergame 4	74,85 %	70,72 %	0,5782	0,4931
N=240	20 matching groups	20 matching groups		

# Do combined ratings encourage more investment in damage reduction?

Investment in DR

Investment in DR	Two Ratings	One Rating	Mann-Whitney p	T-test p
All data	**58,77 %**	**73,58 %**	**0,0155**	**0,0188**
Supergame 1	58,69 %	67,62 %	0,1157	0,1700
Supergame 2	60,73 %	72,03 %	0,1294	0,0943
Supergame 3	57,60 %	78,13 %	0,0034	0,0036
Supergame 4	58,08 %	76,53 %	0,0297	0,0252
N=240	20 matching groups	20 matching groups		

Do consumers condition their purchases on DR reputation?
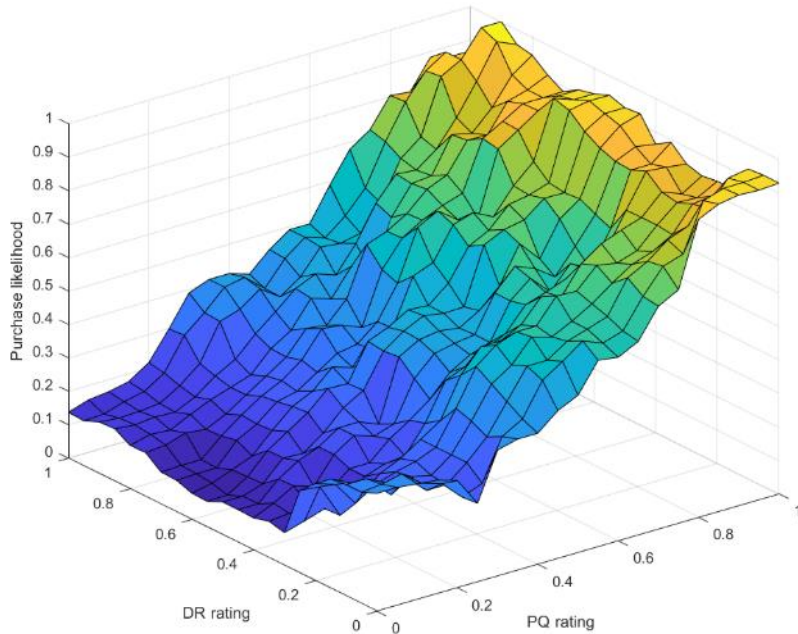
Regression	Separate ratings treatment	
	Purchase	p-value
Reputation PQ	0,8283 (0,0491)	0,000
Reputation DR	-0,0510 (0,0279)	0,083
	N=2667	

Standard errors clustered at 20 matching groups

Conclusions

- We study the effect of integrating information regarding externalities and consumer product ratings into one rating

- We argue (with our theoretical model) that this can result in increased pressure on firms to reduce externalities
  - This as the market pressure now comes from all potential consumers, not just from 'green' consumers

Conclusions

- In our experiment we identify a 15 percent point increase in investment in 'damage reduction' with combined ratings, and we find with separate ratings, externalities don't enter the consumers' considerations

- Future treatments on our "wish list" are adding explicit competition between vendors/producers, and allowing consumers to gather costly information regarding the composition of a 'bundled' rating

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