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Online Reputation Systems and Cumulative Advantage

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Outline

Online Reputation Research

- Motivation
- Research Questions and Evidence

Cumulative Advantage (CA)

- What is CA?
- Micro level analysis (revisited)
- Macro level analysis
- Conclusions

Online Reputation Research – Motivation

- Trust has been an important ingredient to human interaction ever since.
- Many types of interactions could simply not take place (i.e. would be too costly) if none of the actors would take the risk of being exploited.
- Two important traditional mechanisms to induce trust and trustworthy behavior in such situations are:
  - repeated interaction ("the shadow of the future")
  - social embeddedness (enabling the exchange of information on an actor's past behavior $\Rightarrow$ reputation)
- However: In interactions mediated through modern technologies these two properties are often missing. Strangers meet anonymously for one-shot exchanges.

Online Reputation Research – Motivation

- Assuming that at least some of the actors are rational and selfish (and that these properties cannot be inferred with certainty), online exchange among strangers would quickly collapse, or not come into existence at all, unless there are some trust-warranting mechanisms.
- One apparent solution to the problem lies in the institutionalization of a reputation system, as it is realized in many online markets such as eBay:
  - Feedback about the behavior of the partner can be provided after a transaction.
  - These “ratings” are made visible for all market participants.
  - The set of ratings an actor received (or a function thereof) provides the actor’s “reputation” and serves therefore as a substitute for social embeddedness.

- Example:

Bewertungskommentar	Von	Datum/Uhrzeit	Artikelnummer
Lief alles sehr zufriedenstellend.	Käufer bschattenkrieger (8)	05.10.04 11:25	8129912307
Schnelle Lieferung . gerne wieder	Käufer arek20 (18 ★)	05.10.04 11:00	8114687702
Schnell und problemlos gelaufen. Vielen Dank!	Käufer hmoppel (privat)	05.10.04 10:43	6324151694
Schnell und problemlos gelaufen. Vielen Dank!	Käufer hmoppel (privat)	05.10.04 10:43	6326427156
Hat alles gepasst, schnell und zuverlässig, Danke!	Käufer vroni_d (17 ★)	05.10.04 10:31	6321162557
Schnelle Lieferung und netter Kontakt. Sehr empfehlenswerter Ebay-Partner!!!	Käufer belex2000 (318 ★)	05.10.04 10:18	8135424559
top ebayer!! hat alles bestens geklappt. sehr netter kontakt	Käufer noja410 (206 ★)	05.10.04 09:01	6317199210
einfach Klasse, besser gehts nicht, schnelle korrekte Abwicklung, SUPER, danke!!	Käufer pesp (128 ★)	04.10.04 23:31	6324654423

Bewertungsprofil: player004 (63203 ★) Power Seller mich

Bewertungsprofil:	**63203**
Positive Bewertungen:	**99,7%**
Mitglieder, die mich positiv bewertet haben:	63376
Mitglieder, die mich negativ bewertet haben:	185
Alle positiven Bewertungen:	85131

Weitere Informationen zur Bedeutung dieser Zahlen.

Jüngste Bewertungen:

	Letzter Monat	Letzte 6 Monate	Letzte 12 Monate
positiv	1614	10277	32063
neutral	9	40	97
negativ	7	27	64

Zurückgezogene Gebote (in den letzten 6 Monaten): 0

Research Questions and Evidence

- However, it is not self-evident, for example
  - what the optimal design for such online reputation systems would be in different contexts,
  - whether an online reputation system is sufficient to enable high levels of trust and cooperation and, therefore, a smooth functioning of online markets,
  - what the actual market value of online reputation is,
  - or what the conditions are to maintain a high level of participation in the feedback mechanism.
- Consequently, there is a large body of research concerned with such questions.

Research Questions and Evidence

- For example, many studies evaluate the importance of online reputation for transaction efficiency and market outcomes (probability of sale, auction prices) using observational data from online markets. Although most studies find effects, the results are somewhat mixed and effect sizes are usually not very large. However, reputation effects have also been confirmed in laboratory and field experiments. We will not further treat this topic in today's session.
- Theoretical studies and simulations are concerned with the conditions under which reputation systems promote the evolution of cooperation. More work needs to be done in this field. Przepiorka's talk today belongs in this domain.
- A growing number of studies focus on the public-good problem of providing feedback, which is the backbone of any online reputation system. Three of today's talks (Berger/Zimmermann; Abraham/Hangartner/Wehrli; Jurca) are related to this topic.

“Reputation effects” on eBay

Transaction process (GOR 2004)

- End price
- Time to first bid
- Probability of sale
- Choice of start price / reserve
- Choice of payment mode

⇒ Direct effects on fitness

Feedback process (GOR 2006)

- Effect of partner reputation on submission rate (first mover)

⇒ Indirect effects on fitness

Open Questions:

- Who has and who gets how much reputation in the network?
- What are the consequences of network growth for the “trust metric” and relative status positions of the users?

What's Cumulative Advantage (CA)?

- "Cumulative advantage [...] refers to the social process through which various kinds of opportunities for scientific inquiry [...] tends to *accumulate*." (Merton 1968, 1988) → Matthew effect!
- "Cumulative advantage is a general mechanism for inequality across any temporal process [...] in which a favorable relative position becomes a resource that produces further relative gains." (Diprete 2006)

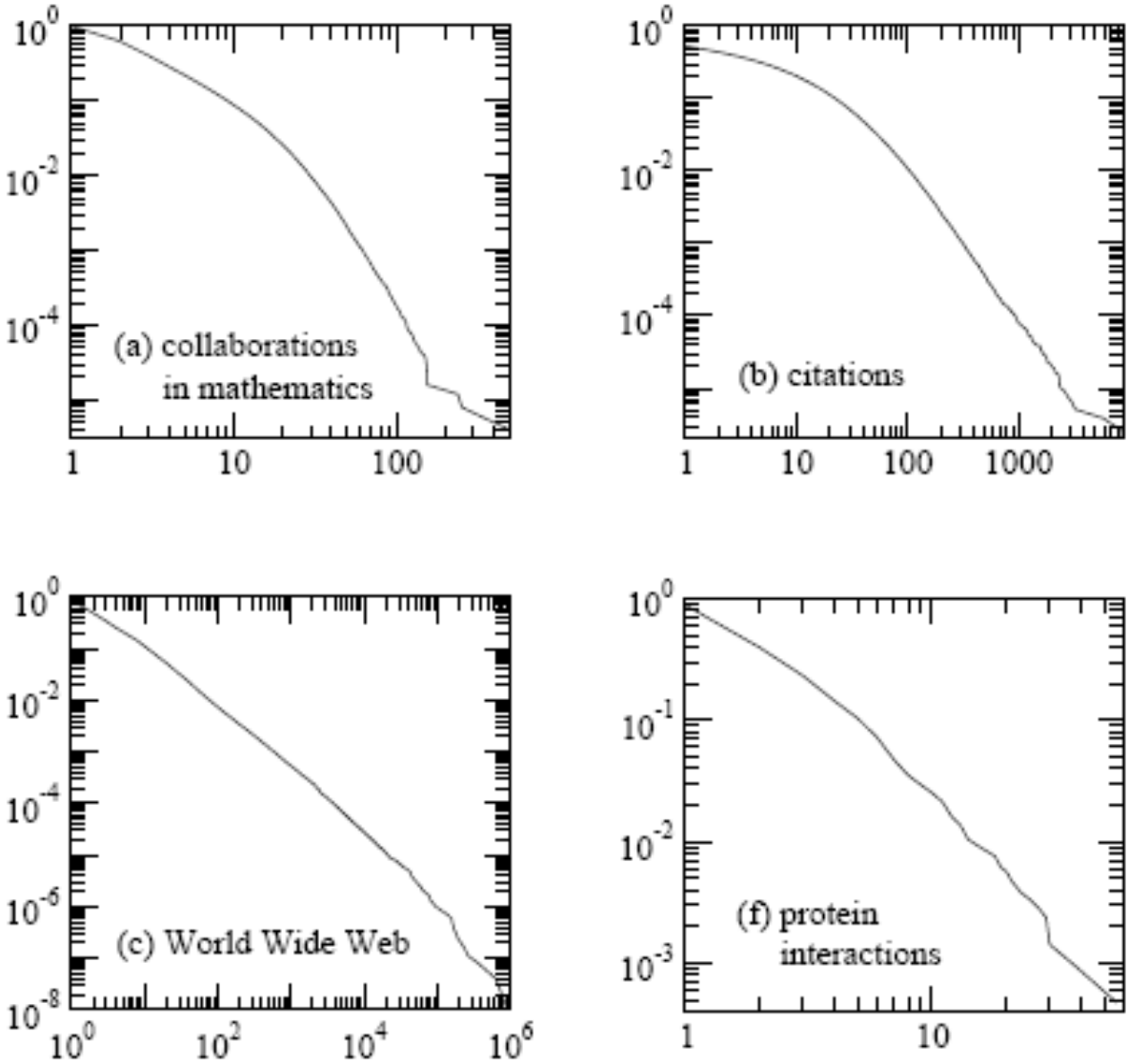
Simple Example:

Capital Stock with fixed interest rate.

CA also known as:

"Preferential Attachment", "multiplier effects", "first mover advantage", "scarring effects", "the rich get richer", ...

Examples for Cumulative Advantage in Networks



Newman (2003): The Structure and Function of Complex Networks.

Data

Micro Level Data

Sample of 170'000 DVD auctions on eBay.de, collected at 12-2004/01-2005 with a spidering approach.

Question: Why do users submit feedback? What are the effects on the submission rate?

Model: Time to feedback after a sucessful transaction for seller and buyers.

Subset out of 1.1 Mio observed auctions (Wehrli 2005).

Macro Level (Network) Data

Distribution of positive and negative feedback at two time points (04-2005 and 10-2006) for two different samples of the German eBay User Base.

Ego Network: Users from the Micro Level Dataset (0.5 Mio)

Alter Network: Part of first snowball wave of the "ego network", i.e. the feedbacks of all users connected with egos (3.2 Mio)

DE Network: Work in progress... (25 Mio)

DVD Market - Descriptives

Submissions of Ratings after Transactions (DVD Market)

	Seller		Buyer	
Number of transactions	177'561	(100%)	177'561	(100%)
Positive Ratings	146'693	(82.62%)	146'300	(82.39%)
Neutral Ratings	209	(0.12%)	702	(0.40%)
Negative Ratings	577	(0.32%)	643	(0.36%)
No Rating	30'082	(16.94%)	29'916	(16.85%)

- In 89.6% of all transaction at least on submission.
- In 53.2% of the cases buyer rates first (Seller: 36.1% /) No or simultanious feedback 10.7%).
- Repeated interactions: ca. 5%.

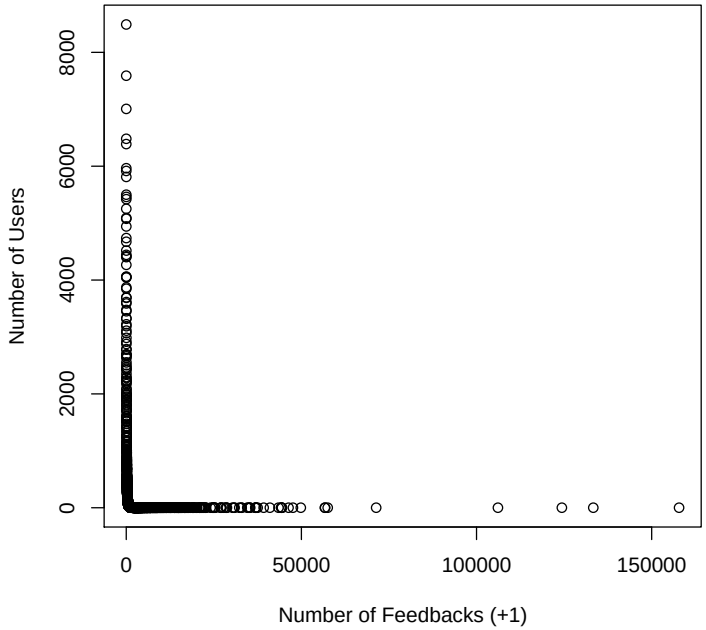
CA on Micro Level

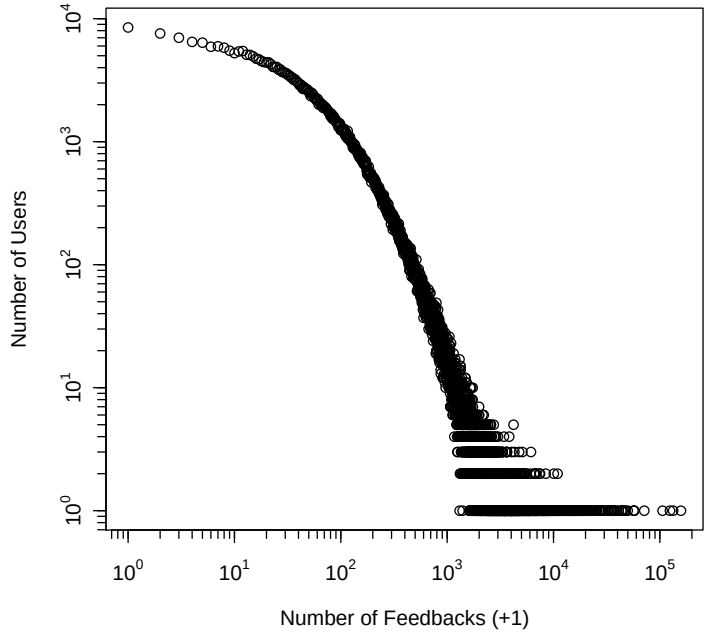
Cox-Model for Submission of positive Feedbacks (DVD Market)

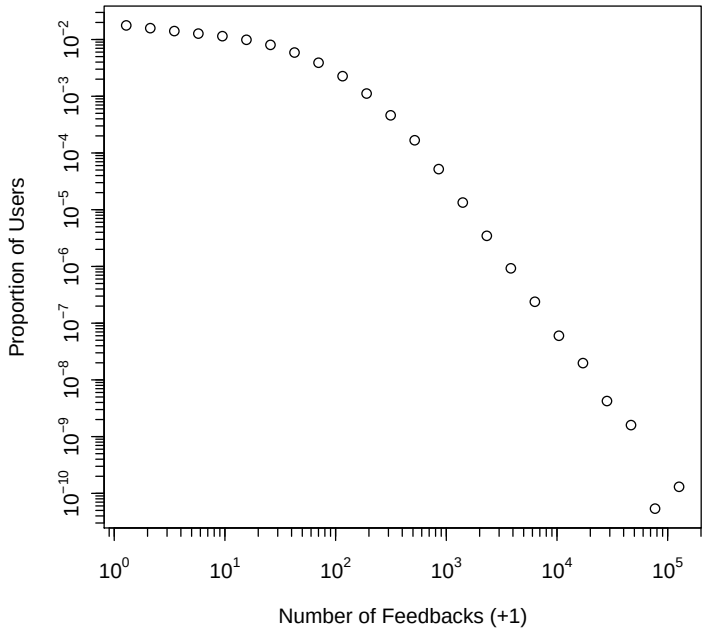
	Seller		Buyer	
Partner first (tvc)	2.021***	(0.118)	0.617***	(0.011)
Positive Partner Reputation	0.088***	(0.006)	0.098***	(0.004)
Negative Partner Reputation	-0.184***	(0.016)	-0.085***	(0.006)
Partner first X Pos. P.Rep.	-0.099***	(0.010)	-0.029***	(0.005)
Partner first X Neg. P.Rep.	0.163***	(0.023)	-0.117***	(0.010)
Ego Positive Reputation	0.050**	(0.016)	0.141***	(0.004)
Ego Negative Reputation	-0.199***	(0.029)	-0.253***	(0.010)
Repeated Interactions	-0.281***	(0.077)	-0.467***	(0.033)
Rolechange	0.175***	(0.051)	0.185***	(0.022)
User is identified	0.210*	(0.084)	0.190***	(0.037)
Price	-0.002	(0.001)	-0.000	(0.000)
(...)				
N (Clusters)	177'561	(29'816)	177'561	(99'139)
Events	146'693		146'300	

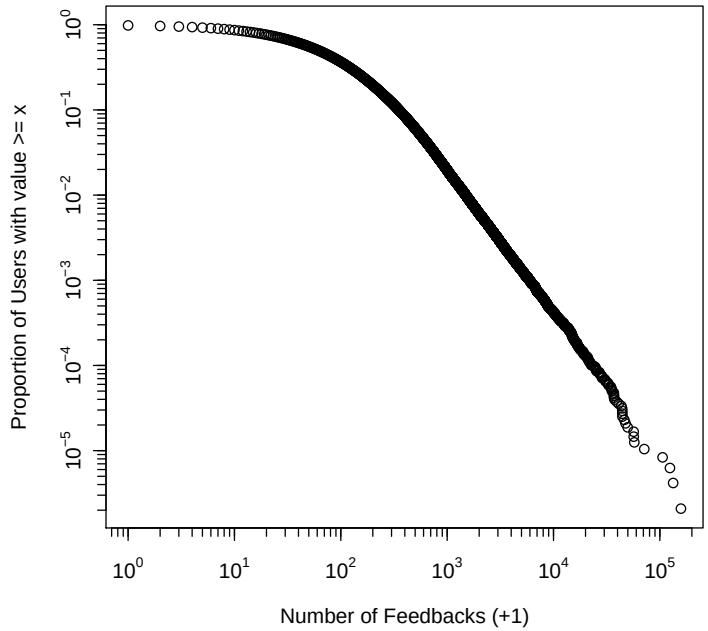
Maximum likelihood estimates of the time to feedback (Cox Proportional Hazard Rate Models) incorporating positive partner feedback as time-varying covariates. Absolute z-statistics in parentheses (adjusted for clustering), significant at $\alpha = 0.05(*), \alpha = 0.01(**), \alpha = 0.001(***)$.

Macro Level: Degree distribution of positive feedback

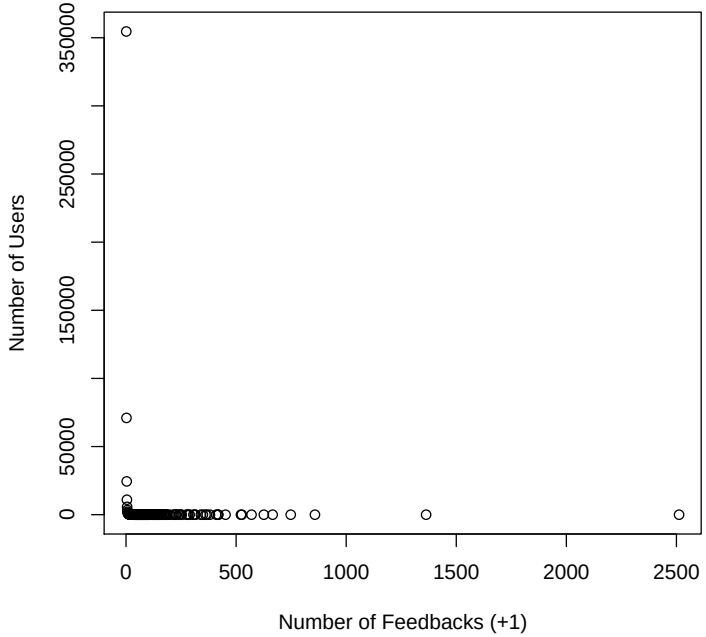


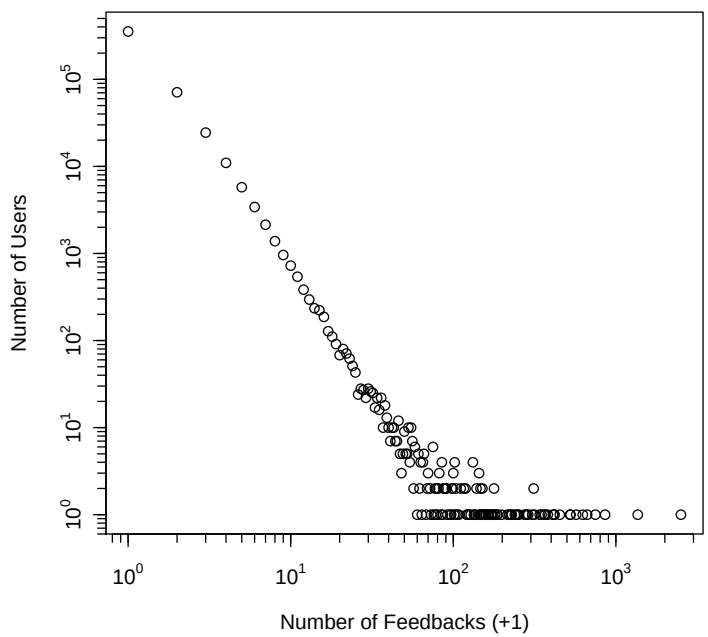


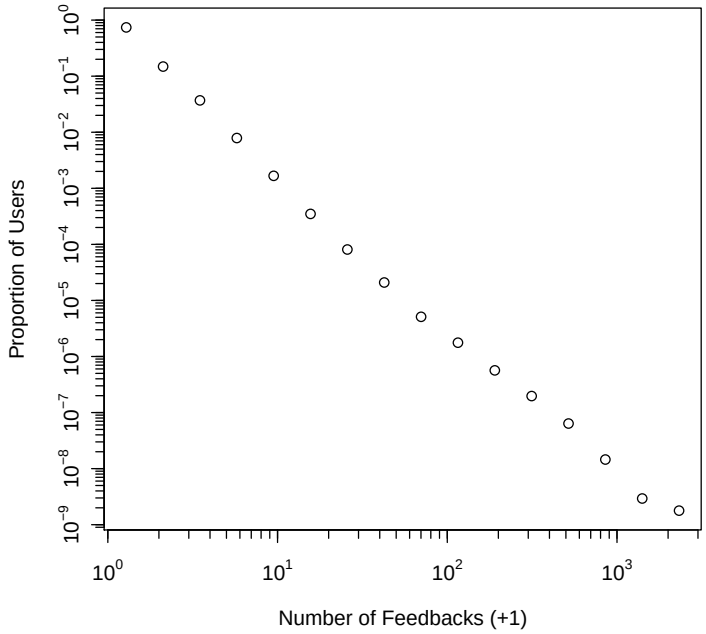


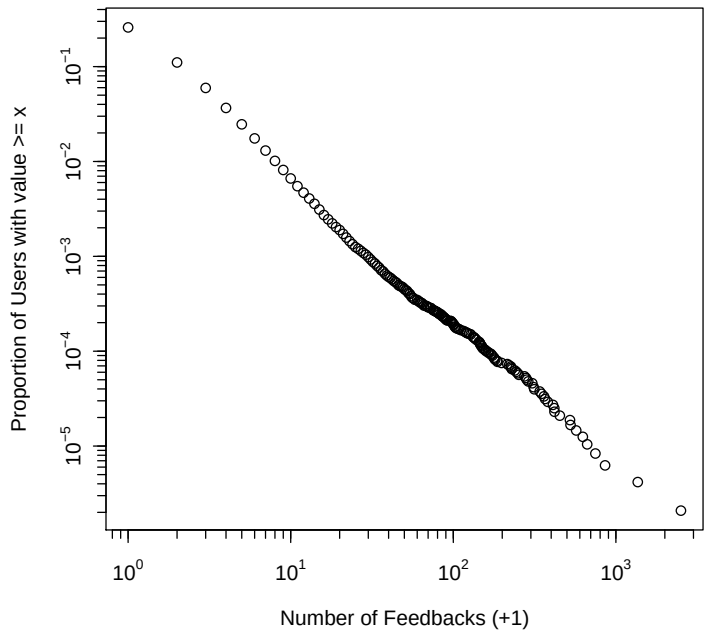


Degree distribution of negative feedback









Estimation of Pareto Index

Maximum Likelihood Estimation with Pareto Distribution:

$CDF: Pr[X \leq x] = 1 - (a/x)^{\alpha}$
$PDF: Pr[X = x] = \alpha a^{\alpha} x^{-(\alpha+1)}$

Hill's Estimator

$$\hat{\alpha} = \frac{n}{\sum_{i=1}^{n} log\left(\frac{x_i}{a}\right)}$$

Power law (PDF):

$Pr[K = k] \sim k^{-\gamma}$
$\Rightarrow \gamma = \alpha + 1$

Bootstrap estimates of $\hat{\alpha}$ for the distribution of positive and negative feedbacks $\Rightarrow$

Distribution of Positive Feedback

	$\hat{\alpha}(a = 1)$	n
2005	**0.257**	457'255
2006	**0.225**	475,311
Alteri	**0.266**	3'280'884

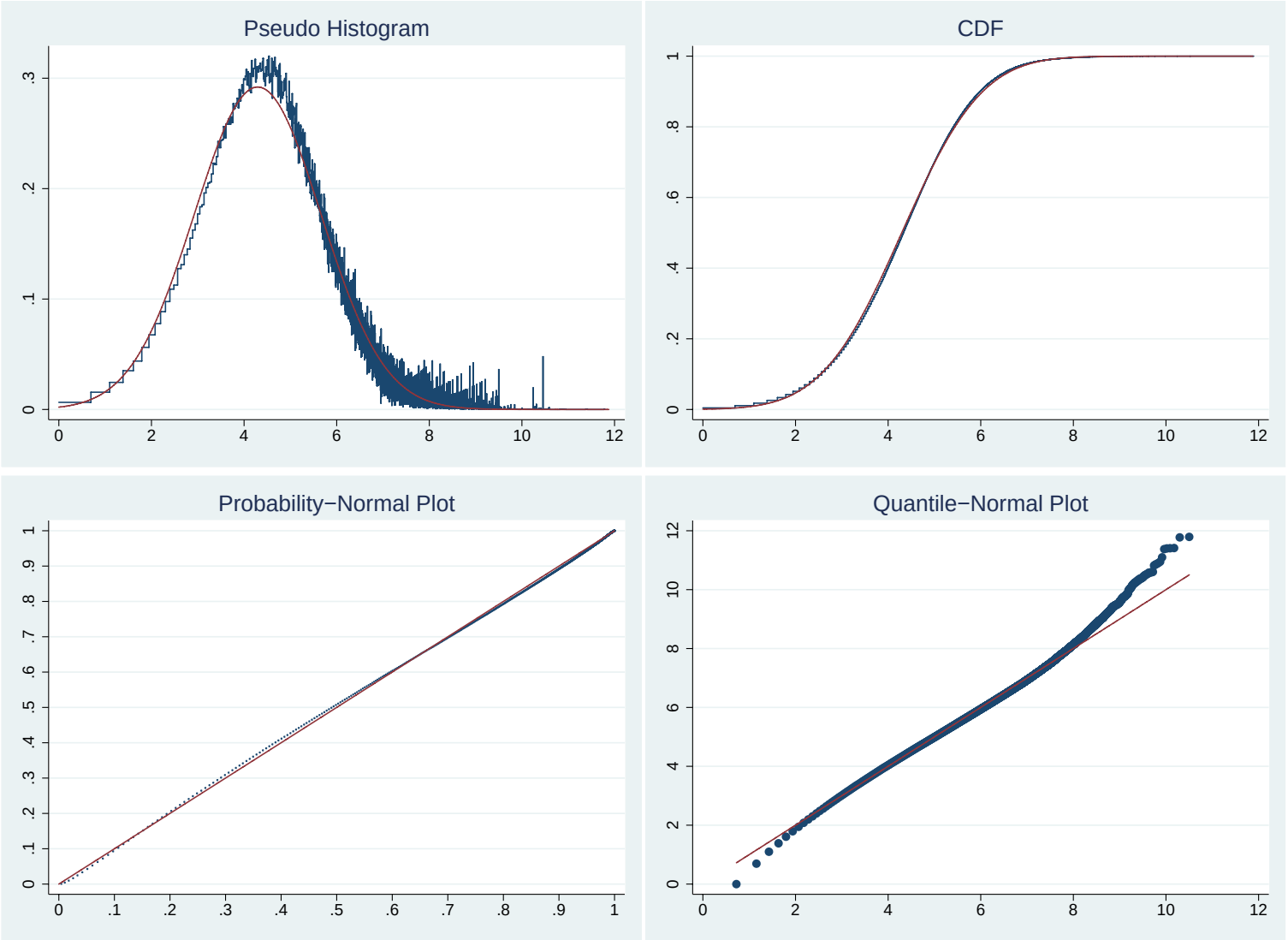
Positives with arbitrary Cutoff

	$\hat{\alpha}(a = 100)$	n
2005	**1.017**	157'925
2006	**0.988**	228'723
Alteri	**1.201**	873'525

Distribution of negative feedback

	$\hat{\alpha}(a = 1)$	n
2005	**2.012**	124,011
2006	**1.643**	174'811
Alteri	**1.874**	933'398

Or: Positive Reputation is lognormally distributed



Sellers only! Pareto und Lognormal distributions are hard to distinguish!

Conclusions CA

- There is empirical evidence for cumulative advantage on the micro and macro level of the reputation network.
- Pareto and Lognormal Distributions indicate that status hierarchies are stable and that the "trust metric" follows a similar logic as financal capital. There are just a few generative processes that can explain the growth of the "eBay reputation network" (Yule- or Gibrat-Process).
- We need further analysis of growth processes in age cohorts to disentangle user base growth from growth due to additional transactions, reciprocity and strict cumulative advantage.