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# **virtual economies and economics**

## **two-way contribution?**

AVEA seminar

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1. my work: virtual “national” accounting and macroeconomic measures
2. someone else’s work: economic (lab) experiments in Second Life
3. a research agenda

# motivations for research

- developer motivation
  - stable economy
  - free price determination
- “experimentation” motivation
  - thousands of voluntary agents
  - data logging
- academic motivation
  - interactions interesting in their own right



# two-way contribution

1. how economics can help understanding virtual economies?
  - developer motivation
2. how could research on virtual economies contribute to economics?
  - data gathering
  - logs
  - experimentation



1. how economics can help understanding virtual economies?
2. how could research on virtual economies contribute to economics?

# virtual economy

- economy:
  - **what** is produced
  - **by who** the production happens
  - **for whom** the products go
  - decisions subject to resource scarcity

$$q = f(L, H, A, K, R)$$

# economy → macroeconomic measures?

- measure state of a national economy
- e.g. inflation and aggregate production
- allow for:
  - comparisons between instants of time
  - comparisons between national economies
  - models
  - forecasts

## existing GNP/GDP estimates

- Edward Castronova: Everquest “GNP” *per capita* USD 2,226
  - BBC News: *Virtual kingdom richer than Bulgaria*, March 29, 2002
  - BBC News: *Virtual gaming worlds overtake Namibia*, August 19, 2004
  - Julian Dibbell: Global virtual GDP in 2006 USD 28.215 billion



# problems of existing “GNP” measures

- focus
  - comparisons between virtual and national economies
- methodology
  - production boundary and *per capita*
  - measures the state of RMT market
- comparisons
  - RMT market can be very volatile
- modeling and forecasts
  - not possible as such

# what is GDP?

A measure of aggregate (total) production of goods and services in an economy

=  $\Sigma$  value added in the economy

i.e. the production approach

=  $\Sigma$  total consumption, capital formation, net X

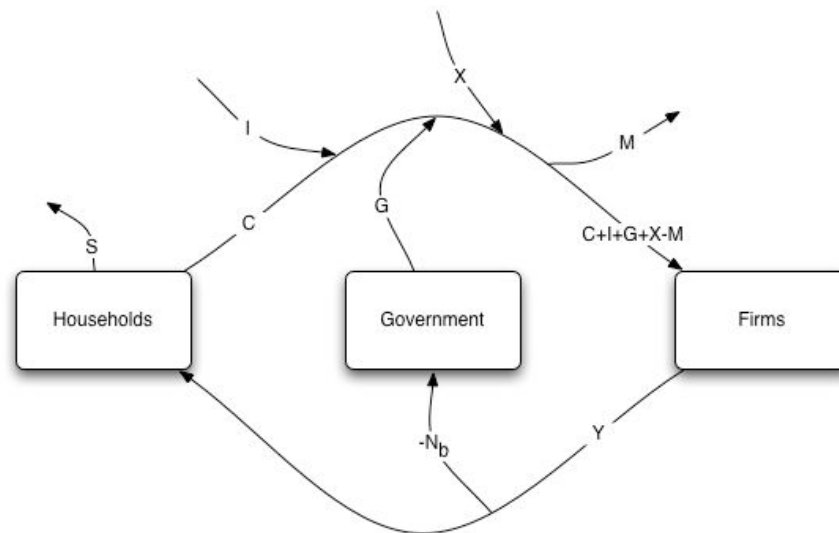
i.e. the expenditure approach

=  $\Sigma$  factor incomes

i.e. the income approach

# gross user product\*

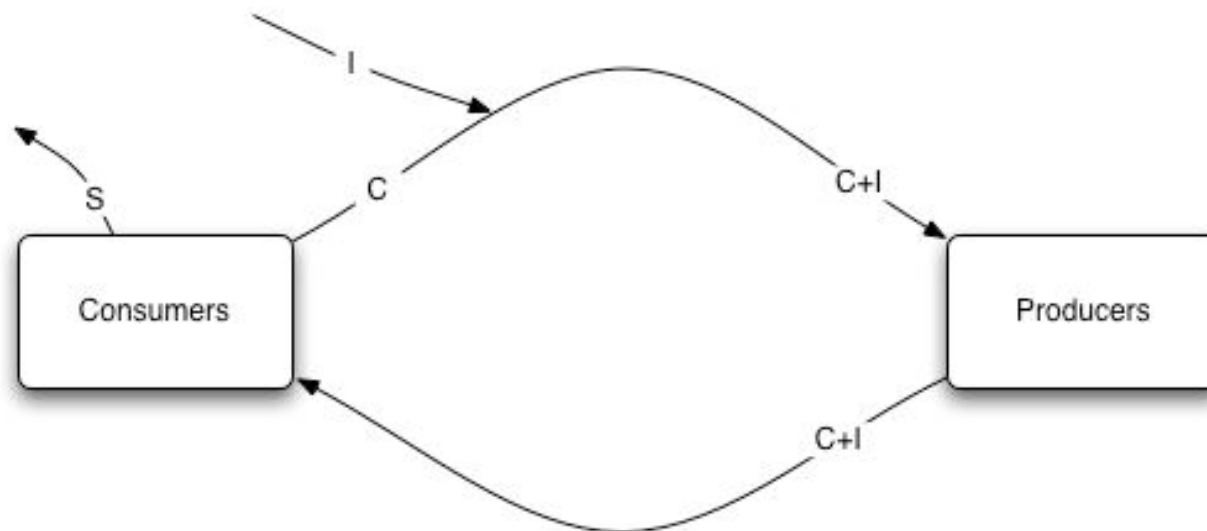
- measure aggregate production properly
  - use principles of the System of National Accounts
- goal: the Gross User Product



\* Lehtiniemi, Tuukka (2008). Macroeconomic Indicators in a Virtual Economy. Master's thesis, University of Helsinki, 17 March 2008.

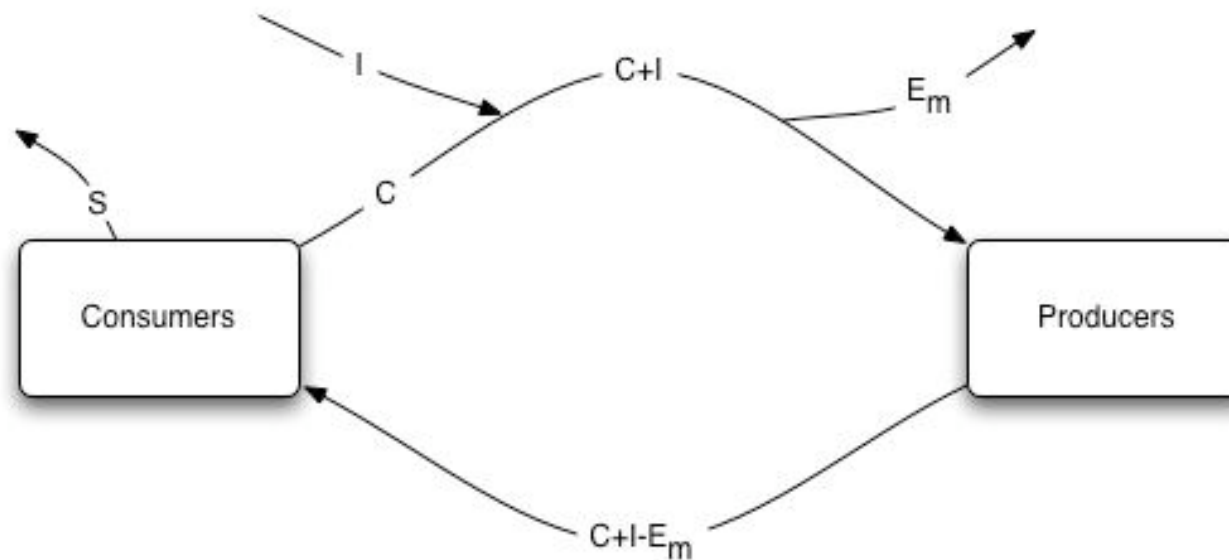
# an overtly simplified flow

- assume users only
- two roles (not sectors)
- own-account production

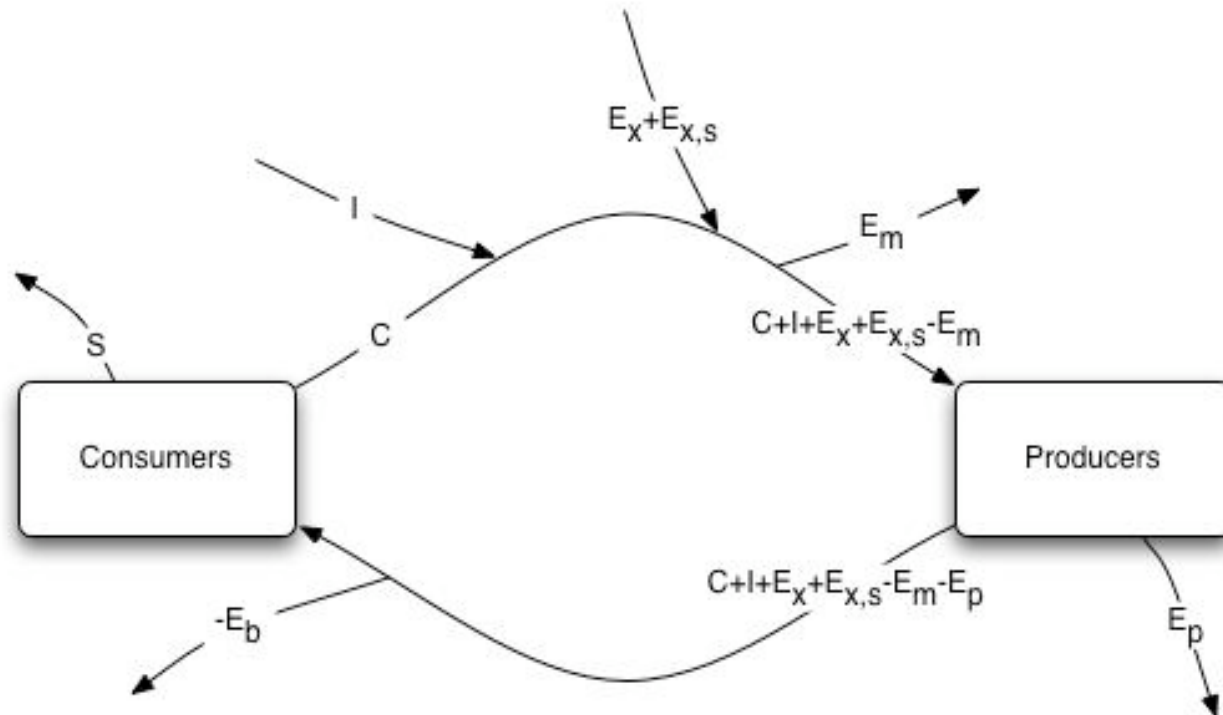


# enter the environment

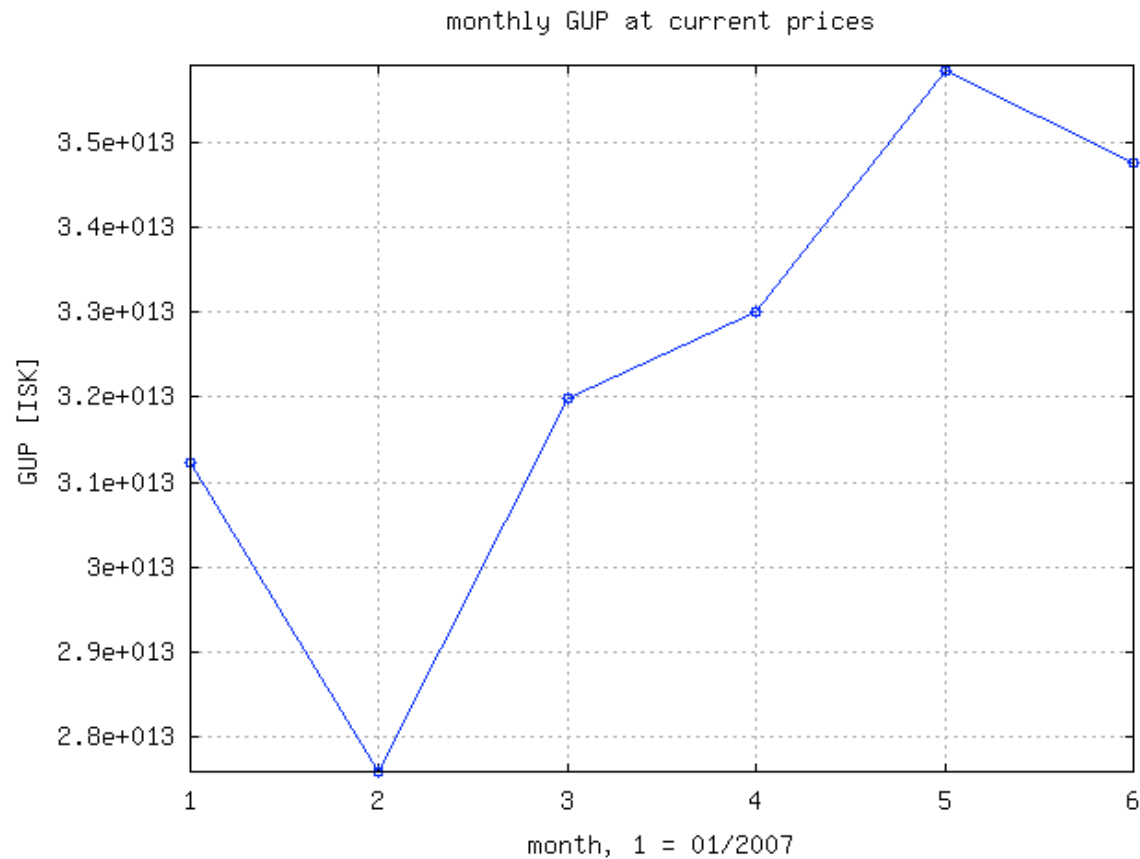
- the environment = metaphorical entity
- supplies intermediate & investment goods



# further roles of the environment



# GUP at current prices in EVE Online

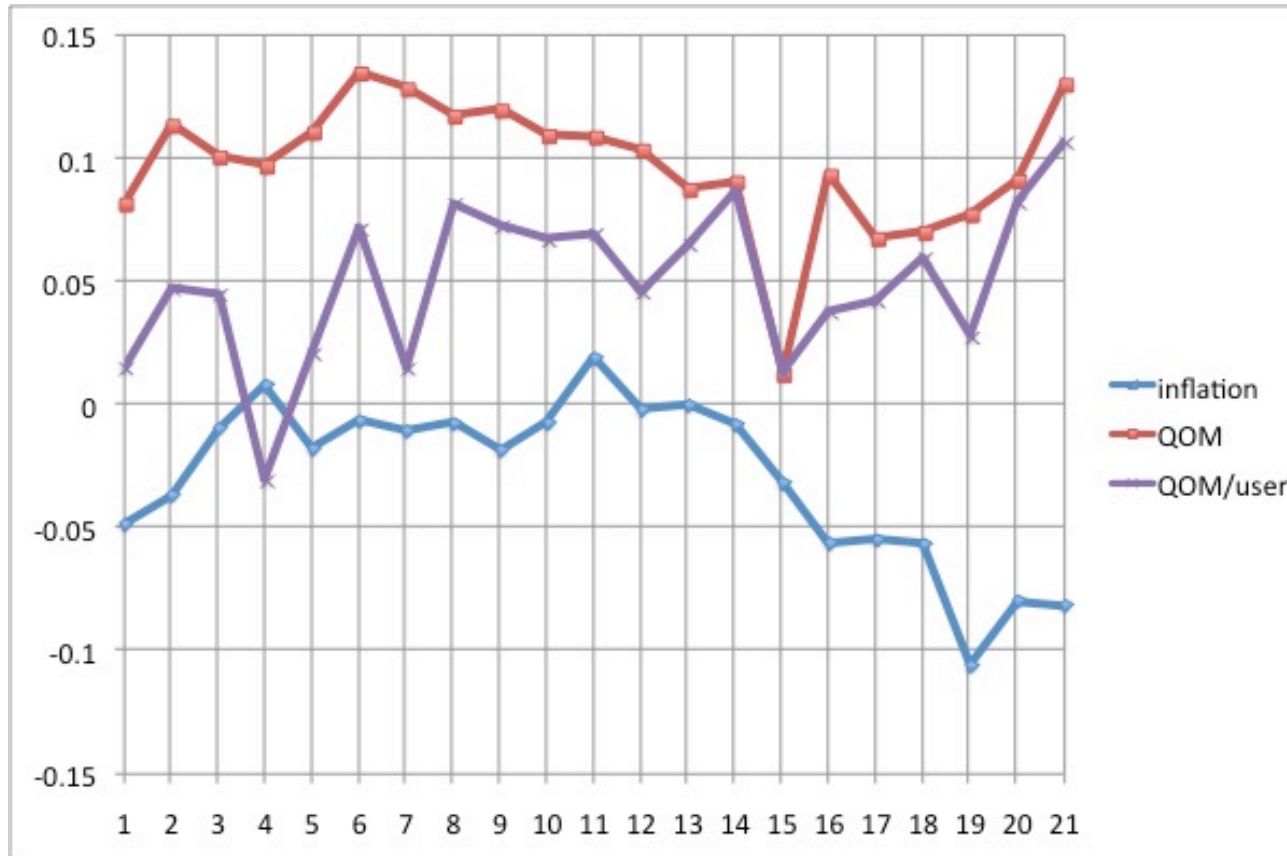


- aim: measure inflation properly
- typical choice: consumer price index
- a better choice: chain-linked, superlative Fisher ideal index

$$P_F^t = \sqrt{\frac{\sum_i p_i^t q_i^t}{\sum_j p_j^{t-1} q_j^t} \times \frac{\sum_m p_m^t q_m^{t-1}}{\sum_n p_n^{t-1} q_n^{t-1}}}$$

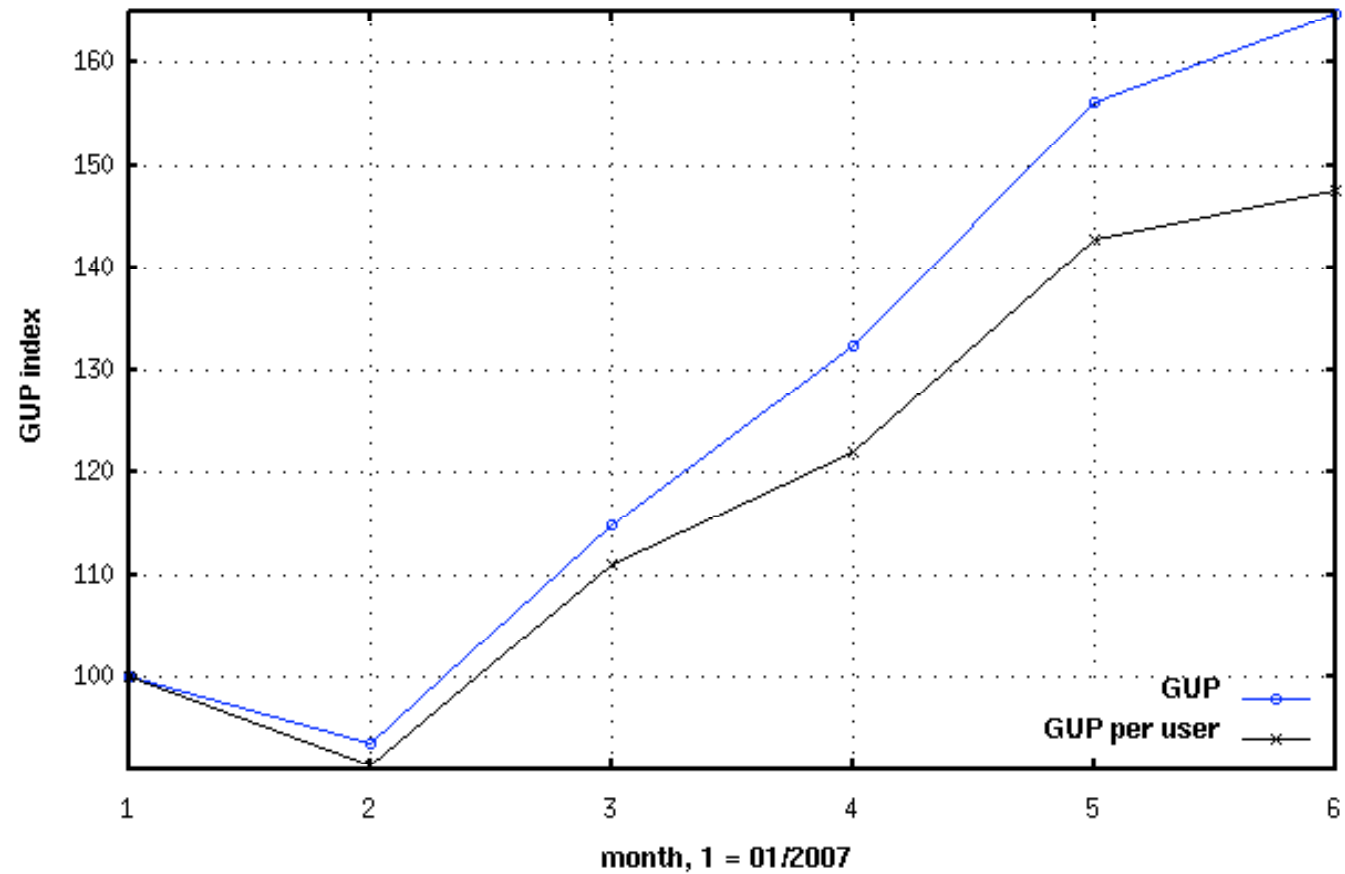


# measured inflation



# deflated GUP index

deflated monthly GUP, period 1 = 100





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# experimentation in VWs

- Chesney et al:  
*“experimental economics the sub-discipline most likely to benefit”*
- experimentation in VWs: improve the realism
  - participants remain in naturalistic settings (field studies)
  - sample cross section may be wider than e.g. when using students

Source:

Chesney, Thomas, Chuah, Swee-Hoon and Hoffman, Robert (2007). Virtual world experimentation: An exploratory study. *Occasional papers* 2007-21. Nottingham University Business School, Industrial Economics Division.

# experimentation: list of problems

- recruitment of appropriate subjects
- collusion prevention
- repeat participation prevention
- user base may lead to sample biases
- behavior may have e.g. more hedonistic or short term tendencies
- etc

## experimental study by Chesney *et al*

- Second Life, SL: no thematic or game focus  
→ increased representativeness?
- **evaluate** the conformity of SL users to standard experiment results
- **assess** the merits of experimentation in VWs
- ultimatum, dictator, public good, guessing, and minimum effort games

# Chesney *et al* experiment setup



Image source: Chesney et al. 2008

# experimentation results

Chesney et al. 2008:

- observed behavior is generally very similar to earlier findings
- e.g. ultimatum game:
  - mean 45.73% (typical)
  - distribution typical (except for hyper-fair outliers)
- differences explainable by demographics
  - mainly more altruistic behavior in dictator game



## a different approach

- does the above approach fully utilize the possibilities of VWs?

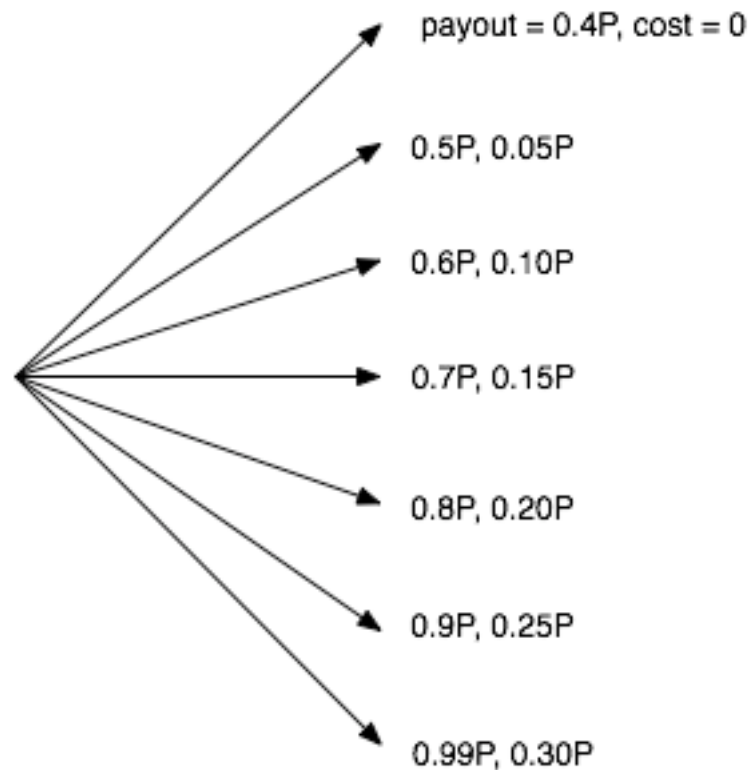
our approach:

- use economic data generated naturally by the users
- observational studies on economic behavior:
  - [ ] fulfills prediction A
  - [ ] does not fulfill prediction A

# risk behavior

- employ data from the insurance system in EVE Online
  - users purchase voluntary insurances for their spaceships
- observations on risk behavior?

# risk behavior - a choice situation



- value of insured assets unknown
- premium known
- insurance coverage known
- ex ante probabilities unknown
- ex post probabilities known

# a lot of numbers

class	threshold probability	ex-post probability	share
50%	0.5	0.367	6.0%
60%	0.5	0.413	2.3%
70%	0.5	0.421	2.1%
80%	0.5	0.448	2.9%
90%	0.5	0.499	3.3%
100%	0.5	0.566	83.5%

preliminary! please do not  
cite without permission

## risk behavior - preliminary results

- the “threshold” probability of loss equal in all cases
- the highest coverage preferred by far the most insurance buyers
- only the highest-coverage insurance actually pays off on the aggregate



1. how economics can help understanding virtual economies?
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# wanted: a serious research question

investigate virtual economy -specific  
economic behavior

vs.

investigate economic behavior via virtual  
economies

→ can anomalous (w.r.t. rationality  
assumption) behavior be found?

## endowment effect

- preferences not always independent of current entitlements
    - ~ indifference curves have a kink at current endowment
  - instrumentally-rational behavior: no endowment effect
  - rationality holds (better) for market participants with intense market experience
- behavior changes as experience accumulates



# endowment effect

how the effect is observed:

1. assign one of two items randomly to random participants
2. give them the opportunity to exchange their new endowment to the other item
3. if no endowment effect exists, 50% of participants should agree to the exchange
4. the actually observed figure is much lower

# virtual economy and endowment effect

- observations on experimental “markets”
- sports memorabilia, mugs, tokens, etc

how about virtual goods in virtual economies?

- actual, working markets, and actual, observable valuations
- data to employ:
  - market transaction data
  - ownership data
  - user experience data

## further possibilities

### loss aversion

- “losses loom larger than gains”
- implies asymmetric own-price elasticity
  - assuming narrow bracketing

### reference dependence

- preferences depend on some reference prices

- external validity?
    - can we generalize and does it matter?
  - internal validity?
    - do empirical observations permit the inference to causal conclusions?
- natural experiments
- e.g. impacts of changes of defaults

# questions

- what would be the interesting research questions?
- what would be the “tests” to run with the data?
- is the aim at a correct level now?

# References

Chesney, Thomas, Chuah, Swee-Hoon and Hoffman, Robert (2007). Virtual world experimentation: An exploratory study. *Occasional papers 2007-21*. Nottingham University Business School, Industrial Economics Division.

Lehtiniemi, Tuukka (2008). Macroeconomic Indicators in a Virtual Economy. Master's thesis, University of Helsinki, 17 March 2008.