ALPEN-ADRIA UNIVERSITÄT
KLAGENFURT I WIEN GRAZ

Antrittsvorlesung

The leisure of the theory class

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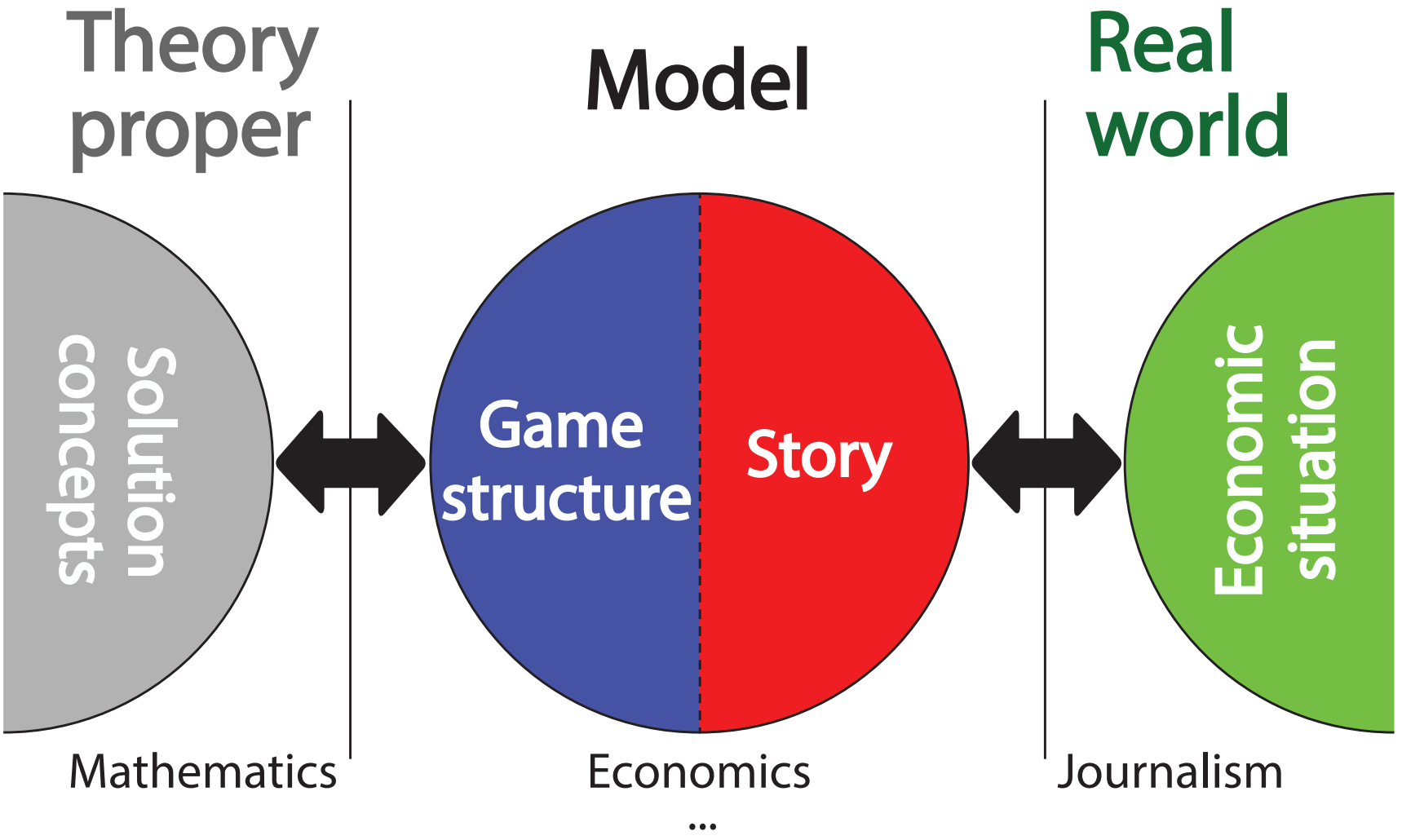
Game theory: The leisure of the theory class

For the past five decades, game theory was the plaything of choice for (micro)economic theorists: it generated seven economics Nobel prizes in the past twenty years, more than any other field.

From my point of view, the main appeal of the theory is its ability to systematically analyze and understand strategic interaction between independent decision makers ("players"). Hence, although there are fruitful applications, what I will show you today is of a more conceptual than applied nature.

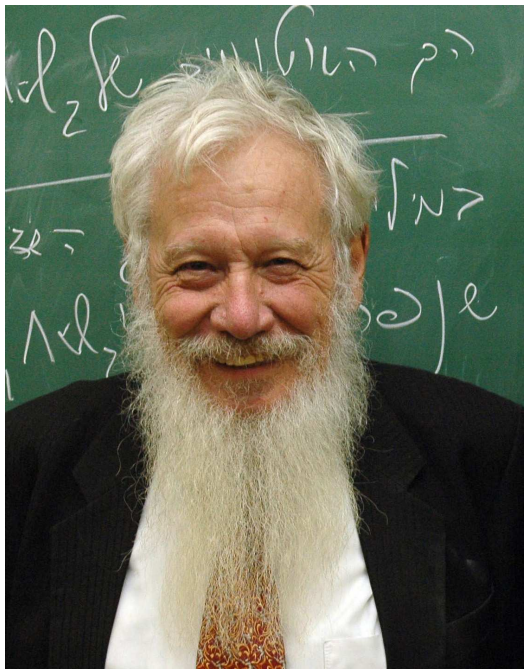
The talk starts with PhD-projects and (hopefully) will end with open questions arising from current work. In a thinly veiled attempt at name dropping, I will show you pictures of the people who most influenced the respective projects and their outcomes.

Theory-world relationship (with Till Grüne-Yanoff)



Repeated games: Queto (quit or veto)

Arup Daripa



Bob Aumann

Abraham Neyman

Motivational story: Partnership dissolution

- A couple (P1, P2) jointly own an indivisible (one-couple) house of either high or low common value θ.
- P1 knows the value of the house, P2 only has an expectation (this is completely representative of info inclusion). Examples of incomplete information on both sides exist.
- P1, P2 start hating each other and living together in the same house becomes hell: one owner needs to move out.
- Since the house is indivisible, full ownership has to be transferred to either P1 or P2 in return for money.
- This is ex-ante not Pareto efficient (hence the no-trade theorems do not apply to this problem).

This is no trivial problem: Goldman-Sachs still has not settled its 1999 IPO partnership dissolution. Suppose we use standard Rubinstein alternating offers bargaining to resolve the issue.
(Compare to "Texas shootout" stage game.)

Results: Queto games

Given that both the complete information repeated game and the signaling stage game have an unbounded number of Nash equilibria, the principal result of the paper may be mildly surprising.

Proposition (JME, 2010)

There exists an essentially unique Perfect Bayes Nash equilibrium (PBNE) in this game; the equilibrium outcome is unique.

This result requires no assumptions on beliefs other than PBNE-built-in (conditional) sequential rationality.

But, obviously, everything about this result depends on exactly which bargaining protocol (i.e., which game) one adopts for the dissolution negotiations. . .

Mechanism design: Queueing with status quo

Benny Moldovanu

Alex Gershkov

Motivational story: Queueing with status quo

- You are sick and need to see a doctor.
- When arriving at the doctor's practice, you take a number, i.e., join a waiting list.
- You privately know how bad you feel (your sickness "type"); but without seeing & diagnosing you, no-one else knows.
- The doctor treats patients in the order of their arrival (FCFS).
- You prefer to be seen rather earlier than later. Waiting is compounded by the severity of your illness.
- Everyone in the waiting room is the same except for their type.

Does it improve efficiency (i.e., shorten overall waiting time) if money transfers are introduced and trading of positions is allowed?

If you don't like the idea of using money in a medical story, think airport landing slots trade instead (nothing important changes).

Results: Queueing with status quo

In the efficient allocation, the queue is rearranged such that the highest waiting cost "sickest" patient is treated first. But which negotiation game should we pick?

We choose a mechanism design approach and ask if there exist any incentive compatible mechanisms featuring the efficient equilibrium allocation.

Proposition (IJGT, 2010)

An existing FCFS-queue cannot be efficiently reorganized.

Proposition (IJGT, 2010)

A sufficiently stochastic initial service allocation can always be efficiently reorganized.

We provide a simple "indirect" auction game implementing this.

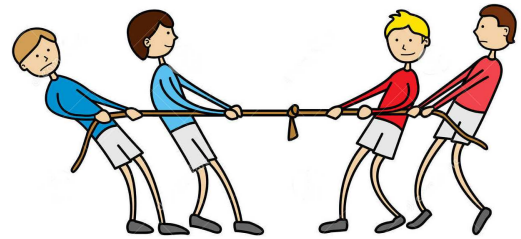
Contract theory: Free riding in teams

Bengt Holmström

Alex Gershkov

Jianpei Li

Motivational story: Free riding in teams



n	total weight	avg weight	add'l weight
1	1.00	1.00	1.00
2	1.86	0.93	0.86
3	2.55	0.85	0.69
4	3.08	0.77	0.53
5	3.50	0.70	0.42
6	3.78	0.63	0.28
7	3.92	0.56	0.14
8	3.92	0.49	0.00

Ringelmann's rope-pulling experiments (1882–87; 1913)

These findings were reported by Moede (1927). The experiments were forgotten until they were recreated by Ingham et al (JESP 1974).

Results: Free riding in teams

Holmström (1982) shows that if efforts are not contractible, efficiency is impossible. We assume that a ranking of efforts ("performance evaluation") is contractible.

Proposition (RAND, 2009)

There exists a ranking-based profit sharing rule which completely abolishes free riding incentives.

Proposition (JET, 2016)

There exists a ranking-based profit sharing rule which provides incentives to truthfully reveal private, production relevant information and exert efficient efforts.

Strategic agglomeration

In an ongoing project, we are working on a multi-dimensional skills model which we use to explain strategic agglomeration in cities.

Contests: Agreeing on efficient emissions reduction

Kai Konrad

Olivier Bos

Bea Roussillon

Story: Agreeing on efficient emissions reduction

- $\nexists$ supranational principal; voluntary agreements.
- Nations jointly suffer from emissions—individually their
  - income & emissions depend on own productive efforts;
  - damage from emissions can be reduced by offsetting productive efforts with abatement efforts.
- Externalities exist because countries
  - reap the full benefit of production but suffer only a fraction of their emissions.
    Thus, overproduction incentives exist.
  - carry the full cost of reductive efforts but only reap a fraction of reduced emissions.
    Thus, reduction free-riding incentives exist.

Results: Agreeing on efficient emissions reduction

Proposition (SJE, 2016)

Given a suitably noisy & partial ranking of reductive efforts, an emission reduction contest awarding a fraction of global output to the nations ranking high in abatement efforts implements both efficient productive & reductive efforts.

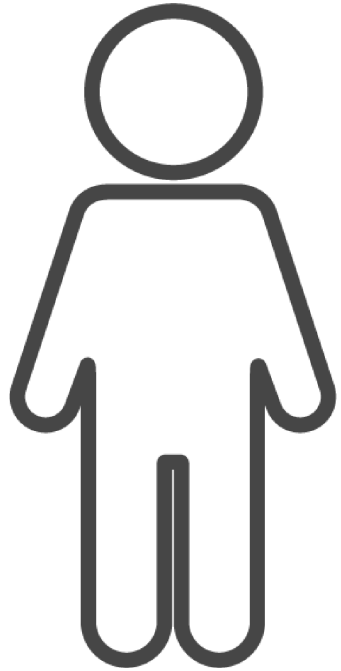
Proposition (SJE, 2016)

Given any redistributive mechanism (from the above characterized class), suitably risk-averse players will find it optimal to join the agreement.

r	β	$1-\beta$	1st	2nd	transfer	%
1	$^2/_3$	$^1/_3$	\$21.3tr	\$10.7tr	±\$5.3tr	±13.3%
2	$^7/_{12}$	$^5/_{12}$	\$18.7tr	\$13.2tr	±\$2.7tr	±6.7%
.	. . .		. . .		. . .	
5	$^8/_{15}$	$^7/_{15}$	\$17.0tr	\$15.0tr	±\$1.0tr	±2.7%
.	. . .		. . .		. . .	
11	$^{17}/_{33}$	$^{16}/_{33}$	\$16.5tr	\$15.5tr	±\$0.5tr	±1.2%

Implementation: Captain MacWhirr's problem

Joseph Conrad



Makoto Shimoji

Motivational story: Captain MacWhirr's problem

The Siamese steamer Nan-Shan transports 200 Chinese workers, who have worked for seven years in the British tropical colonies, from Singapore to their home of Fu-chau. Each worker's accumulated savings are stored in individual camphor wood chests aboard the ship. When a typhoon strikes with ferocious force on Christmas Eve, the boxes burst open and the workers' silver dollars are scattered between decks.

In the ensuing chaos, the Captain's orders result in the passengers' belongings to be amassed in a coal bunker. As soon as the storm calms down, the Captain intends to return the men's savings to their rightful owners. But the Captain faces an information revelation problem:

> *You couldn't tell one man's dollars from another's, he said, and if you asked each man how much money he brought on board he was afraid they would lie, and he would find himself a long way short. (Conrad, 1902)*

Results: Captain MacWhirr's problem

Pro: Planner has some information (unknown to the players) in the form of the total amount of money originally contained in chests.

Con: Even if all other players are telling the truth, each player has an incentive to exaggerate. Thus incentive compatibility fails.

This renders all standard implementation results inapplicable.

Proposition (GEB, 2015)

There exists a sufficient condition on players' beliefs regarding the state under which every player has a unique rationalizable action, namely, to tell the truth.

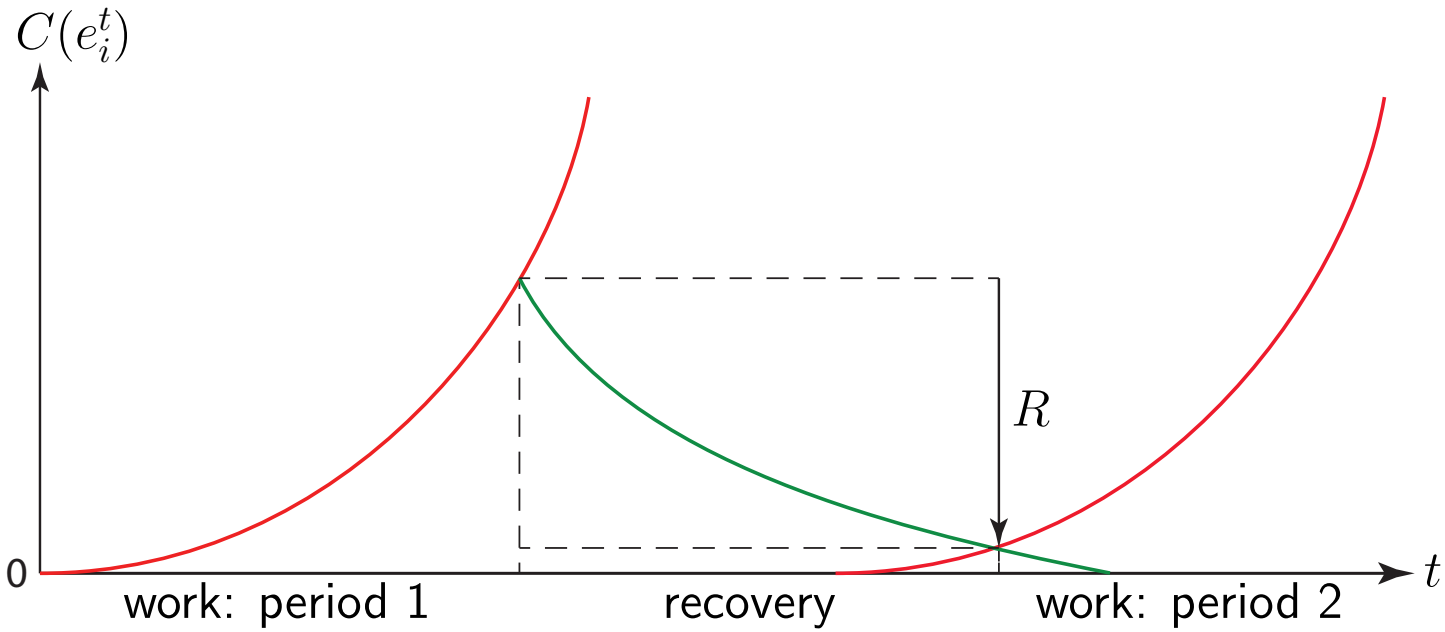
Thus, in the settings we discuss, the planner's information can bypass the lack of incentive compatibility and we achieve full implementation.

Unpublished work & ongoing projects

Alex Gershkov Thomas Giebe Bettina Klose Miguel Portela Ella Segev

Dynamic mechanism design: Incentives & regeneration

We study the effects of introducing intertemporal cost or productivity spillovers into standard microeconomic principal-agent incentive theory. As motivational example we discuss a worker's need for rest or recreation in a dynamic labor market incentive wage model.



The saw-tooth pattern of effort costs and (incomplete) recuperation.

Results: Incentives & regeneration

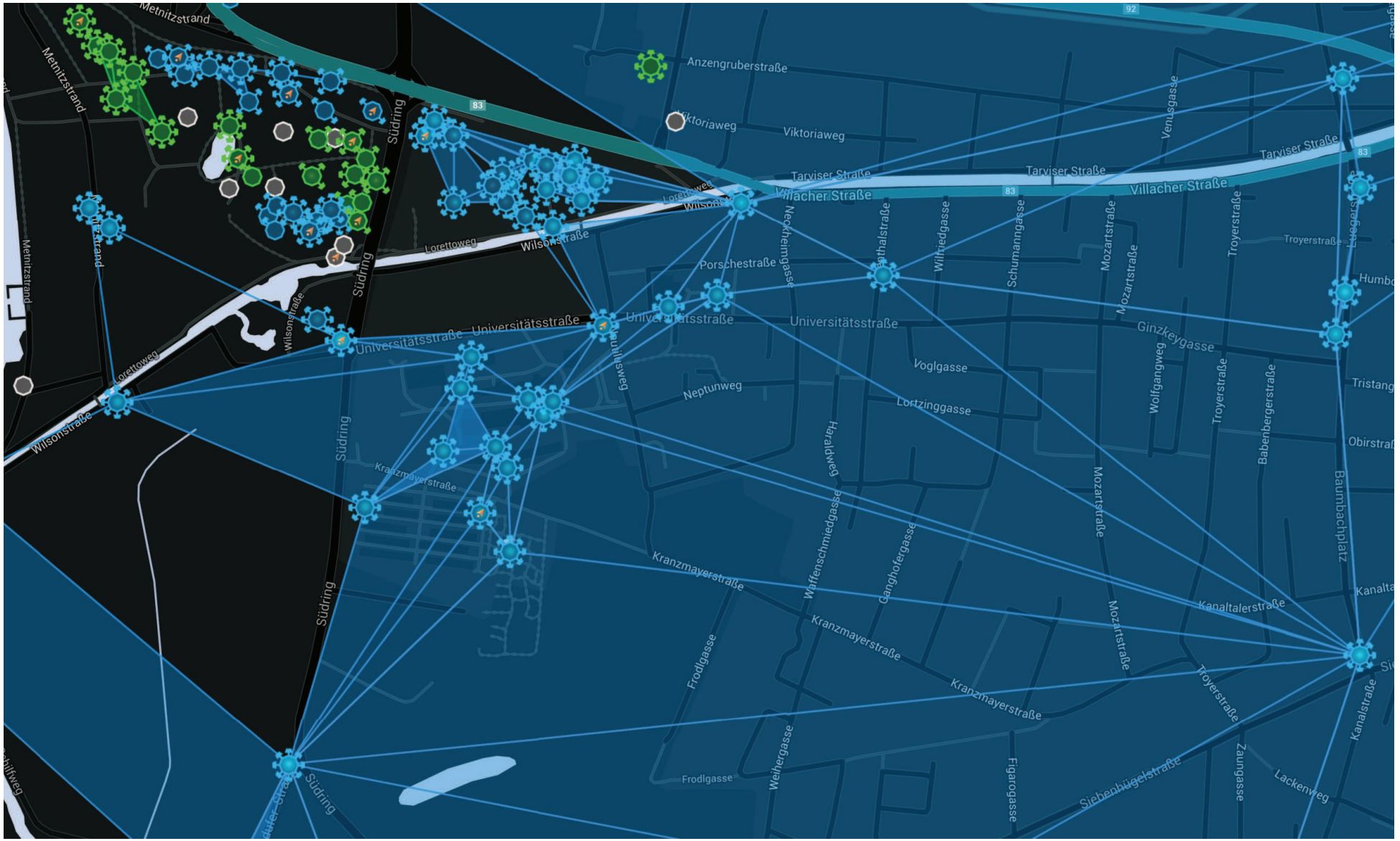
In a flexible workload setup, the agent can determine her effort costs (or productivity) endogenously by substituting overtime for regeneration to the extent admitted by the principal.

Informational problems (moral hazard and adverse selection) arise naturally. In the resulting setup, the agent's response to changes in incentives differs fundamentally from the standard environment.

Proposition (preliminary)

In the presence of dynamic history-dependent effort costs, commitment to a well/designed long-term contract approaches first-best while renegotiated spot-contracts conditioning on all available time-t information does not.

Niantic Lab's Ingress: Staking your claim



Results: Staking your claim

This story relates to

- the Novel "The Three-Body Problem" by Liu Cixin
- graph coloring and covering problems (standard problems in Operations Research).

As far as we know, this problem has not been studied in a competitive, strategic framework where multiple players compete for the resource.

Proposition (very preliminary)

The repeated game interaction can be replicated by appropriately duplicating players into teams.

Empirical: Parental Co-Immunization Hypothesis

In this project we attempt to answer a simple empirical question: does having children make a parent live longer?

The hypothesis we offer is that a parent's immune system is refreshed by a child's infections at a time when their own protection starts wearing thin. With the boosted immune system, the parent has a better chance to fend off whatever infections might strike when old and weak.

Thus, parenthood is rewarded in evolutionary and individual terms. This, if you like, is the "game" aspect in this project.

Results: Parental Co-Immunization Hypothesis

Proposition (preliminary)

Using the Office for National Statistics Longitudinal Study data set following one percent of the population of England and Wales along five census waves 1971, 1981, 1991, 2001, and 2011, we are unable to reject this hypothesis.

We find in our key result that women with children have a roughly 8% higher survival probability than women without children.

Wrapping up & disclaimer

In this summary of my work, I managed to leave out my two currently most active research areas: asymmetric mechanism design and matching theory.

But as these are relatively well-developed projects, I trust you'll have the opportunity to attend a "real" talk on these topics if there should be any interest left after this overview.

Thank you for your attention!