Blockchains:
Some Challenges for Economic Design

Jens Leth Hougaard

Center for Blockchains and Electronic Markets

UNIVERSITY OF COPENHAGEN
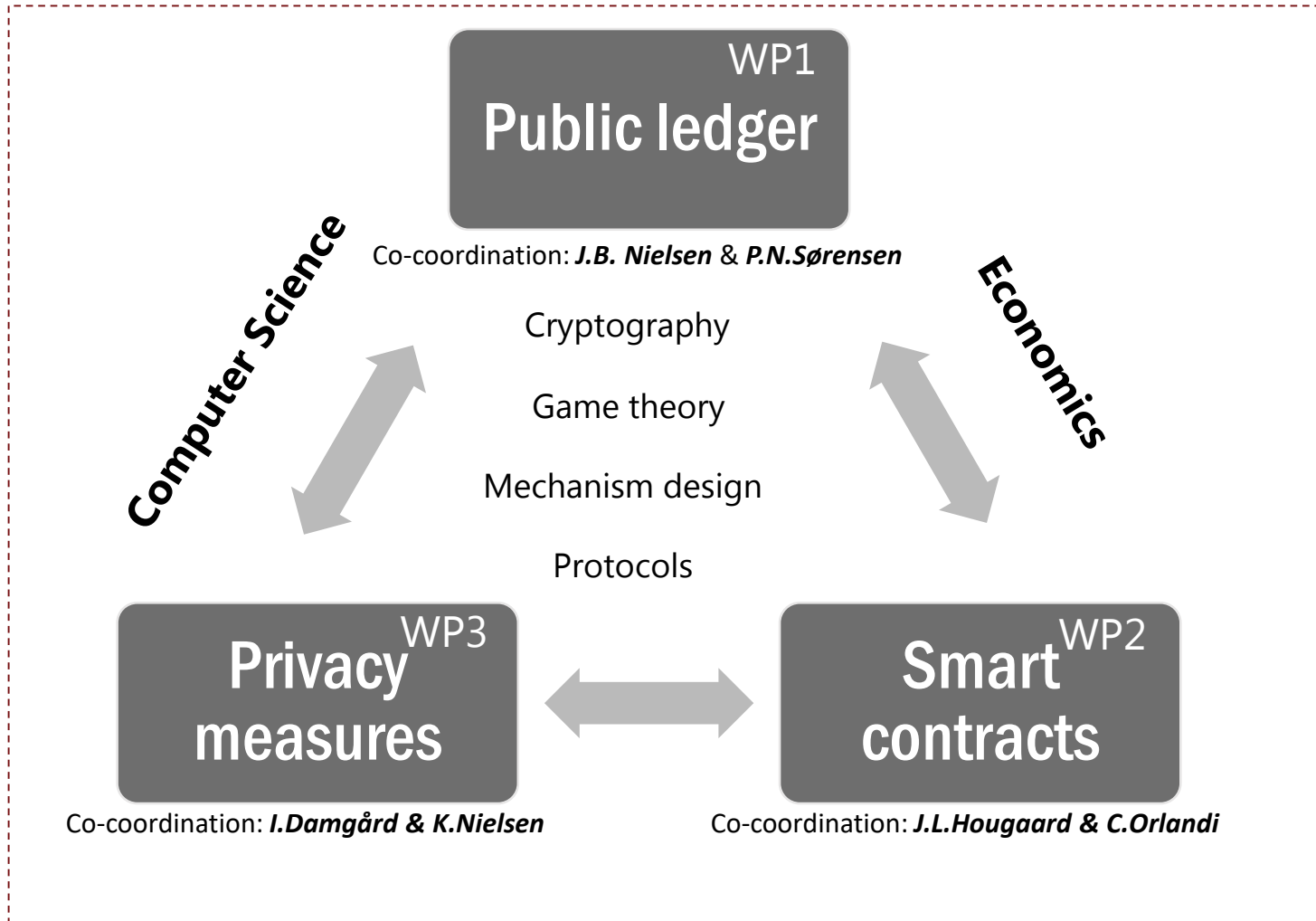
Who are we?

	KU	AU
Lead	Prof. Jens Leth Hougaard	Prof. Ivan Damgård
Core staff	Prof. Peter Norman Sørensen Ass. Prof. Kurt Nielsen	Prof. Jesper Buus Nielsen Ass. Prof. Claudio Orlandi
Junior staff (directly funded by BCM)	PhD student (not named) Post doc (Jens Gudmundsson) Post doc (not named)	PhD student (not named) Post doc (not named) Post doc (not named)

Overview of BCMs research agenda and methodology:

WP1
Public ledger

Co-coordination: *J.B. Nielsen* & *P.N.Sørensen*

Computer Science

Economics

Cryptography

Game theory

Mechanism design

Protocols

Privacy measures WP3

Smart contracts WP2

Co-coordination: *I.Damgård & K.Nielsen*

Co-coordination: *J.L.Hougaard & C.Orlandi*

The Ledger - keeping track of transactions:

Traditionally, a trusted third party validates the ledger.
- think of MobilePay

A decentralized network uses a consensus mechanism.

- Proof-of-Work, Proof-of-Stake, or something else?

- Security: a main issue in computer science.

The Ledger: some focus areas of economic design.

How are miners incentivized to authorize blocks?

- Can incentives be optimized through appropriate design of the reward scheme? (Hougaard, Moreno-Ternero, Østerdal, 2019)
- Does PoW provide incentives to maintain a single "longest" chain, or can forks occur in equilibrium?
- *The longest chain is a Markov perfect equilibrium in a stochastic game played by the miners, but there also exist equilibria where forks occur* (Biais et al, 2019)

- Allocation issues: to mine a block is like winning a lottery. How can miners smoothen out their income?

- Reallocation in mining pools – how do we provide incentives to share the reward?
  - Centralized vs. Decentralized mining pools

Smart Contracts and Apps - guiding economic interaction:

- To what extent can decentralized mechanisms replace the functions of traditional firms and organizations?

  - Example: https://covee.network – decentralized self-organizing teams.
  - Staking mechnisms ensure coordination and motivation along with a mechanism that distributes the common revenue among network members based on relative evaluations of the others performance (strategy-proof but not group strategy-proof!)

Smart Contracts and Apps cont':

- Designing market platforms (typically for computational agents).
  - Economists have recently gained experience with market design (Roth and others)
  - "On-line" auction and matching mechanisms.
  - "On-line" allocation rules.
  - The assumptions of Game Theory fit well with computational agents!

- Operational issues (mechanisms should be able to run in practice) – how does that influence/restrict mechanism design?

Privacy Measures - making sure private information stays private

- Privacy measures make computations heavy:
  - To what extent can we minimize the use of private information in mechanism design while maintaining certain market functionalities and characteristics of the market outcome: like efficiency, stability, fairness, etc?

Conclusion

- Lots of challenges liking Economics and Computer Science.

- Bright future for Economic Design - hereby also the tools of game theory/mechanism design.

Thanks!