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Humans against Virus or Humans against Humans? A Game Theory Approach to a Pandemic

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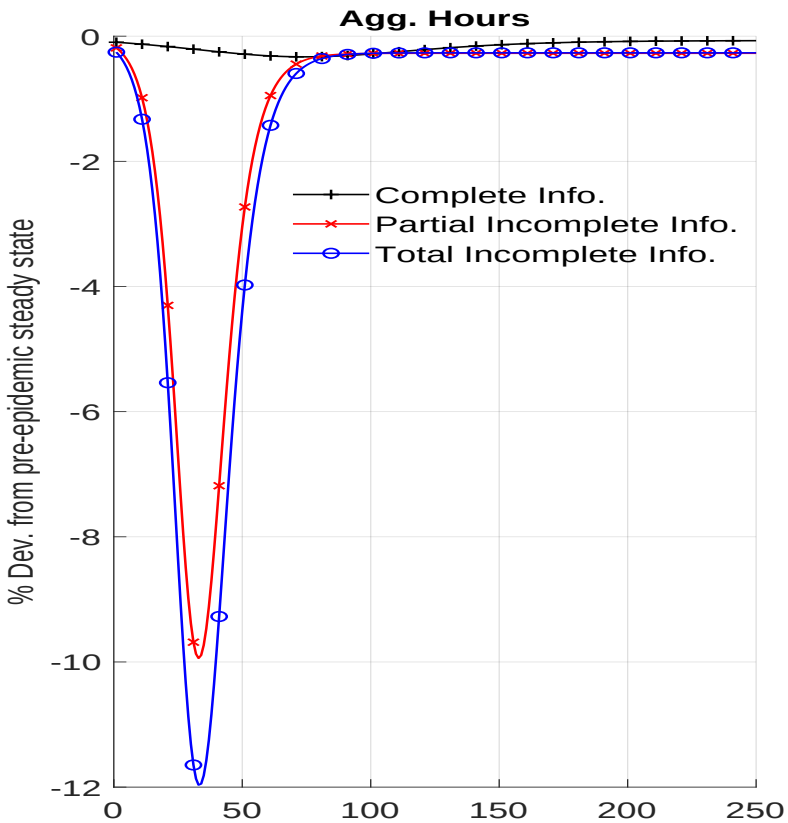
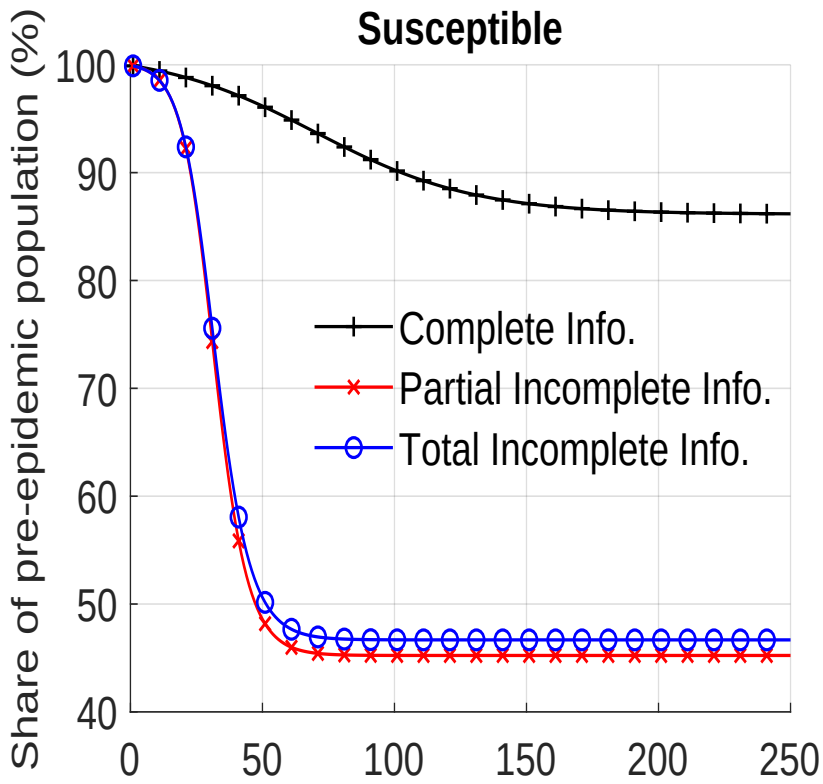
Motivation and contribution

- Analyze the impact of private info about health status on health and economic outcomes in a pandemic
- Study individual behavior in one shot repeated interaction games with complete and incomplete info

Quick Summary of Findings

- Info about health status major determinant of econ-epi outcomes!





- With perfect information no lockdown necessary, without it lockdown beneficial!

Discussion Outline

- Why is information about health status so important?
- Private info and externality
- Heterogeneity and limits to the power of information
- Green passes
- Concluding thoughts and advice

Information about health status: static effect

- Consider the beginning of a pandemic when few people are infected
- Production is organized 2 persons teams
- Complete information: large majority of teams healthy $\rightarrow$ can produce at full capacity $\rightarrow$ minimal economic disruption

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- Production is organized 2 persons teams
- Complete information: large majority of teams healthy $\rightarrow$ can produce at full capacity $\rightarrow$ minimal economic disruption
- Incomplete information: every team faces possibility of having an infectious member $\rightarrow$ all reduce production to reduce risk of infection and death (large cost) $\rightarrow$ diffused and larger economic disruption

Information about health status: dynamic effect

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Information about health status: dynamic effect

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- Incomplete information: all teams only partially reduce activity $\rightarrow$ more transmission of disease $\rightarrow$ faster growth of epidemics

Information about health status: summary

- Information allow optimal labor choice conditional on health status of team members
  - reduces static economic damage (healthy teams can operate at full capacity)
  - reduces dynamic spreading of pandemics (teams with sick members mostly shut down)

Information about health status: summary

- Information allow optimal labor choice conditional on health status of team members
  - reduces static economic damage (healthy teams can operate at full capacity)
  - reduces dynamic spreading of pandemics (teams with sick members mostly shut down)
- More information is better, however informational constraints are primitives!
- Does the lack of information increases the gap between competitive equilibrium and constrained efficient allocation?

Information and externality

- Even with complete information, competitive equilibrium is inefficient
- Consider I,S couple: marginal increase in I work has no health cost for I but positive cost for S (not internalized by i): private net benefit $>$ social net benefit

Information and externality

- Even with complete information, competitive equilibrium is inefficient
- Consider I,S couple: marginal increase in I work has no health cost for I but positive cost for S (not internalized by i): private net benefit $>$ social net benefit
- Does private information increase the externality (and inefficiency)?

Information and externality

- Consider labor choice of infected member i in team $i = I, j = S$

	Equilibrium	Planner
Obj:	$u(wn_i, n_i)$	$u(wn_i, n_i) - \pi n_i n_j \Delta$
FOC:	$u_c = u_n$	$u_c = u_n + \underbrace{\pi n_j \Delta}_{\text{External cost of } n_i}$

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- Complete information: j knows i is infected, reduces n_j, minimizes externality
- Incomplete information: j does not know partner type, exerts average effort, $n_j^{PI} > n_j^{CI}$, externality larger

Information and externality

- Private information of health status, by disabling private self protection of susceptible individuals, increases externality and calls for more stringent lockdowns graph
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- Private information of health status, by disabling private self protection of susceptible individuals, increases externality and calls for more stringent lockdowns graph
- Lockdown necessary but still far from a complete info benchmark graph
- Recommendation: stress this point and relate the paper to the current discussion on lockdowns v/s *laissez faire* (Krueger, Uhlig and Xie, 2021) and behavioral responses

Further thoughts on externalities

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- Focus on two persons team, however economic activity organized in more complex forms or networks (Azzimonti et al., 2020) where some individuals can have many contacts
- Health externalities of labor choices might be much larger, and private info more costly

Green passes

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- Framework of the paper ideal to evaluate impact of Green Passes
- Vaccination is a (noisy) signal of health status, and requiring proof of vaccination to be part of a team is a way of increasing information available to team members
- A simple exercise: assume that a fixed fraction is vaccinated and evaluate outcomes with and without GP
- Stress the informational and not just health value of vaccines!

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- Information crucial in containment because susceptible individuals know when at risk, and limit their labor supply to lower their infection prob.
- Many workers might not limit labor supply even when they know they are teamed up with an infectious person
  - Because they are poor (high marginal utility of consumption)
  - Because they are young (low risk of serious health consequences)
- In a world with heterogeneity even perfect information might not be enough to achieve efficiency

Final thoughts

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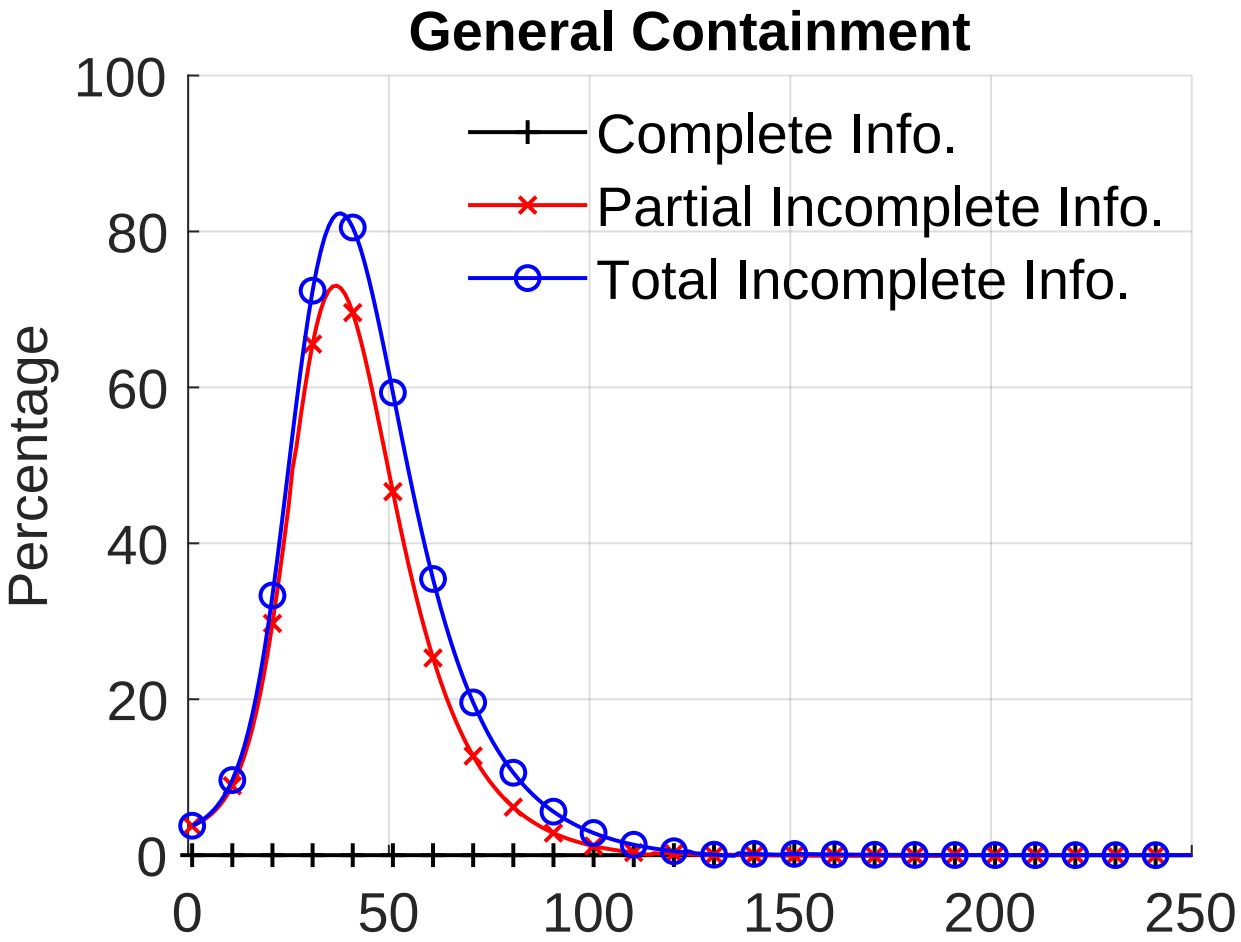
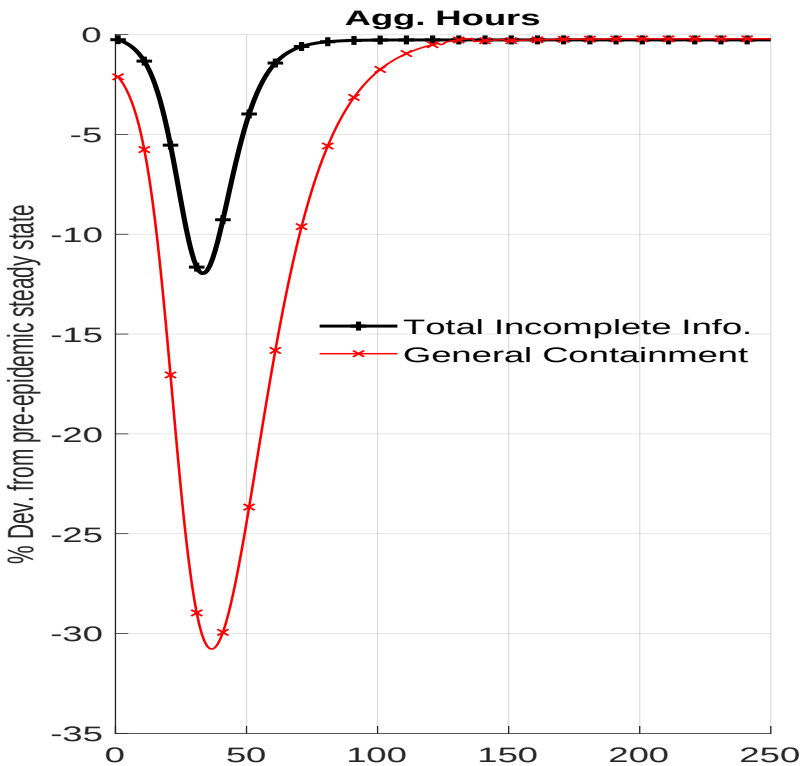
- Develop a clear and useful framework to assess value of information in a pandemic
- Marketing advice: the fact that information is valuable not exactly a surprise (see early massive efforts on testing)
- Also there are technological limits on how much information can be shared (asymptomatic cases hard to detect)
- I found much more interesting the interaction between private info and externalities, as it really contributes to the debate on the necessity of lockdowns!
- Also ideal framework to study effects of currently hotly debated information based policies like Green Passes

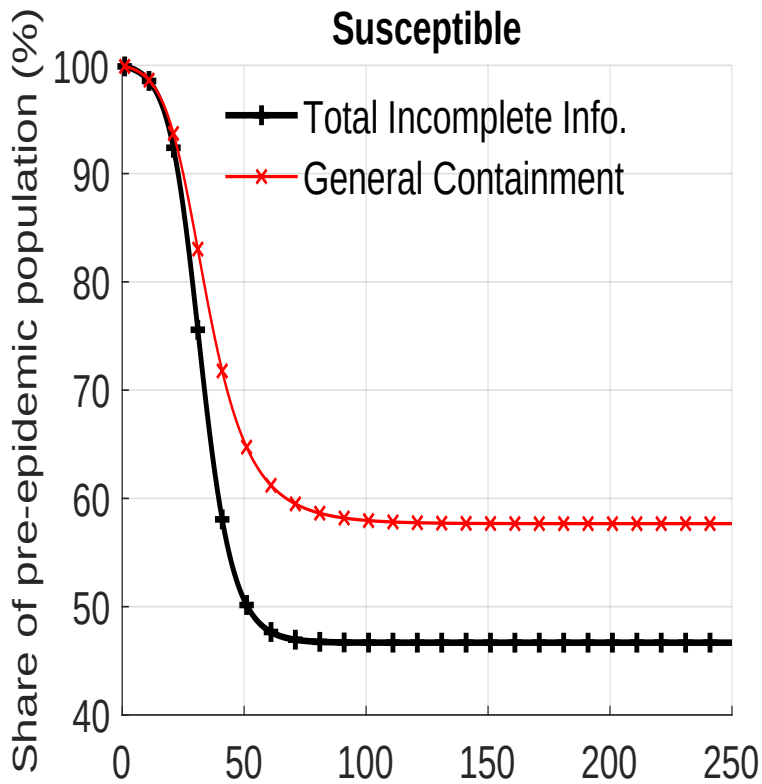
Optimal lockdowns



- With complete info no lockdown necessary (self protection basically eliminates externality)
- With private info, optimal to restrict activity with taxes exceeding 80%

Effect of lockdowns





- Lockdowns cause a drastic reduction of economic activity (relative to *laissez-faire*)..
- yet they only mitigate the epidemic outcomes, necessary but blunt..

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