

Overthrowing the dictator: a game-theoretic approach

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Introduction

- Objective – what is the effect of communication technology (mass or social media) to overthrow a dictator
 - Two types of individuals
- Coordination failures
- Individuals may benefit from choosing an action that changes the overall result, but it would require the coordination of a sufficient number of individuals to do so.

The Game

- Players
 - Finite set of individuals, $N = \{1, 2, \dots, n\}$, and a dictator
- Strategies
 - Each individual chooses an action $a_i \in \{r, s\}$, $r \rightarrow$ revolt, $s \rightarrow$ stays at home
- Type
 - Each individual is either of type $\tau_i = w$ (*willing to revolt*)
 - Or $\tau_i = x$ (*unwilling*)
 - W is the number of individuals who are willing to revolt
 - $\#\{i: \tau_i = w\} = W, W \in (0, n)$
- Individuals decide in a sequence.
 - Type vector $\tau = (\tau_1, \tau_2, \dots, \tau_n)$

The Game (contd..)

- Utility of each individual
 - depends on individual's type and the outcome of the revolution.

- $u_{w, r, R} > u_{w, s} > u_{w, r, F}$

R : overall revolt succeeds

F : overall revolt fails

- $u_{x, r} < u_{x, s}$

w : individual is willing to participate in revolt

x : not willing

r : participates in revolt

s : stays at home

Key highlights of the game

- When is the revolution successful?
 - If at least t individuals decide to revolt (i.e., $\#\{j \in N : a_j = r\} \geq t$)
 - otherwise the dictator will remain in power
- Gist of the Game:
 - Even if there are sufficient willing individuals in the society to change the regime, and overthrowing the dictator is efficient, the change requires coordination.

The research

- To show:
- How different communication technologies would affect the outcome of the revolution?
 - No technology
 - Mass media technology –Radio, newspaper, television
 - Social media technology – Facebook, Twitter

Information sets

- ϕ_i denote the information that individual i has
- p_i represent the number of individuals who have decided to revolt up to individual i
- No technology
 - individuals only know their own types, but nothing about other individuals' decisions.
 - $\phi_i = \{\tau_i\}$

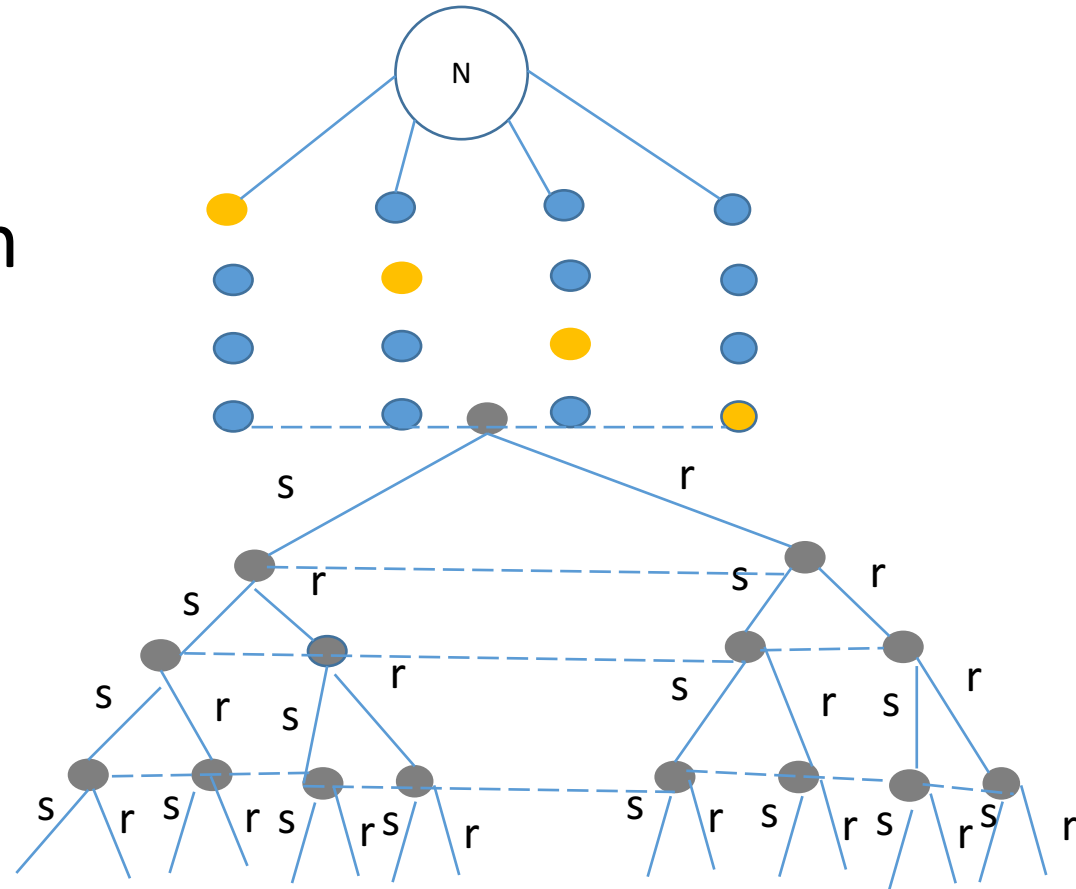
Information sets (contd..)

- Mass media
 - individuals know the amount of predecessors who decided to participate in the revolt, and the number of individuals who decided to stay at home
 - $\phi_i = \{\tau_i, p_i, i-p_i-1\}$
- Social media
 - Individuals know each of the predecessors decision in order
 - $\phi_i = \{\tau_i, \{a_j, \forall j < i\}\}$

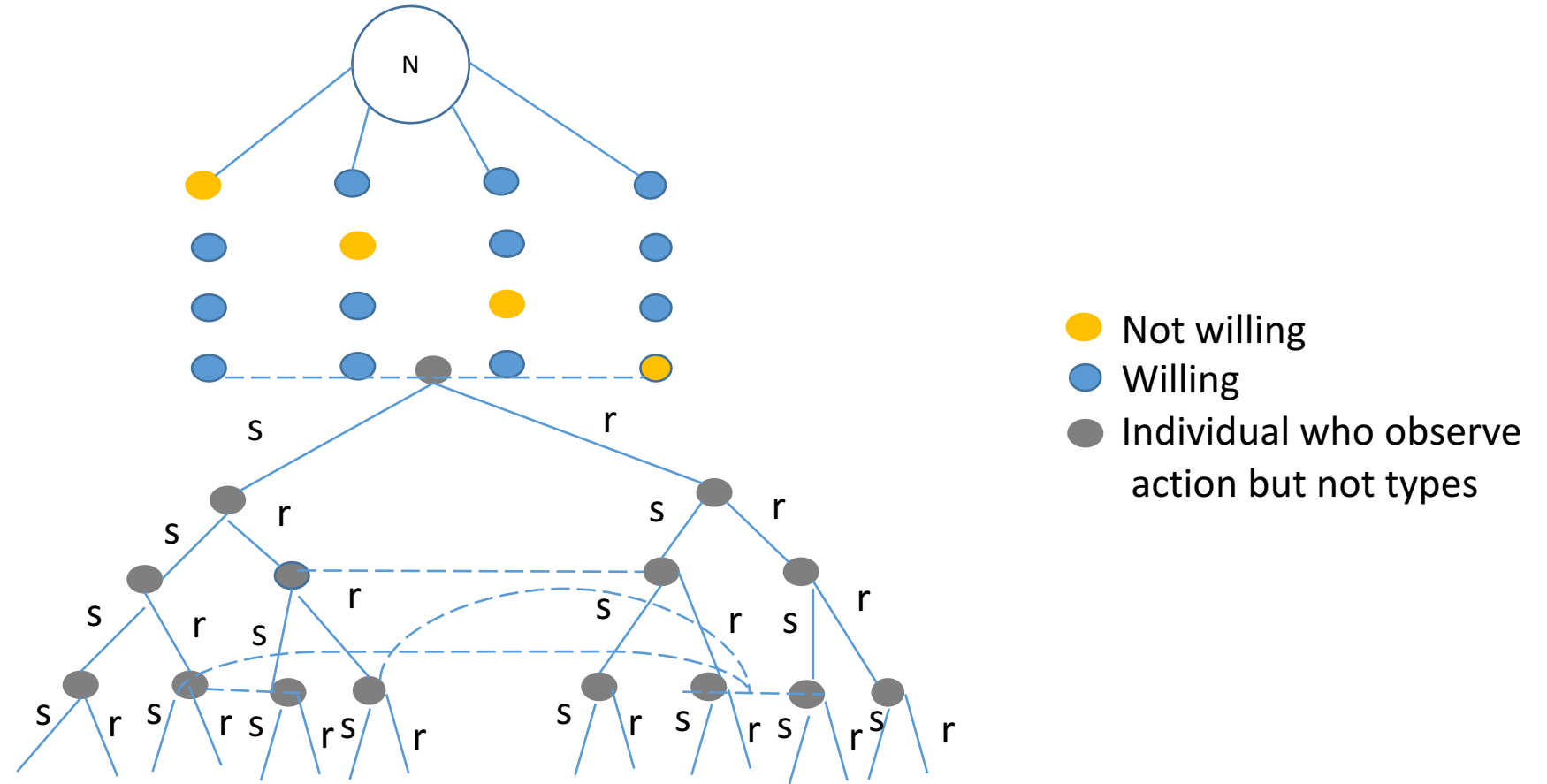
Extensive-form representation of the game

No
communication
technology

- Agents decide without knowing decisions of their predecessors
- All nodes at a given position belong to the same information set



- Not willing
- Willing
- Individual who observe action but not types

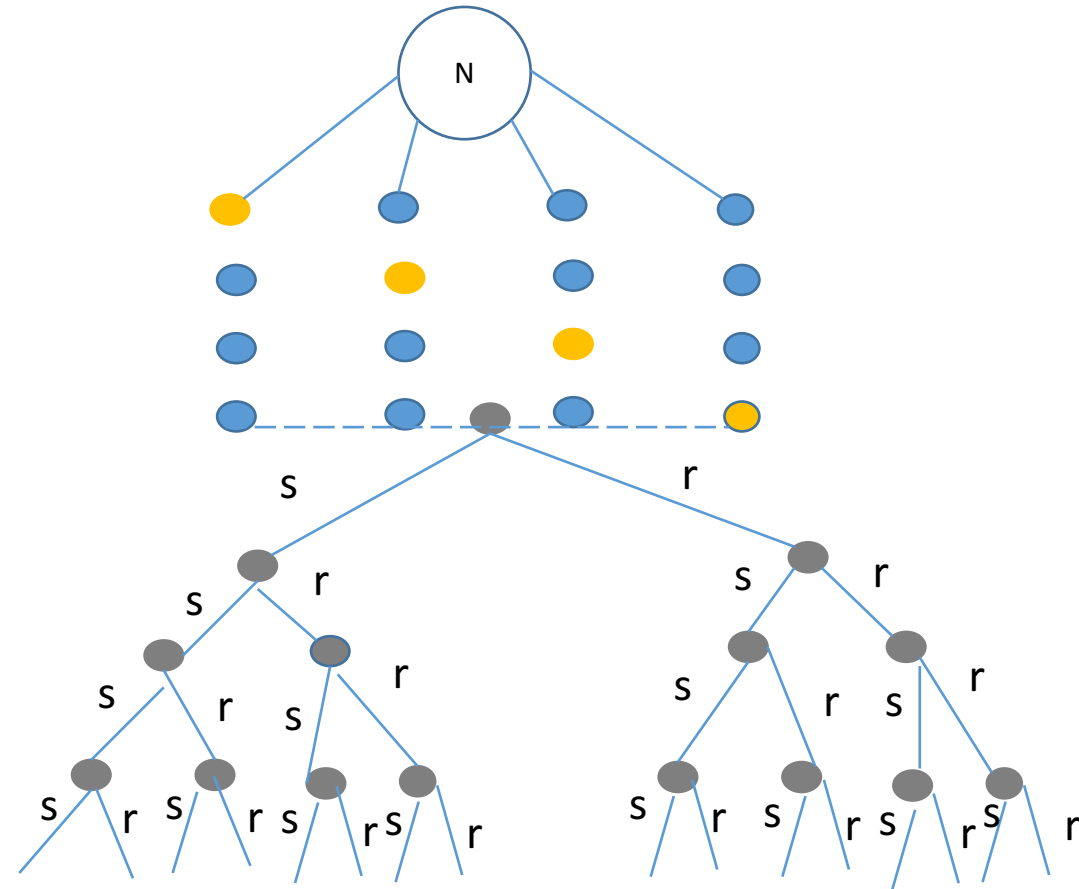


Extensive-form representation of the game

Social Media

- Agents are able to identify perfectly the sequence of decisions

- Information sets are singletons



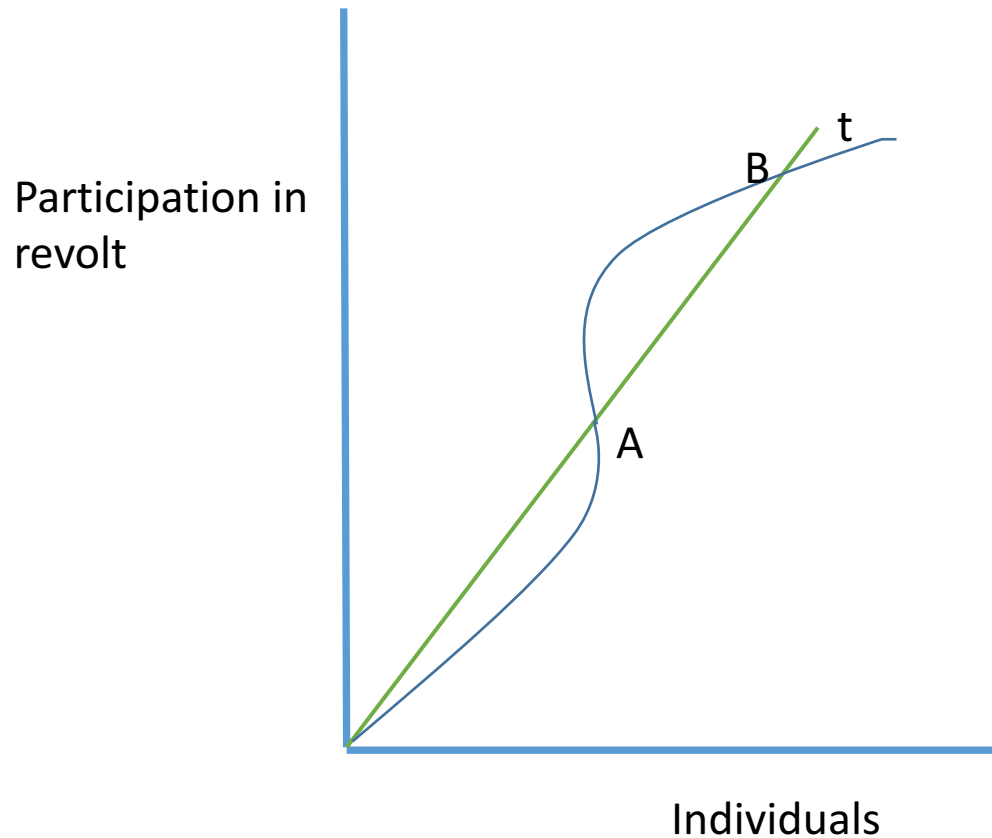
- Not willing
- Willing
- Individual who observe action but not types

The game becomes more sequential as we move from the case without communication towards social media.

Is more Information good for revolution?

- Maybe good
 - because it allows individuals to make their actions more visible to the subsequent citizens
- Bad
 - it could also foster coordination failure, e.g. if individuals find out that too many of their predecessors have chosen not to participate in the revolution.
 - Note that they may observe many individuals staying at home because those observed citizens were the unwilling ones.

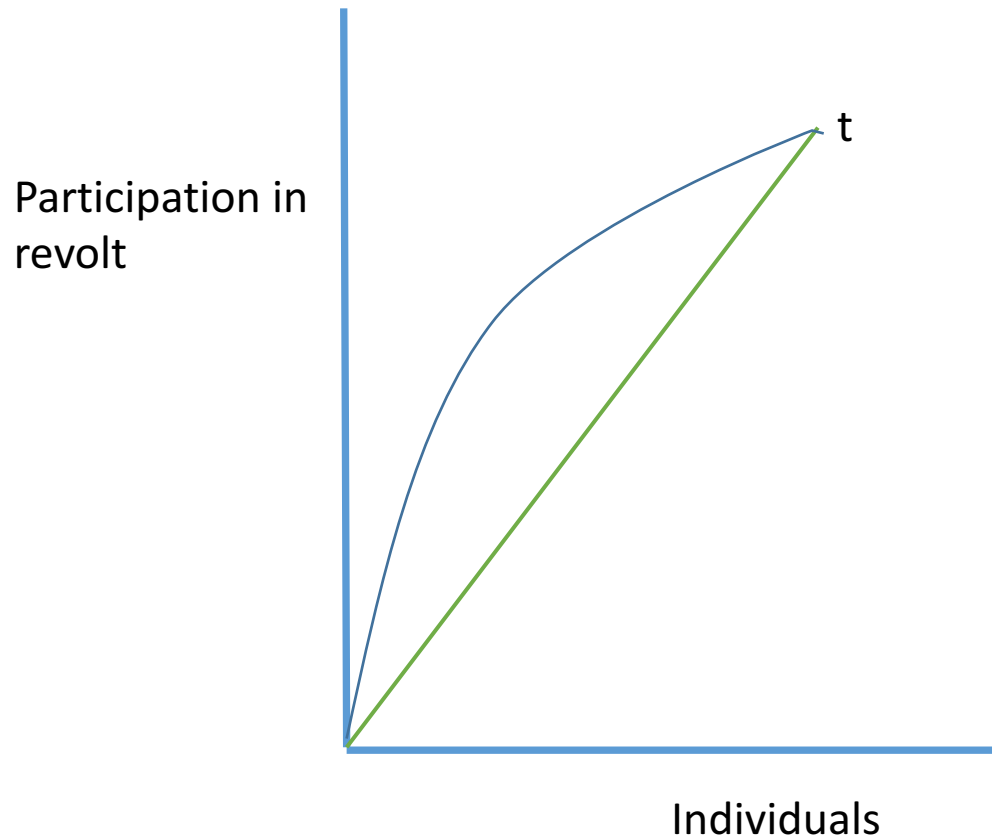
Simulation – No communication Technology



- If no communication technology is available in the society, there are multiple equilibria.
- There are two symmetric equilibria: one in which all willing individuals participate in the revolution; and another one in which no willing individual goes to the streets.
- Since , $u_{w,r,R} > u_{w,s} > u_{w,r,F}$ for the willing individuals it is optimal to revolt if the other willing individuals are revolting, while it is optimal to stay at home if nobody else is revolting.
- This result does not depend on whether type is a public information or not.

Simulation – Mass and Social Media

(Type is a public information)



- Every willing individual revolts in any subgame perfect equilibrium under both communication technologies
- Rationale
 - A willing individual chooses to join the revolution if she observes $t-1$ individuals have revolted
 - A willing individual who observes $t-2$ people participating in the revolution decides to revolt if she knows that after her there is at least one more willing individual.
- Guarantees that revolution triumphs

Simulation Results

- Three different predictions of the model
 - In no communication technology there are multiple equilibria, therefore it is possible to have the inefficient outcome in which individuals decide not to revolt (benchmark scenario)
 - In other two
 - Type is public: willing individuals will revolt
 - Type is private:
 - Mass media - there are equilibria in which willing individuals decide not to revolt
 - Social media - revolution will always succeed

Simulation – Mass and Social Media

(Type is a private information)

- Problem:
 - Unable to distinguish between “willing and stay at home” and “unwilling” people
- What an individual knows?
 - *actions* of predecessors
 - Mass media
 - $\phi_i = \{\tau_i, p_i, i-p_i-1\}$, individual knows only his type and how many have revolted before him
 - Social media
 - $\phi_i = \{\tau_i, \{a_j, \forall j < i\}\}$
 - Individual knows the exact sequence of decisions
 - But cannot distinguish perfectly the type of her predecessors (i.e. who have revolted or stayed at home? – willing or unwilling”
 - contradiction

Applying Bayesian Nash equilibrium

(because type cannot be observed)

- Results - under social media
 - being truthful is the unique equilibrium profile
 - unique Bayesian Nash equilibrium.
 - staying at home when an individual is unwilling and revolting when willing
- Under mass media
 - revolution succeeds only when certain conditions are met
 - $t < \lceil n/(n-W+1) \rceil + 1$, each willing individual revolts and the revolution succeeds
 - $t \geq \lceil n/(n-W+1) \rceil + 1$, there are equilibria where the revolution is unsuccessful and nobody revolts for certain values of $u_{w,r,R}$, $u_{w,s}$ and $u_{w,r,F}$

Example 1

- $n = 4, w = 3, t = 3$, communication technology exists
- Revolt succeeds, when (Set A)
 - $i = 4$ and $\tau_i = w$ and $p_4 = 2 ; \{a_i = r\}$
 - $i = 3$ and $\tau_i = w$ and $p_3 = 2 ; \{a_i = r\}$
 - $i = 2$ and $\tau_i = w$ and $p_2 = 1 ; \{a_i = r\}$
- Fails when, (Set B)
 - $i = 4$ and $\tau_i = w$ and $p_4 = \{0,1\} ; \{a_i = s\}$
 - $i = 3$ and $\tau_i = w$ and $p_3 = 0 ; \{a_i = s\}$

Example 1

- Ambiguous when
 - $i = 1$ and $\tau_i = w ; p_1 ; \{a_i = ?\}$
 - $i = 2$ and $\tau_i = w$ and $p_3 = 1 ; \{a_i = ?\}$
 - $i = 3$ and $\tau_i = w$ and $p_2 = 1 ; \{a_i = ?\}$

Equilibrium without revolution – mass media

- Individuals act optimally at Set A and Set B
- And In Ambiguous set – nobody chooses to revolt
- Proof that nobody has a profitable unilateral deviation
 - First individual - deviation consists in revolting instead of staying at home
 - Profitable if second individual is willing
 - Probability second individual is unwilling = $1/3$
 - Unilateral deviation is profitable if and only if
 - $u_{w,s} < (2/3) u_{w,r,R} + (1/3) u_{w,r,F}$ [does not hold for payoffs $u_{w,r,R} = 1$, $u_{w,s} = 0$ and $u_{w,r} = -10$]
 - Third person (willing) observes $p_3 = 1$ (off-equilibrium decision) – 1 willing individual revolted and 1 willing individual deviated and revolted

Equilibrium in Social Media

- There is a unique equilibrium in which all willing individuals revolt and succeed in overthrowing the dictator.
- Proof:
 - Fourth individual observes two other citizens have revolted (the order does not matter) , then the individual revolts
 - Third individual(willing) joins protests when observing two protesters
 - Second individual (willing) , observed the first citizen to protest , will revolt as well, anticipating that the last willing individual will join the protest.

Equilibrium in Social Media (contd..)

- First citizen revolted
- The second one stayed at home
- The third individual can be sure that the second individual was the unwilling one (a willing individual in the second position would have joined the uprising upon observing that the first citizen revolted)
- Hence the third individual knows that last citizen is willing and would revolt.

What made the difference between mass media and social media?

- In social media individuals are able to distinguish the histories (r, s) and (s, r) .
- While with mass media individuals may believe that (with some positive probability) the one who stayed at home is a willing individual.

Future work

- Analyzing proportion of the society to overthrow the dictator
- How punishment would impact coordination?
- Coordination failures on different domain
 - Failure of a successful technology product

THANK YOU