How Much is too Much?
Beliefs about Perceived Inequality in a Coordination Game

Tim Schulz

Simon Fraser University
Department of Economics

August 2, 2016

Motivation

History:

- many successful revolutions when inequality "got out of hand"
- many failed revolutions (e.g. Arab Spring)

Motivation

History:

- many successful revolutions when inequality "got out of hand"
- many failed revolutions (e.g. Arab Spring)

Hypotheses about the future:

- Piketty: "Capital in the Twenty-First Century"

Goals

Describe how...

- poor perceive inequality

Goals

Describe how...

- poor perceive inequality
  - When do I believe that other poor people decide to revolt against inequality?

Goals

Describe how...

- poor perceive inequality
  - When do I believe that other poor people decide to revolt against inequality?
  - For what levels of inequality do I believe that rich people think there may be a problem and start "defending" against a possible revolution?

Goals

Describe how...

- poor perceive inequality
  - When do I believe that other poor people decide to revolt against inequality?
  - For what levels of inequality do I believe that rich people think there may be a problem and start "defending" against a possible revolution?
- rich perceive inequality

Goals

Describe how...

- poor perceive inequality
  - When do I believe that other poor people decide to revolt against inequality?
  - For what levels of inequality do I believe that rich people think there may be a problem and start "defending" against a possible revolution?
- rich perceive inequality
  - What levels of inequality do I believe poor people will accept?

Goals

Describe how...

- poor perceive inequality
  - When do I believe that other poor people decide to revolt against inequality?
  - For what levels of inequality do I believe that rich people think there may be a problem and start "defending" against a possible revolution?
- rich perceive inequality
  - What levels of inequality do I believe poor people will accept?
  - When do I start worrying about possible adverse consequences of inequality and try to insure myself against revolutions?

Goals

Describe how...

- poor perceive inequality
  - When do I believe that other poor people decide to revolt against inequality?
  - For what levels of inequality do I believe that rich people think there may be a problem and start "defending" against a possible revolution?
- rich perceive inequality
  - What levels of inequality do I believe poor people will accept?
  - When do I start worrying about possible adverse consequences of inequality and try to insure myself against revolutions?
- success of coordination depends on observed inequality

Payoffs

What determines inequality?
– Inequality in possible payoffs

Payoffs

What determines inequality?
– Inequality in possible payoffs
Payoffs for poor players:

Table: General Payoffs of Poor

Under `no insurance` (n)

	revolt	do nothing
revolt	h_n, h_n	l_n, m_n
do nothing	m_n, l_n	m_n, m_n

Under `insurance` (i)

	revolt	do nothing
revolt	h_i, h_i	l_i, m_i
do nothing	m_i, l_i	m_i, m_i

Payoffs of poor players depending on the other poor player's decision and depending on whether the rich person opted for insurance.

Some simplifications:

- $h_n = h_i = h$
- $m_n = m_i = m$

Some simplifications:

- $h_n = h_i = h$
- $m_n = m_i = m$

Table: Simplified Payoffs of Poor

	revolt	do nothing
revolt	h, h	l_j, m
do nothing	m, l_j	m, m

Where $j \in \{i, n\}$ and $l_n > l_i$.

Payoffs

Payoffs for rich players

Table: Payoffs of Rich

General Form

number of revolts	insurance	no insurance
0	y_{0i}	y_{0n}
1	y_{1i}	y_{1n}
2	y_{2i}	y_{2n}

Simplified Form

number of revolts	insurance	no insurance
0	y_{fi}	y_{0n}
1	y_{fi}	y_{1n}
2	y_2	y_2

where

$$y_{0n} > y_{0i} = y_{1i} = y_{fi} > y_{1n} > y_{2i} = y_{2n} = y_2$$

Decision Making Process – Rich

γ – the believed probability of a poor person revolting

Decision Making Process – Rich

γ – the believed probability of a poor person revolting
A rich person believes that

- nobody revolts with probability $(1-\gamma)^2$

Decision Making Process – Rich

γ – the believed probability of a poor person revolting
A rich person believes that

- nobody revolts with probability $(1-\gamma)^2$
- 1 poor player revolts with probability $2\gamma(1-\gamma)$

Decision Making Process – Rich

γ – the believed probability of a poor person revolting

A rich person believes that

- nobody revolts with probability $(1-\gamma)^2$
- 1 poor player revolts with probability $2\gamma(1-\gamma)$
- both poor players revolt with probability γ^2

Decision Making Process – Rich

γ – the believed probability of a poor person revolting

A rich person believes that

- nobody revolts with probability $(1-\gamma)^2$
- 1 poor player revolts with probability $2\gamma(1-\gamma)$
- both poor players revolt with probability γ^2

Decision Making Process – Rich

γ – the believed probability of a poor person revolting

A rich person believes that

- nobody revolts with probability $(1-\gamma)^2$
- 1 poor player revolts with probability $2\gamma(1-\gamma)$
- both poor players revolt with probability γ^2

Then, a rich person purchases insurance if

$$\left[(1-\gamma)^2 + 2\gamma(1-\gamma)\right] y_{fi} + \gamma^2 y_2 \geq (1-\gamma)^2 y_{0n} + 2\gamma(1-\gamma) y_{1n} + \gamma^2 y_2$$

$$\gamma \geq \frac{y_{0n} - y_{fi}}{y_{fi} + y_{0n} - 2y_{1n}} \equiv \gamma_1.$$

Decision Making Process – Poor

δ – the believed probability of a rich person having insurance

Decision Making Process – Poor

δ – the believed probability of a rich person having insurance

A rational poor person will choose to revolt if

$$\gamma h + (1-\gamma)\left[(1-\delta)l_n + \delta l_i\right] \geq m$$

Decision Making Process – Poor

δ – the believed probability of a rich person having insurance

A rational poor person will choose to revolt if

$$\gamma h + (1-\gamma)\left[(1-\delta)l_n + \delta l_i\right] \geq m$$

Assume I believe there is insurance ($\gamma > \gamma_1$): Revolt if

$$\gamma h + (1-\gamma) l_i \geq m$$

$$\gamma \geq \frac{m - l_i}{h - l_i} \equiv \gamma_2$$

Decision Making Process – Poor

δ – the believed probability of a rich person having insurance

A rational poor person will choose to revolt if

$$\gamma h + (1-\gamma)\left[(1-\delta)l_n + \delta l_i\right] \geq m$$

Assume I believe there is insurance ($\gamma > \gamma_1$): Revolt if

$$\gamma h + (1-\gamma) l_i \geq m$$
$$\gamma \geq \frac{m - l_i}{h - l_i} \equiv \gamma_2$$

Assume I believe there is no insurance ($\gamma < \gamma_1$): Revolt if

$$\gamma h + (1-\gamma) l_n \geq m$$
$$\gamma \geq \frac{m - l_n}{h - l_n} \equiv \gamma_3$$

Possible outcomes of the game

4 possible outcomes:

- no insurance, no revolution

Possible outcomes of the game

4 possible outcomes:

- no insurance, no revolution
- no insurance, revolution

Possible outcomes of the game

4 possible outcomes:

- no insurance, no revolution
- no insurance, revolution
- insurance, no revolution

Possible outcomes of the game

4 possible outcomes:

- no insurance, no revolution
- no insurance, revolution
- insurance, no revolution
- insurance, revolution

Possible outcomes of the game

4 possible outcomes:

- no insurance, no revolution
- no insurance, revolution
- insurance, no revolution
- insurance, revolution

Possible outcomes of the game

4 possible outcomes:

- no insurance, no revolution
- no insurance, revolution
- insurance, no revolution
- insurance, revolution

Only way to rationally allow for all 4 outcomes: Arrange payoffs such that

$$0 \leq \gamma_3 < \gamma_1 < \gamma_2 \leq 1$$

The Experiment

- $2 \times 2 \times 3$ design

The Experiment

- $2 \times 2 \times 3$ design
    - randomly assigned to role of rich or poor player

The Experiment

- $2 \times 2 \times 3$ design
  - randomly assigned to role of rich or poor player
  - low or high (internal) risk

The Experiment

- $2 \times 2 \times 3$ design
  - randomly assigned to role of rich or poor player
  - low or high (internal) risk
  - low, medium or high inequality

The Experiment

- $2 \times 2 \times 3$ design
  - randomly assigned to role of rich or poor player
  - low or high (internal) risk
  - low, medium or high inequality
- groups of 3 (2 poor, 1 rich)

The Experiment

- $2 \times 2 \times 3$ design
  - randomly assigned to role of rich or poor player
  - low or high (internal) risk
  - low, medium or high inequality
- groups of 3 (2 poor, 1 rich)
- 30 rounds

The Experiment

- $2 \times 2 \times 3$ design
  - randomly assigned to role of rich or poor player
  - low or high (internal) risk
  - low, medium or high inequality
- groups of 3 (2 poor, 1 rich)
- 30 rounds
- random order of treatments

Table: Payoff Treatments

Treatment		Payoffs						
Risk	Inequality	l_i	l_n	m	h	y_{1n}	y_{fi}	y_{on}
low	low	130	280	440	750	490	1100	1820
low	medium	130	280	440	750	980	2200	3640
low	high	130	280	440	750	1960	4400	7280
high	low	75	130	320	750	500	2250	4000
high	medium	75	130	320	750	1000	4500	8000
high	high	75	130	320	750	2000	9000	16000

What a round looks like

1. participants are randomly selected into groups of three and randomly assigned to the role of rich or poor person

What a round looks like

1. participants are randomly selected into groups of three and randomly assigned to the role of rich or poor person
2. all players are informed about everybody's endowment

What a round looks like

1. participants are randomly selected into groups of three and randomly assigned to the role of rich or poor person
2. all players are informed about everybody's endowment
3. all players are informed about everybody's payoff tables

What a round looks like

1. participants are randomly selected into groups of three and randomly assigned to the role of rich or poor person
2. all players are informed about everybody's endowment
3. all players are informed about everybody's payoff tables
4. poor players choose whether to revolt

What a round looks like

1. participants are randomly selected into groups of three and randomly assigned to the role of rich or poor person
2. all players are informed about everybody's endowment
3. all players are informed about everybody's payoff tables
4. poor players choose whether to revolt
5. rich players indicate if they believe a successful revolution to occur and decide whether to buy insurance

What a round looks like

1. participants are randomly selected into groups of three and randomly assigned to the role of rich or poor person
2. all players are informed about everybody's endowment
3. all players are informed about everybody's payoff tables
4. poor players choose whether to revolt
5. rich players indicate if they believe a successful revolution to occur and decide whether to buy insurance
6. all players are informed about the number of revolutionaries, the existence of insurance, and their respective payoffs

What a round looks like

1. participants are randomly selected into groups of three and randomly assigned to the role of rich or poor person
2. all players are informed about everybody's endowment
3. all players are informed about everybody's payoff tables
4. poor players choose whether to revolt
5. rich players indicate if they believe a successful revolution to occur and decide whether to buy insurance
6. all players are informed about the number of revolutionaries, the existence of insurance, and their respective payoffs
7. payment for 3 randomly selected periods ($1 per 1000 points)

Simulation Study

Some deviations from the experiment:

- no switching between the roles of poor and rich players

Simulation Study

Some deviations from the experiment:

- no switching between the roles of poor and rich players
- (near) continuum of treatments (1,707 different payoff allocations)

Simulation Study

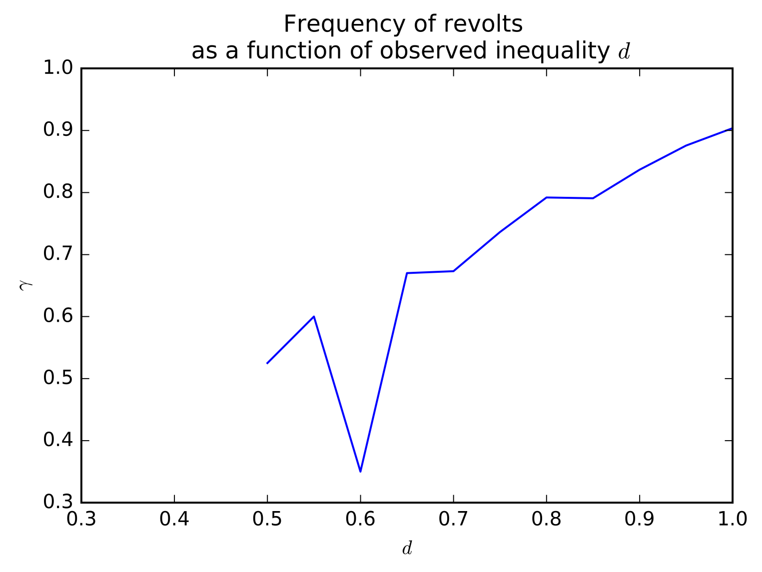
Some deviations from the experiment:

- no switching between the roles of poor and rich players
- (near) continuum of treatments (1,707 different payoff allocations)
- 500 rounds

Simulation Study

Some deviations from the experiment:

- no switching between the roles of poor and rich players
- (near) continuum of treatments (1,707 different payoff allocations)
- 500 rounds
- observable: $d = 1 - \frac{m}{y_{0n}}$ as a measure of inequality


Frequency of revolts
as a function of observed inequality d
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
γ
0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
d

Analysis

Calculate γ from rich players' frequency of believing in a successful revolution (γ^2)

Analysis

Calculate γ from rich players' frequency of believing in a successful revolution (γ^2)

$$\begin{aligned}\gamma_{it} = b_0 &+ b_1 \mathbb{1}\{inequality_t = medium\} \\ &+ b_2 \mathbb{1}\{inequality_t = high\} \\ &+ b_3 \mathbb{1}\{role_t = rich\} \\ &+ b_4 \mathbb{1}\{risk_t = high\} + \kappa_i + \epsilon_{it}\end{aligned}$$

Some Initial Hypotheses

- $0 < b_1 < b_2$: higher inequality $\implies$ higher probability of revolution

Some Initial Hypotheses

- $0 < b_1 < b_2$: higher inequality $\implies$ higher probability of revolution
- $b_3 < 0$: rich perceive inequality as less significant than poor

Some Initial Hypotheses

- $0 < b_1 < b_2$: higher inequality $\implies$ higher probability of revolution
- $b_3 < 0$: rich perceive inequality as less significant than poor
- b_4 not immediately clear, mostly as control variable