

# Common agency with Informed Principals: Revelation Principle

Nicolas Riquelme

University of Rochester

Midwest Economic Theory Conference, 2017

# Introduction

Revelation Principle (RP) is an important tool for mechanism design problems: simplify the problem

One principal - one agent

$$\pi : M \rightarrow Y \quad F : \Theta \rightarrow Y$$

RP: If  $F$  can be implemented by an indirect mechanism  $\pi$ , then  $F$  can be implemented by an IC direct mechanism

$$\tilde{\pi} : \Theta \rightarrow Y$$

This paper: Multiple privately informed principals

$$\pi_i : M_i \rightarrow Y_i \quad F : \Theta \times T_1 \times T_2 \rightarrow Y_1 \times Y_2$$

# Introduction

Revelation Principle (RP) is an important tool for mechanism design problems: simplify the problem

One principal - one agent

$$\pi : M \rightarrow Y \quad F : \Theta \rightarrow Y$$

RP: If  $F$  can be implemented by an indirect mechanism  $\pi$ , then  $F$  can be implemented by an IC direct mechanism

$$\tilde{\pi} : \Theta \rightarrow Y$$

This paper: Multiple privately informed principals

$$\pi_i : M_i \rightarrow Y_i \quad F : \Theta \times T_1 \times T_2 \rightarrow Y_1 \times Y_2$$

# Introduction

Revelation Principle (RP) is an important tool for mechanism design problems: simplify the problem

One principal - one agent

$$\pi : M \rightarrow Y \quad F : \Theta \rightarrow Y$$

RP: If  $F$  can be implemented by an indirect mechanism  $\pi$ , then  $F$  can be implemented by an IC direct mechanism

$$\tilde{\pi} : \Theta \rightarrow Y$$

This paper: Multiple privately informed principals

$$\pi_i : M_i \rightarrow Y_i \quad F : \Theta \times T_1 \times T_2 \rightarrow Y_1 \times Y_2$$

# Introduction

Revelation Principle (RP) is an important tool for mechanism design problems: simplify the problem

One principal - one agent

Indirect Mechanism

$$\begin{array}{c} \downarrow \\ \pi : M \rightarrow Y \end{array} \quad F : \Theta \rightarrow Y$$

RP: If  $F$  can be implemented by an indirect mechanism  $\pi$ , then  $F$  can be implemented by an IC direct mechanism

$$\tilde{\pi} : \Theta \rightarrow Y$$

This paper: Multiple privately informed principals

$$\pi_i : M_i \rightarrow Y_i \quad F : \Theta \times T_1 \times T_2 \rightarrow Y_1 \times Y_2$$

# Introduction

Revelation Principle (RP) is an important tool for mechanism design problems: simplify the problem

One principal - one agent

$$\begin{array}{c} \text{Message space} \\ \downarrow \\ \pi : M \rightarrow Y \end{array} \quad F : \Theta \rightarrow Y$$

RP: If  $F$  can be implemented by an indirect mechanism  $\pi$ , then  $F$  can be implemented by an IC direct mechanism

$$\tilde{\pi} : \Theta \rightarrow Y$$

This paper: Multiple privately informed principals

$$\pi_i : M_i \rightarrow Y_i \quad F : \Theta \times T_1 \times T_2 \rightarrow Y_1 \times Y_2$$

# Introduction

Revelation Principle (RP) is an important tool for mechanism design problems: simplify the problem

One principal - one agent

$$\begin{array}{ccc} & \text{Allocation} & \\ & \downarrow & \\ \pi : M \rightarrow Y & & F : \Theta \rightarrow Y \end{array}$$

RP: If  $F$  can be implemented by an indirect mechanism  $\pi$ , then  $F$  can be implemented by an IC direct mechanism

$$\tilde{\pi} : \Theta \rightarrow Y$$

This paper: Multiple privately informed principals

$$\pi_i : M_i \rightarrow Y_i \quad F : \Theta \times T_1 \times T_2 \rightarrow Y_1 \times Y_2$$

# Introduction

Revelation Principle (RP) is an important tool for mechanism design problems: simplify the problem

One principal - one agent

$$\begin{array}{ccc} & \text{Outcome function} & \\ & \downarrow & \\ \pi : M \rightarrow Y & & F : \Theta \rightarrow Y \end{array}$$

RP: If  $F$  can be implemented by an indirect mechanism  $\pi$ , then  $F$  can be implemented by an IC direct mechanism

$$\tilde{\pi} : \Theta \rightarrow Y$$

This paper: Multiple privately informed principals

$$\pi_i : M_i \rightarrow Y_i \quad F : \Theta \times T_1 \times T_2 \rightarrow Y_1 \times Y_2$$



# Introduction

Revelation Principle (RP) is an important tool for mechanism design problems: simplify the problem

One principal - one agent

$$\pi : M \rightarrow Y \quad F : \Theta \rightarrow Y$$

↑  
Agent private information

RP: If  $F$  can be implemented by an indirect mechanism  $\pi$ , then  $F$  can be implemented by an IC direct mechanism

$$\tilde{\pi} : \Theta \rightarrow Y$$

This paper: Multiple privately informed principals

$$\pi_i : M_i \rightarrow Y_i \quad F : \Theta \times T_1 \times T_2 \rightarrow Y_1 \times Y_2$$

# Introduction

Revelation Principle (RP) is an important tool for mechanism design problems: simplify the problem

One principal - one agent

$$\pi : M \rightarrow Y \quad F : \Theta \rightarrow Y$$

RP: If  $F$  can be implemented by an indirect mechanism  $\pi$ , then  $F$  can be implemented by an IC direct mechanism

$$\tilde{\pi} : \Theta \rightarrow Y$$

This paper: Multiple privately informed principals

$$\pi_i : M_i \rightarrow Y_i \quad F : \Theta \times T_1 \times T_2 \rightarrow Y_1 \times Y_2$$

# Introduction

Revelation Principle (RP) is an important tool for mechanism design problems: simplify the problem

One principal - one agent

$$\pi : M \rightarrow Y \quad F : \Theta \rightarrow Y$$

RP: If  $F$  can be implemented by an indirect mechanism  $\pi$ , then  $F$  can be implemented by an IC direct mechanism

$$\tilde{\pi} : \Theta \rightarrow Y$$

**This paper: Multiple privately informed principals**

$$\pi_i : M_i \rightarrow Y_i \quad F : \Theta \times T_1 \times T_2 \rightarrow Y_1 \times Y_2$$

# Introduction

Revelation Principle (RP) is an important tool for mechanism design problems: simplify the problem

One principal - one agent

$$\pi : M \rightarrow Y \quad F : \Theta \rightarrow Y$$

RP: If  $F$  can be implemented by an indirect mechanism  $\pi$ , then  $F$  can be implemented by an IC direct mechanism

$$\tilde{\pi} : \Theta \rightarrow Y$$

This paper: Multiple privately informed principals

$$\pi_i : M_i \rightarrow Y_i \quad F : \Theta \times T_1 \times T_2 \rightarrow Y_1 \times Y_2$$

# Introduction

Revelation Principle (RP) is an important tool for mechanism design problems: simplify the problem

One principal - one agent

$$\pi : M \rightarrow Y \quad F : \Theta \rightarrow Y$$

RP: If  $F$  can be implemented by an indirect mechanism  $\pi$ , then  $F$  can be implemented by an IC direct mechanism

$$\tilde{\pi} : \Theta \rightarrow Y$$

This paper: Multiple privately informed principals

$$\pi_i : M_i \rightarrow Y_i \quad F : \Theta \times T_1 \times T_2 \rightarrow Y_1 \times Y_2$$

Principals private information

# Introduction

Revelation Principle (RP) is an important tool for mechanism design problems: simplify the problem

One principal - one agent

$$\pi : M \rightarrow Y \quad F : \Theta \rightarrow Y$$

RP: If  $F$  can be implemented by an indirect mechanism  $\pi$ , then  $F$  can be implemented by an IC direct mechanism

$$\tilde{\pi} : \Theta \rightarrow Y$$

This paper: Multiple privately informed principals

$$\pi_i : M_i \rightarrow Y_i \quad F : \Theta \times T_1 \times T_2 \rightarrow Y_1 \times Y_2$$

# Introduction

Question: Is the Revelation Principle valid?

# Introduction

Question: Is the Revelation Principle valid?

Agents have **endogenous information**: principals mechanisms

New information: **allocations** available and information this  
mechanisms signal about others **principals types**

Principals may want to screen that information

This might lead to a **failure of the revelation principle**



# Introduction

Question: Is the Revelation Principle valid?

Agent have **endogenous information**: principals mechanisms

New information: **allocations** available and information this  
mechanisms signal about others **principals types**

Principals may want to screen that information

This might lead to a **failure of the revelation principle**

This paper: Sufficient conditions such that RP is valid

# Literature

## Multiple principals

- ▶ Uninformed principals:
  - ▶ Epstein and Peters (1999)
  - ▶ Peters (2001)
  - ▶ Martimort and Stole (2002)
  - ▶ Peters (2003, 2007)
  - ▶ Attar et al. (2008)
  - ▶ Pavan and Calzolari (2010)
- ▶ Privately informed principals
  - ▶ This paper

## Example of failure of revelation principle

2 Principals, 1 Agent

Principal 1 private information  $\{t_h, t_l\}$ ,  $P(t_h) = 0.5$

$Y_i = \{I, NI\}$ ,  $M_i = \{a, b\}$

## Example of failure of revelation principle

2 Principals, 1 Agent

Principal 1 private information  $\{t_h, t_l\}$ ,  $P(t_h) = 0.5$

$Y_i = \{I, NI\}$ ,  $M_i = \{a, b\}$

	<i>I</i>	<i>NI</i>
<i>I</i>	4, 3, 3	3, 4, 0
<i>NI</i>	2, 1, 2	1, 2, 1

$t_h$

	<i>I</i>	<i>NI</i>
<i>I</i>	1, 1, 1	1, 2, 0
<i>NI</i>	2, 1, 2	2, 2, 1

$t_l$

## Example of failure of revelation principle

2 Principals, 1 Agent

Principal 1 private information  $\{t_h, t_l\}$ ,  $P(t_h) = 0.5$

$Y_i = \{I, NI\}$ ,  $M_i = \{a, b\}$

	<i>I</i>	<i>NI</i>
<i>I</i>	4, 3, 3	3, 4, 0
<i>NI</i>	2, 1, 2	1, 2, 1

$t_h$

	<i>I</i>	<i>NI</i>
<i>I</i>	1, 1, 1	1, 2, 0
<i>NI</i>	2, 1, 2	2, 2, 1

$t_l$

- **Direct mechanisms:** (*I*, *NI*) on  $t_h$  and (*NI*, *NI*) on  $t_l$

# Example of failure of revelation principle

2 Principals, 1 Agent

Principal 1 private information  $\{t_h, t_l\}$ ,  $P(t_h) = 0.5$

$Y_i = \{I, NI\}$ ,  $M_i = \{a, b\}$

	<i>I</i>	<i>NI</i>
<i>I</i>	4, 3, 3	3, 4, 0
<i>NI</i>	2, 1, 2	1, 2, 1

$t_h$

	<i>I</i>	<i>NI</i>
<i>I</i>	1, 1, 1	1, 2, 0
<i>NI</i>	2, 1, 2	2, 2, 1

$t_l$

- ▶ Direct mechanisms: (*I*, *NI*) on  $t_h$  and (*NI*, *NI*) on  $t_l$
- ▶ **Indirect mechanisms:** (*I*, *I*) on  $t_h$  and (*NI*, *I*) on  $t_l$

## Example of failure of revelation principle

2 Principals, 1 Agent

Principal 1 private information  $\{t_h, t_l\}$ ,  $P(t_h) = 0.5$

$Y_i = \{I, NI\}$ ,  $M_i = \{a, b\}$

	<i>I</i>	<i>NI</i>
<i>I</i>	4, 3, 3	3, 4, 0
<i>NI</i>	2, 1, 2	1, 2, 1

$t_h$

	<i>I</i>	<i>NI</i>
<i>I</i>	1, 1, 1	1, 2, 0
<i>NI</i>	2, 1, 2	2, 2, 1

$t_l$

- ▶ Direct mechanisms:  $(I, NI)$  on  $t_h$  and  $(NI, NI)$  on  $t_l$
- ▶ Indirect mechanisms:  $(I, I)$  on  $t_h$  and  $(NI, I)$  on  $t_l$

An outcome function implemented with indirect mechanisms **can not be implemented with direct mechanisms**

## Example of failure of revelation principle

2 Principals, 1 Agent

Principal 1 private information  $\{t_h, t_l\}$ ,  $P(t_h) = 0.5$

$Y_i = \{I, NI\}$ ,  $M_i = \{a, b\}$

	<i>I</i>	<i>NI</i>
<i>I</i>	4, 3, 3	3, 4, 0
<i>NI</i>	2, 1, 2	1, 2, 1

$t_h$

	<i>I</i>	<i>NI</i>
<i>I</i>	1, 1, 1	1, 2, 0
<i>NI</i>	2, 1, 2	2, 2, 1

$t_l$

- ▶ Direct mechanisms: (*I*, *NI*) on  $t_h$  and (*NI*, *NI*) on  $t_l$
- ▶ Indirect mechanisms: (*I*, *I*) on  $t_h$  and (*NI*, *I*) on  $t_l$

An outcome function implemented with indirect mechanisms **can not be implemented with direct mechanisms**



## Assumption: Weak outcome separability (WOS)

	<i>I</i>	<i>NI</i>
<i>I</i>	4, 3, 2	3, 4, 0
<i>NI</i>	2, 1, 3	1, 2, 1

$t_h$

	<i>I</i>	<i>NI</i>
<i>I</i>	1, 1, 1	1, 2, 0
<i>NI</i>	2, 1, 2	2, 2, 1

$t_l$

## Assumption: Weak outcome separability (WOS)

	<i>I</i>	<i>NI</i>
<i>I</i>	4, 3, 2	3, 4, 0
<i>NI</i>	2, 1, 3	1, 2, 1

$t_h$

	<i>I</i>	<i>NI</i>
<i>I</i>	1, 1, 1	1, 2, 0
<i>NI</i>	2, 1, 2	2, 2, 1

$t_l$

- ▶ **Direct mechanisms:** (*I*, *NI*) on  $t_h$  and (*NI*, *NI*) on  $t_l$
- ▶ **Indirect mechanisms:** (*I*, *NI*) on  $t_h$  and (*NI*, *NI*) on  $t_l$

## Assumption: Weak outcome separability (WOS)

	<i>I</i>	<i>NI</i>
<i>I</i>	4, 3, 2	3, 4, 0
<i>NI</i>	2, 1, 3	1, 2, 1

$t_h$

	<i>I</i>	<i>NI</i>
<i>I</i>	1, 1, 1	1, 2, 0
<i>NI</i>	2, 1, 2	2, 2, 1

$t_l$

- ▶ Direct mechanisms: (*I*, *NI*) on  $t_h$  and (*NI*, *NI*) on  $t_l$
- ▶ Indirect mechanisms: (*I*, *NI*) on  $t_h$  and (*NI*, *NI*) on  $t_l$

Weak outcome Separability (WOS): Agent's preference over one principal's allocation does not depend on the other principal's allocations

## Assumption: Weak outcome separability (WOS)

	<i>I</i>	<i>NI</i>
<i>I</i>	4, 3, 2	3, 4, 0
<i>NI</i>	2, 1, 3	1, 2, 1

$t_h$

	<i>I</i>	<i>NI</i>
<i>I</i>	1, 1, 1	1, 2, 0
<i>NI</i>	2, 1, 2	2, 2, 1

$t_l$

- ▶ Direct mechanisms: (*I*, *NI*) on  $t_h$  and (*NI*, *NI*) on  $t_l$
- ▶ Indirect mechanisms: (*I*, *NI*) on  $t_h$  and (*NI*, *NI*) on  $t_l$

Weak outcome Separability (WOS): Agent's preference over one principal's allocation does not depend on the other principal's allocations

$$U(y_i, y_{-i}, \theta, t) > U(y'_i, y_{-i}, \theta, t) \Rightarrow U(y_i, y'_{-i}, \theta, t) > U(y'_i, y'_{-i}, \theta, t)$$

## Assumption: Weak outcome separability (WOS)

	<i>I</i>	<i>NI</i>
<i>I</i>	4, 3, 2	3, 4, 0
<i>NI</i>	2, 1, 3	1, 2, 1

$t_h$

	<i>I</i>	<i>NI</i>
<i>I</i>	1, 1, 1	1, 2, 0
<i>NI</i>	2, 1, 2	2, 2, 1

$t_l$

- ▶ Direct mechanisms: (*I*, *NI*) on  $t_h$  and (*NI*, *NI*) on  $t_l$
- ▶ Indirect mechanisms: (*I*, *NI*) on  $t_h$  and (*NI*, *NI*) on  $t_l$

Weak outcome Separability (WOS): Agent's preference over one principal's allocation does not depend on the other principal's allocations

$$U(y_i, y_{-i}, \theta, t) > U(y'_i, y_{-i}, \theta, t) \Rightarrow U(y_i, y'_{-i}, \theta, t) > U(y'_i, y'_{-i}, \theta, t)$$

RP is valid

## Example of failure of revelation principle

	<i>I</i>	<i>NI</i>
<i>I</i>	4, 4, 3	1, 2, 2
<i>NI</i>	2, 1, 2	1, 1, 0

$t_h$

	<i>I</i>	<i>NI</i>
<i>I</i>	1, 1, 1	1, 2, 1
<i>NI</i>	2, 1, 1	4, 4, 2

$t_l$

## Example of failure of revelation principle

	<i>I</i>	<i>NI</i>
<i>I</i>	4, 4, 3	1, 2, 2
<i>NI</i>	2, 1, 2	1, 1, 0

$t_h$

	<i>I</i>	<i>NI</i>
<i>I</i>	1, 1, 1	1, 2, 1
<i>NI</i>	2, 1, 1	4, 4, 2

$t_l$

- ▶ **Direct mechanisms:** (*I*, *NI*) on  $t_h$  and (*NI*, *NI*) on  $t_l$
- ▶ **Indirect mechanisms:** (*I*, *I*) on  $t_h$  and (*NI*, *NI*) on  $t_l$

## Example of failure of revelation principle

	<i>I</i>	<i>NI</i>
<i>I</i>	4, 4, 3	1, 2, 2
<i>NI</i>	2, 1, 2	1, 1, 0

$t_h$

	<i>I</i>	<i>NI</i>
<i>I</i>	1, 1, 1	1, 2, 1
<i>NI</i>	2, 1, 1	4, 4, 2

$t_l$

- ▶ Direct mechanisms: (*I*, *NI*) on  $t_h$  and (*NI*, *NI*) on  $t_l$
- ▶ **Indirect mechanisms:** (*I*, *I*) on  $t_h$  and (*NI*, *NI*) on  $t_l$



## Example of failure of revelation principle

	<i>I</i>	<i>NI</i>
<i>I</i>	4, 4, 3	1, 2, 2
<i>NI</i>	2, 1, 2	1, 1, 0

$t_h$

	<i>I</i>	<i>NI</i>
<i>I</i>	1, 1, 1	1, 2, 1
<i>NI</i>	2, 1, 1	4, 4, 2

$t_l$

- ▶ Direct mechanisms: (*I*, *NI*) on  $t_h$  and (*NI*, *NI*) on  $t_l$
- ▶ Indirect mechanisms: (*I*, *I*) on  $t_h$  and (*NI*, *NI*) on  $t_l$

RP **fails**

## Example of failure of revelation principle

	<i>I</i>	<i>NI</i>
<i>I</i>	4, 4, 3	1, 2, 2
<i>NI</i>	2, 1, 2	1, 1, 0

$t_h$

	<i>I</i>	<i>NI</i>
<i>I</i>	1, 1, 1	1, 2, 1
<i>NI</i>	2, 1, 1	4, 4, 2

$t_l$

- ▶ Direct mechanisms: (*I*, *NI*) on  $t_h$  and (*NI*, *NI*) on  $t_l$
- ▶ Indirect mechanisms: (*I*, *I*) on  $t_h$  and (*NI*, *NI*) on  $t_l$

RP **fails**

## Assumption: Weak type separability (WTS)

	<i>I</i>	<i>NI</i>
<i>I</i>	4, 4, 3	1, 2, 2
<i>NI</i>	2, 1, 2	1, 1, 0

$t_h$

	<i>I</i>	<i>NI</i>
<i>I</i>	1, 1, 1	1, 2, 1
<i>NI</i>	2, 1, 2	4, 4, 1

$t_l$

## Assumption: Weak type separability (WTS)

	<i>I</i>	<i>NI</i>
<i>I</i>	4, 4, 3	1, 2, 2
<i>NI</i>	2, 1, 2	1, 1, 0

$t_h$

	<i>I</i>	<i>NI</i>
<i>I</i>	1, 1, 1	1, 2, 1
<i>NI</i>	2, 1, 2	4, 4, 1

$t_l$

Direct mechanisms: (*I*, *NI*) on  $t_h$  and (*NI*, *NI*) on  $t_l$

Indirect mechanisms: (*I*, *NI*) on  $t_h$  and (*NI*, *NI*) on  $t_l$

## Assumption: Weak type separability (WTS)

	<i>I</i>	<i>NI</i>
<i>I</i>	4, 4, 3	1, 2, 2
<i>NI</i>	2, 1, 2	1, 1, 0

$t_h$

	<i>I</i>	<i>NI</i>
<i>I</i>	1, 1, 1	1, 2, 1
<i>NI</i>	2, 1, 2	4, 4, 1

$t_l$

Direct mechanisms: (*I*, *NI*) on  $t_h$  and (*NI*, *NI*) on  $t_l$

Indirect mechanisms: (*I*, *NI*) on  $t_h$  and (*NI*, *NI*) on  $t_l$

Weak type Separability (WTS): Agent's preference over one principal does not depend on the other principal's types

## Assumption: Weak type separability (WTS)

	<i>I</i>	<i>NI</i>
<i>I</i>	4, 4, 3	1, 2, 2
<i>NI</i>	2, 1, 2	1, 1, 0

$t_h$

	<i>I</i>	<i>NI</i>
<i>I</i>	1, 1, 1	1, 2, 1
<i>NI</i>	2, 1, 2	4, 4, 1

$t_l$

Direct mechanisms: (*I*, *NI*) on  $t_h$  and (*NI*, *NI*) on  $t_l$

Indirect mechanisms: (*I*, *NI*) on  $t_h$  and (*NI*, *NI*) on  $t_l$

Weak type Separability (WTS): Agent's preference over one principal does not depend on the other principal's types

$$U(y_i, y_{-i}, \theta, t_i, t_{-i}) > U(y'_i, y_{-i}, \theta, t_i, t_{-i})$$

$\Rightarrow$

$$U(y_i, y_{-i}, \theta, t_i, t'_{-i}) > U(y'_i, y_{-i}, \theta, t_i, t'_{-i})$$

## Assumption: Weak type separability (WTS)

	<i>I</i>	<i>NI</i>
<i>I</i>	4, 4, 3	1, 2, 2
<i>NI</i>	2, 1, 2	1, 1, 0

$t_h$

	<i>I</i>	<i>NI</i>
<i>I</i>	1, 1, 1	1, 2, 1
<i>NI</i>	2, 1, 2	4, 4, 1

$t_l$

Direct mechanisms: (*I*, *NI*) on  $t_h$  and (*NI*, *NI*) on  $t_l$

Indirect mechanisms: (*I*, *NI*) on  $t_h$  and (*NI*, *NI*) on  $t_l$

Weak type Separability (WTS): Agent's preference over one principal does not depend on the other principal's types

$$U(y_i, y_{-i}, \theta, t_i, t_{-i}) > U(y'_i, y_{-i}, \theta, t_i, t_{-i})$$

$\Rightarrow$

$$U(y_i, y_{-i}, \theta, t_i, t'_{-i}) > U(y'_i, y_{-i}, \theta, t_i, t'_{-i})$$

RP Valid

# Weak Revelation Principle (WRP)

Extra assumption:

- ▶ No Indifference (NI): The agent is never indifferent to a change of other principal's allocations

$$U(y_i, y_{-i}, \theta, t) \neq U(y_i, y'_{-i}, \theta, t)$$



# Weak Revelation Principle (WRP)

Extra assumption:

- ▶ No Indifference (NI): The agent is never indifferent to a change of other principal's allocations

$$U(y_i, y_{-i}, \theta, t) \neq U(y_i, y'_{-i}, \theta, t)$$

## Theorem

*Assume WOS, WTS and NI.*

*If  $F$  can be implemented by a PBE using indirect mechanisms, then  $F$  can be implemented by a PBE using IC direct mechanisms*

$$\tilde{\pi}_i : \Theta \rightarrow Y_i$$

## Example Strong Revelation Principle (SRP)

	<i>I</i>	<i>NI</i>
<i>I</i>	4, 4, 3	1, 2, 2
<i>NI</i>	2, 1, 2	1, 1, 0

$t_h$

	<i>I</i>	<i>NI</i>
<i>I</i>	1, 1, 1	1, 2, 1
<i>NI</i>	2, 1, 1	4, 4, 2

$t_l$

- ▶ Indirect mechanisms (*I, I*) on  $t_h$  and (*NI, NI*) on  $t_l$
- ▶ Instead of assuming WTS, we can enlarge the message space of direct mechanisms
- ▶ Principal 2 may need at least two messages, which is the cardinality of the principal 1 type space

# Strong Revelation Principle (SRP)

## Theorem

*Assume OS and NI.*

*If  $F$  can be implemented by a PBE using indirect mechanisms,  
then  $F$  can be implemented by a PBE using IC direct mechanisms*

$$\tilde{\pi}_i : \Theta \times T_{-i} \rightarrow Y_i$$

# Conclusion and Extras

This paper

- ▶ Sufficient conditions for WRP
- ▶ Sufficient conditions for SRP

Extra on the paper:

- ▶ Applications:
  - ▶ Manufacturers competition
  - ▶ Policy delegation
- ▶ Necessity of WOS
- ▶ Robustness of the PBE
- ▶ Non-delegation mechanisms case