Strategy and Politics:
Extensive Form Games with Perfect Information

Matt Golder

Pennsylvania State University

Notes

Sequential Decision-Making

The model of a strategic (normal form) game suppresses the sequential structure of decision-making.

- When applying the model to situations in which players move sequentially, we assume that each player chooses her plan of action once and for all. She is committed to this plan, which she cannot modify as events unfold.

The model of an extensive form game, by contrast, describes the sequential structure of decision-making explicitly, allowing us to study situations in which each player is free to change her mind as events unfold.

Notes

Perfect Information

Perfect information describes a situation in which players are always fully informed about all of the previous actions taken by all players.

This assumption is used in all of the following lecture notes that use "perfect information" in the title.

Later we will also study more general cases where players may only be imperfectly informed about previous actions when choosing an action.

Notes

Extensive Form Games

To describe an extensive form game with perfect information we need to specify the set of **players** and their **preferences**, just as for a strategic game.

In addition, we also need to specify the order of the players' moves and the actions each player may take at each point (or decision node).

We do so by specifying the set of all sequences of actions that can possibly occur, together with the player who moves at each point in each sequence.

We refer to each possible sequence of actions $(a^1, a^2, \dots a^k)$ as a **terminal history** and to the function that denotes the player who moves at each point in each terminal history as the **player function.**

Notes

Extensive Form Games

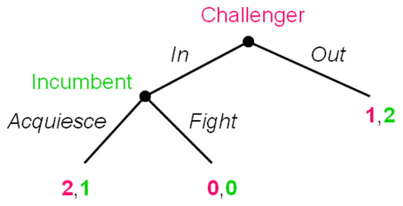
An **extensive game** has four components:

1. Players
2. Terminal histories
3. Player function
4. Preferences for the players

Notes

Extensive Form Game: Example

Figure: Entry Game



This is an extensive form game in which the terminal histories are *(In, Acquiesce)*, *(In, Fight)*, and *Out*, and the player function assigns the challenger to the start of the game and the incumbent to the history *In*.

Notes

Extensive Form Game: Definition

Definition: An **extensive form game with perfect information** consists of

- a set of **players**
- a set of sequences (**terminal histories**) with the property that no sequence is a proper subhistory of any other sequence
- a function (the **player function**) that assigns a player to every sequence that is a proper subhistory of some terminal history
- for each player, **preferences** over the set of terminal histories

Notes

Extensive Form Game: Definition

At the start of an extensive form game, and after any sequence of events, a player chooses an action.

The set of actions available to the players are not, however, explicitly in the description of the game.

Instead, the description of the game simply specifies the set of terminal histories and the player function. And it is from these that we can deduce the available set of actions for all players.

In the Entry Game, for example, the actions available to the challenger at the start of the game are *In* and *Out*, because these actions (and no others) begin terminal histories, and the actions available to the incumbent are *Acquiesce* and *Fight*, because these actions (and no others) follow *In* in terminal histories.

Notes

Histories, Subhistories, and Terminal Histories

The terminal histories of a game are specified as a set of sequences in a game. But not every set of sequences is a legitimate set of terminal histories.

A sequence that is a **proper subhistory** of a terminal history cannot itself be a terminal history.

- This restriction is the only one that we need to impose on a set of sequences in order for the set to be interpretable as a set of terminal histories.

Notes

Histories, Subhistories, and Terminal Histories

The **subhistories** of a finite sequence of $(a^1, a^2, \ldots, a^k)$ of actions include the empty sequence consisting of no actions, denoted $\emptyset$ (the empty history representing the start of the game), and all sequences of the form $(a^1, a^2, \ldots, a^m)$ where $1 \leq m \leq k$. Note that the entire sequence is a subhistory of itself.

A subhistory not equal to the entire sequence is called a **proper subhistory**.

A sequence of actions that is a subhistory of some terminal history is simply called a **history**.

Notes

Histories, Subhistories, and Terminal Histories

Example: Entry Game

- The set of terminal histories are *(In, Acquiesce)*, *(In, Fight)*, and *Out*.
- The subhistories of the terminal history *(In, Acquiesce)* are the empty history $\emptyset$ and the sequences *In* and *(In, Acquiesce)*.
- The proper subhistories of the terminal history *(In, Acquiesce)* are the empty history $\emptyset$ and the sequence *In*.
- What are the subhistories and proper subhistories of the following terminal histories: *(In, Fight)* and *Out*?

Notes

Preferences

As usual, the players' preferences are represented by a payoff function.

Outcomes are typically associated with each terminal history. Players' preferences are naturally defined over these outcomes, rather than directly over the terminal histories.

However, any preferences over outcomes can be translated into preferences over terminal histories.

In the definition of an extensive form game, outcomes are identified with terminal histories and preferences are defined directly over these histories, avoiding the need for an additional element (outcomes) in the specification of the game.

Notes

Extensive Form Game: Entry Game

Description: An incumbent faces the possibility of entry by a challenger.

- The challenger may be a politician competing for the leadership of a party, or a firm considering entry into an industry currently occupied by a monopolist.
- The challenger may *enter* or *stay out*.
- If she enters, the incumbent may either *acquiesce* or *fight*.
- Suppose that the challenger's payoff is 2 if the terminal history is *(In, Acquiesce)*, 1 if it is *Out*, and 0 if it is *(In, Fight)*.
- And, the incumbent's payoff is 2 if the terminal history is *Out*, 1 if it is *(In, Acquiesce)*, and 0 if it is *(In, Fight)*.

Notes

Extensive Form Game: Entry Game

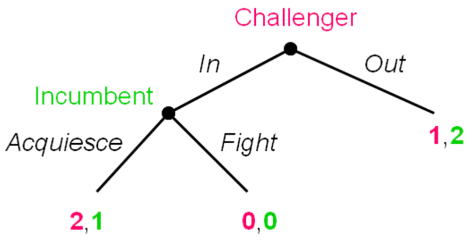
This situation can be modeled as the following extensive form game with perfect information:

- **Players**: The Challenger and the Incumbent
- **Terminal histories**: (In, Acquiesce), (In, Fight), and Out.
- **Player function**: $P(\emptyset) = Challenger$ and $P(In) = Incumbent$.
- **Preferences**: The Challenger's preferences are represented by the payoff function u_1 for which $u_1(In, Acquiesce) = 2$, $u_1(Out) = 1$, and $u_1(In, Fight) = 0$, and the Incumbent's preferences are represented by the payoff function u_2 for which $u_2(Out) = 2$, $u_2(In, Acquiesce) = 1$, and $u_2(In, Fight) = 0$.

Notes

Extensive Form Game: Entry Game

Figure: Entry Game

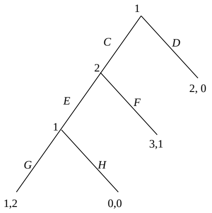


Notes

Strategies and Outcomes

A **strategy** specifies the action a player *i* takes at every history to which the player function assigns *i*.

Figure: Extensive Form Game



Player 1's strategies are (*CG*, *CH*, *DG*, *DH*) and Player 2's strategies are (*E*, *F*).

Notes

Strategies and Outcomes

Note that the definition of a strategy requires that a strategy of any player i specify an action for *every* history after which it is player i's turn to move even for histories that, if the strategy is followed, do not occur.

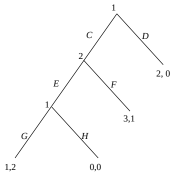
In effect, a strategy is a *plan of action* or *contingency plan*: it indicates the action the player intends to take, whatever the other players do.

Notes

Strategies and Outcomes

An **outcome** of a game is a terminal history induced by a *strategy profile* $s = (s_1, s_2, \ldots s_n)$. We refer to this terminal history as the outcome of strategy profile s, i.e. $O(s)$.

Figure: Extensive Form Game



The strategy profiles $s = (s_1, s_2)$ for this game are *(CG; E)*, *(CG; F)*, *(DG; E)*, *(DG; F)*, *(CH; E)*, *(CH; F)*, *(DH; E)*, and *(DH; F)*.

Notes

Strategies and Outcomes

Table: Strategies, Outcomes, and Payoffs

Strategy Profiles, s	Outcome $O(s)$	Payoff
(CG; E)	CEG	(1,2)
(CG; F)	CF	(3,1)
(DG; E)	D	(2,0)
(DG; F)	D	(2,0)
(CH; E)	CEH	(0,0)
(CH; F)	CF	(3,1)
(DH; E)	D	(2,0)
(DH; F)	D	(2,0)

Note that to determine $O(s)$, we do not need to refer to any component of any player's strategy that specifies her actions after histories precluded by that strategy.

Notes

Nash Equilibrium

The strategy profile s^* in an extensive form game with perfect information is a Nash equilibrium if, for every player i and every strategy r_i, the terminal history $O(s^*)$ generated by s^* is at least as good according to player i's preferences as the terminal history $O(r_i, s^*_{-i})$ in which player i chooses r_i while every other player j chooses s^*_j.

Equivalently, for each player i

$$u_i(O(s^*)) \geq u_i(O(r_i, s^*_{-i})) \quad \text{for every strategy } r_i \text{ of player } i$$

where u_i is a payoff function that represents player i's preferences and O is the outcome function of the game.

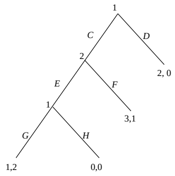
Notes

Nash Equilibrium

One way to find a Nash equilibrium of an extensive form game in which each player has finitely many strategies is to transform it into a normal or strategic form game.

Consider the following extensive form game again.

Figure: Extensive Form Game

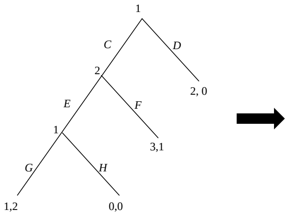


Notes

Nash Equilibrium

One way to find a Nash equilibrium of an extensive form game in which each player has finitely many strategies is to transform it into a normal or strategic form game.

Figure: Extensive Form and Normal Form Game



		2	
		E	F
1	CG	1, **2**	**3**, 1
	CH	0, 0	**3**, **1**
	DG	**2**, **0**	2, **0**
	DH	**2**, **0**	2, **0**

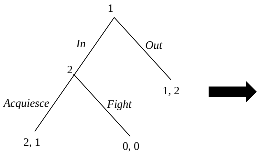
The NE are (*CH; F*), (*DG; E*), and (*DH; E*).

Notes

Nash Equilibrium

Here's another example.

Figure: Extensive Form and Normal Form Game



		2	
		Acquiesce	Fight
1	In	**2**, **1**	0, 0
	Out	1, **2**	**1**, **2**

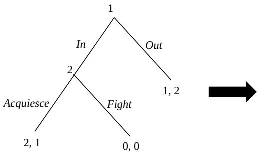
The NE are (*In; Acquiesce*) and (*Out; Fight*).

Notes

Nash Equilibrium

Here's another example.

Figure: Extensive Form and Normal Form Game



		2	
		Acquiesce	Fight
1	In	**2**, **1**	0, 0
	Out	1, **2**	**1**, **2**

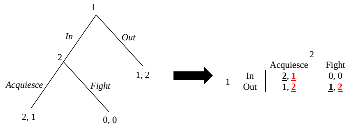
The NE are (*In; Acquiesce*) and (*Out; Fight*).

But think about the NE (*Out; Fight*). Something is weird about it. What is it?

Notes

Nash Equilibrium

Figure: Extensive Form and Normal Form Game



		2	
		Acquiesce	Fight
1	In	2, 1	0, 0
	Out	1, 2	1, 2

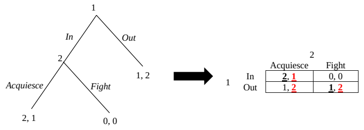
Suppose that the NE is (*Out; Fight*) and that you are Player 1. Why would you think that Player 2 would fight in the part of the game that is never reached?

Player 1 never experiences what Player 2 will do if he does not enter. This obviously causes problems for our steady state interpretation of a Nash equilibrium.

Notes

Nash Equilibrium

Figure: Extensive Form and Normal Form Game



		2	
		Acquiesce	Fight
1	In	2, 1	0, 0
	Out	1, 2	1, 2

Suppose that the NE is (*Out; Fight*) and that you are Player 1. Why would you think that Player 2 would fight in the part of the game that is never reached?

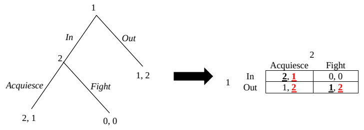
Player 1 never experiences what Player 2 will do if he does not enter. This obviously causes problems for our steady state interpretation of a Nash equilibrium.

To avoid this problem, we can think about a slightly perturbed steady state in which players occasionally make mistakes or experiment. This allows each player to eventually observe every other players' actions after *every* history.

Notes

Nash Equilibrium

Figure: Extensive Form and Normal Form Game



		2	
		Acquiesce	Fight
1	In	2, 1	0, 0
	Out	1, 2	1, 2

But now there is another problem. If Player 1 does decide to experiment and enter, the subsequent behavior of Player 2 – *Fight* – is not a steady state in the remainder of the game.

In other words, Player 2's choice to *Fight* if Player 1 enters is not credible since *Acquiesce* gives a higher payoff at this point.

The desire to avoid this odd equilibria where players have non-credible strategies led to a refinement of the NE concept.

Notes

Subgame Perfect Nash Equilibrium

The notion of a NE ignores the sequential structure of an extensive form game and treats strategies as if they were choices made once and for all.

As a result, the steady state that corresponds to the NE may not be robust.

We now need to build a notion of equilibrium that models a robust steady state.

This is going to require that each players' strategy be optimal, given the other players' strategies, not only at the start of the game but after every possible history.

The refinement we are looking for is called a subgame perfect Nash equilibrium.

Notes

What is a subgame?

Definition: For any nonterminal history h, the **subgame** following h is the part of the game that remains after h has occurred.

The subgame following the empty history $\emptyset$ is the entire game.

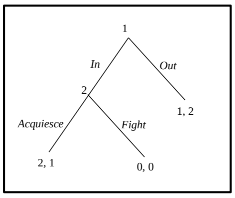
Every other subgame is called a **proper subgame**.

Because there is a subgame for every nonterminal history, the number of subgames is equal to the number of nonterminal histories.

Notes

What is a subgame? Example 1

Figure: Entry Game



First subgame: The entire game itself (i.e., the game after the empty history $\emptyset$).

Notes

What is a subgame? Example 1

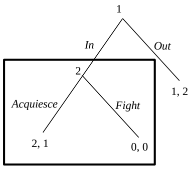


Figure: Entry Game

Second subgame: The remaining game starting with the Player 2's choice after the history *In*. This is a proper subgame!

Notes

What is a subgame? Example 2

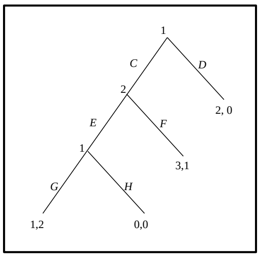


Figure: Subgame 1

First subgame: The entire game itself (i.e., the game after the empty history $\emptyset$).

Notes

What is a subgame? Example 2

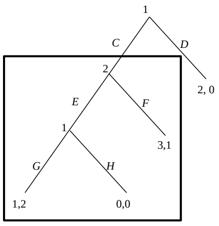


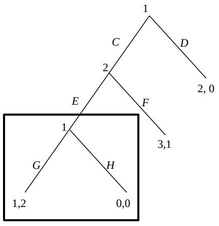
Figure: Subgame 2

Second subgame: The remaining game starting with the Player 2's choice after the history *C*. This is a proper subgame!

Notes

What is a subgame? Example 2

Figure: Subgame 3



Third subgame: The remaining game starting with the Player 1's choice after the history *CE*. This is also a proper subgame!

Notes

Summarizing the Two Examples

The Entry Game has two nonterminal histories, ($\emptyset$, *In*), and hence two subgames: the entire game following the empty history $\emptyset$ and the game following the history *In*.

The second game has three nonterminal histories, ($\emptyset$, *C*, *CE*), and hence three subgames: the entire game following the empty history $\emptyset$, the game following the history *C*, and the game following the history *CE*. The latter two games are proper subgames.

Notes

Subgame Perfect Nash Equilibrium

A subgame perfect Nash equilibrium is a strategy profile s^* with the property that in no subgame can any player i do better by choosing a strategy different from s_i^*, given that every other player j adheres to s_j^*.

Alternatively, a subgame perfect Nash equilibrium is a strategy profile s^* such that

$$u_i(O_h(s^*) \geq u_i(O_h(r_i, s^*_{-i})) \quad \text{for every strategy } r_i \text{ of player } i$$

where $O_h(s)$ is the outcome of the game following history h if all players do s (Note the subscript h).

The key here is that each player's strategy is required to be optimal for every history after which it is the player's turn to move, and not only at the start of the game as with a Nash equilibrium.

Notes

Comparing SPNE and NE

In an SPNE, every player's strategy is optimal after the empty history. As a result, every SPNE is also a NE.

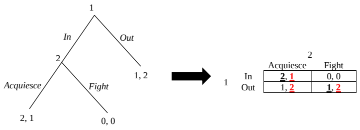
- All SPNE are NE.
- But not all NE are SPNE.

In fact, an SPNE generates a Nash equilibrium in every subgame. Thus, we could define an SPNE as a strategy profile that induces a Nash equilibrium in every subgame.

Notes

The Entry Game Revisited

Figure: Entry Game



		Acquiesce	Fight
1	In	$\underline{2}, \underline{1}$	0, 0
	Out	1, $\underline{2}$	$\underline{1}, \underline{2}$

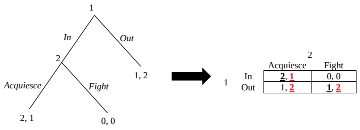
The Entry Game has two pure strategy Nash equilibria: (*In; Acquiesce*) and (*Out; Fight*).

- Is (*Out; Fight*) an SPNE?

Notes

The Entry Game Revisited

Figure: Entry Game



		Acquiesce	Fight
1	In	$\underline{2}, \underline{1}$	0, 0
	Out	1, $\underline{2}$	$\underline{1}, \underline{2}$

The Entry Game has two pure strategy Nash equilibria: (*In; Acquiesce*) and (*Out; Fight*).

- Is (*Out; Fight*) an SPNE?
- No, it is not an SPNE because Player 2 only gets 0 from *Fight* following the history *In* but could get 1 if he chooses *Acquiesce*.

Notes

The Entry Game Revisited

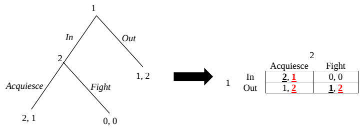


Figure: Entry Game

The Entry Game has two pure strategy Nash equilibria: (*In; Acquiesce*) and (*Out; Fight*).

- Is (*In; Acquiesce*) an SPNE?

Notes

The Entry Game Revisited

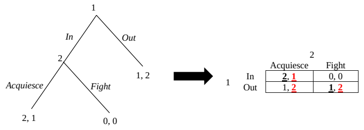


Figure: Entry Game

The Entry Game has two pure strategy Nash equilibria: (*In; Acquiesce*) and (*Out; Fight*).

- Is (*In; Acquiesce*) an SPNE?
- Yes, because
  1. Player 2's strategy to *Acquiesce* following the history *In* is optimal and
  2. Player 1's strategy to choose *In* at the start of the game is optimal given Player 2's choice to Acquiesce following the history *In*.

Notes

Finding SPNE via Backward Induction

One way to find an SPNE of a finite horizon extensive form game is to transform it into a normal form game, find the NE, and then check to see which of the NE are actually SPNE.

An alternative and much simpler approach is to use backward induction.

Define the length of a subgame to be the length of the longest history in the subgame.

Notes

Backward Induction

- Backward induction involves finding the optimal actions of the players who move in the subgames of length 1 (the “last” subgames).
- Then, taken these as given, we find the optimal actions of the players who move first in the subgames of length 2.
- We continue working back to the beginning of the game, at each stage k finding the optimal actions of the players who move at the start of the subgame of length k, given the optimal actions we have found in all shorter subgames.

To identify the optimal actions for the players who move at the start of each subgame, we simply look for the action that provides the highest payoff given the actions chosen by players later in the subgame.

Notes

Finding SPNE via Backward Induction

The set of SPNE of a finite horizon extensive form game with perfect information is equal to the set of strategy profiles isolated by the procedure of backward induction.

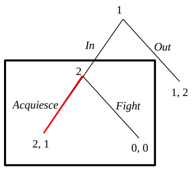
Every finite extensive game with perfect information has an SPNE.

- Note that this result does not claim that a finite extensive game has a single SPNE.

Notes

Finding SPNE via Backward Induction: Example 1

Figure: Entry Game



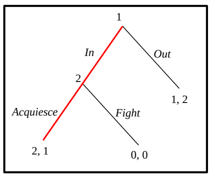
Player 2 is better off by choosing *Acquiesce*, because $u_2(In; Acquiesce) = 1 > u_2(In; Fight) = 0.$

(*Acquiesce*) is the Nash equilibrium of this subgame.

Notes

Finding SPNE via Backward Induction: Example 1

Figure: Entry Game



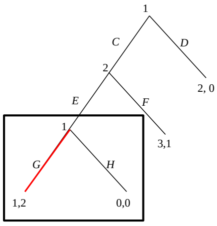
Player 1 is better off by choosing *In*, because
$u_1(In; Acquiesce) = 2 > u_1(Out; Acquiescence) = 1.$

(*In; Acquiesce*) is not only the NE of this subgame but also the unique SPNE.

Notes

Finding SPNE via Backward Induction: Example 2

Figure: Example 2



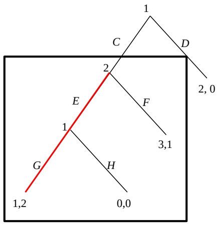
Player 1 is better off by choosing *G*, because
$u_1(CG; E) = 1 > u_1(CH; E) = 0.$

(*G*) is the Nash equilibrium of this subgame.

Notes

Finding SPNE via Backward Induction: Example 2

Figure: Example 2



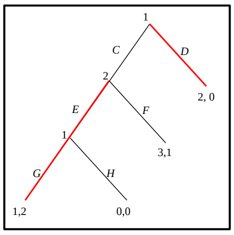
Player 2 is better off by choosing *E*, because $u_2(CG; E) = 2 > u_2(C; F) = 1.$

(*G; E*) is the Nash equilibrium of this subgame.

Notes

Finding SPNE via Backward Induction: Example 2

Figure: Example 2



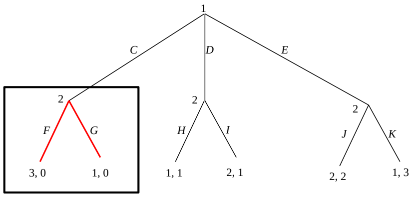
Player 1 is better off by choosing *D*, because $u_1(DG;E) = 2 > u_1(CG;E) = 1$.

(*DG; E*) is not only the NE of this subgame but also the unique SPNE.

Notes

Finding SPNE via Backward Induction: Example 3

Figure: Example 3



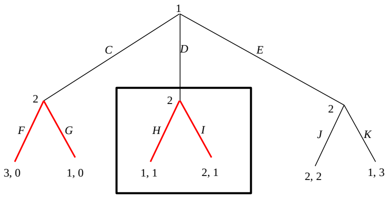
Player 2 will choose either *F* or *G*, because $u_2(C;F) = u_2(C;G) = 0$.

(*F*) and (*G*) are both Nash equilibria in this subgame.

Notes

Finding SPNE via Backward Induction: Example 3

Figure: Example 3



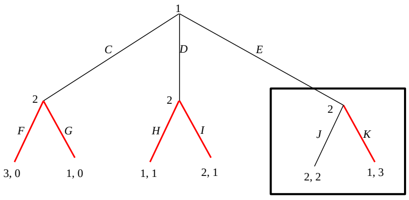
Player 2 will choose either *H* or *I*, because $u_2(D;H) = 1u_2(D;I) = 1$.

(*H*) and (*I*) are both Nash equilibria in this subgame.

Notes

Finding SPNE via Backward Induction: Example 3

Figure: Example 3



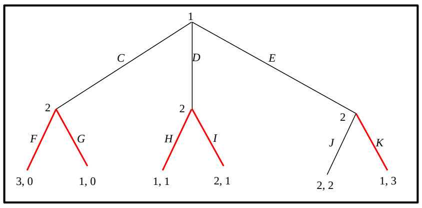
Player 2 will choose *K*, because $u_2(E;K) = 3 > u_2(E;J) = 2$.

(*K*) is the Nash equilibrium in this subgame.

Notes

Finding SPNE via Backward Induction: Example 3

Figure: Example 3



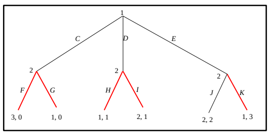
To figure out what is optimal for Player 1, we need to see what is optimal for him for *each* of the optimal strategies for Player 2.

Player 2 has four optimal strategies: *(FHK)*, *(GHK)*, *(FIK)*, and *(GIK)*.

Notes

Strategies and Outcomes

Figure: Example 3



- If Player 2 chooses *(FHK)*, then *C* is optimal for Player 1 because $u_1(C;FHK) = 3 > u_1(D;FHK) = u_1(E;FHK) = 1$.
- If Player 2 chooses *(GHK)*, then *C*, *D*, and *E* are all optimal for Player 1 because $u_1(C;GHK) = u_1(D;GHK) = u_1(E;GHK) = 1$.
- If Player 2 chooses *(FIK)*, then *C* is optimal for Player 1 because $u_1(C;FIK) = 3 > u_1(D;FIK) = u_1(E;FIK) = 1$.
- If Player 2 chooses *(GIK)*, then *D* is optimal for Player 1 because $u_1(D;GIK) = 2 > u_1(C;GIK) = u_1(E;GIK) = 1$.

Notes

Strategies and Outcomes

Table: Strategies, Outcomes, and Payoffs

SPNE	Outcome $O(s)$	Payoff
(C; FHK)	CF	(3,0)
(C; GHK)	CG	(1,0)
(D; GHK)	DH	(1,1)
(E; GHK)	EK	(1,3)
(C; FIK)	CF	(3,0)
(D; GIK)	DI	(2,1)

You could transform the game used in this example into a normal form to check that all 6 SPNE that we have found are also NE.

Notes

Allowing for Simultaneous Moves

It is relatively straightforward to combine sequential and simultaneous moves in an extensive form game.

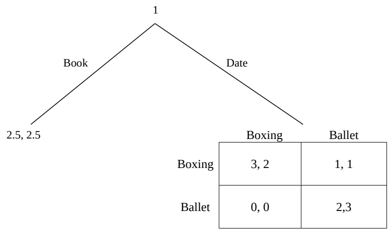
Definition: An **extensive form game with perfect information and simultaneous moves** consists of

- a set of **players**
- a set of sequences (**terminal histories**) with the property that no sequence is a proper subhistory of any other sequence
- a function (the **player function**) that assigns a player to every sequence that is a proper subhistory of some terminal history
- for each proper subhistory h of each terminal history and each player i that is a member of the set of players assigned to h by the player function, a set $A_i(h)$ (the set of **actions** available to player i after the history h)
- for each player, **preferences** over the set of terminal histories

Notes

Variant of Battle of the Sexes

Figure: Variant of Battle of the Sexes



Notes

Variant of Battle of the Sexes

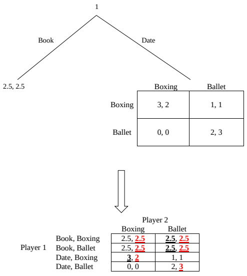
The formal definition of the Variant of Battle of the Sexes is:

- **Players**: Players 1 and 2.
- **Terminal histories**: *Book*, *(Date, (Boxing; Boxing))*, *(Date, (Boxing; Ballet))*, *(Date, (Ballet; Ballet))*, *(Date, (Ballet; Boxing))*.
- **Player function**: $P(\emptyset) = Player1$, $P(Date) = \{Player1, Player2\}$.
- **Actions**: The set of Player 1's actions at the empty history $\emptyset$ is $A_1(\emptyset) = \{Book, Ballet\}$ and the set of her actions after the history *Date* is $A_1(Date) = \{Boxing, Ballet\}$; the set of Player 2's actions after the history *Date* is $A_2(Date) = \{Boxing, Ballet\}$.
- **Preferences**:
  - Player 1 prefers $(Date, (Boxing; Boxing))$ to *Book* to $(Date, (Ballet; Ballet)$ to $(Date, (Boxing; Ballet))$ to $(Date, (Ballet; Boxing))$.
  - Player 2 prefers $(Date, (Ballet; Ballet))$ to *Book* to $(Date, (Boxing; Boxing))$ to $(Date, (Boxing; Ballet))$ to $(Date, (Ballet; Boxing))$.

Notes

Variant of Battle of the Sexes: Finding NE

Figure: Variant of Battle of the Sexes

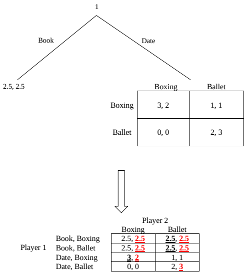


To find the NE, we transform the extensive form game into a normal form game.

Notes

Variant of Battle of the Sexes: Finding NE

Figure: Variant of Battle of the Sexes

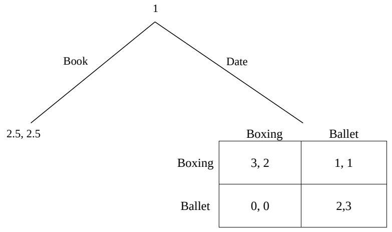


There are 3 NE: $((Book, Boxing); Ballet)$, $((Book, Ballet); Ballet)$, and $((Date, Boxing); Boxing)$.

Notes

Variant of Battle of the Sexes: Finding the SPNE

Figure: Variant of Battle of the Sexes



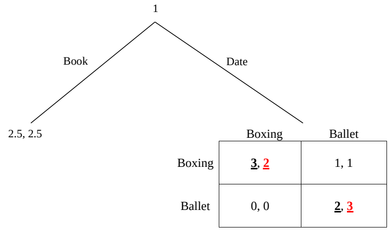
	Boxing	Ballet
Boxing	3, 2	1, 1
Ballet	0, 0	2,3

To find the SPNE, we first identify the subgames. There are two subgames; the first begins at the empty history $\emptyset$ and the second begins after the history *Date*.

Notes

Variant of Battle of the Sexes: Finding the SPNE

Figure: Variant of Battle of the Sexes



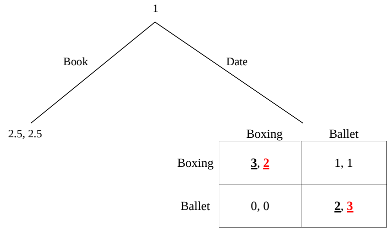
	Boxing	Ballet
Boxing	3, 2	1, 1
Ballet	0, 0	2, 3

To find the SPNE, we first find the NE in the second subgame: (Boxing; Boxing) and (Ballet; Ballet)

Notes

Variant of Battle of the Sexes: Finding the SPNE

Figure: Variant of Battle of the Sexes



	Boxing	Ballet
Boxing	3, 2	1, 1
Ballet	0, 0	2, 3

We now need to find the optimal response for Player 1 to each of the two NE in the second subgame..

There are two SPNE: $((Date, Boxing); Boxing)$ and $((Book, Ballet); Ballet)$.

Notes

What is Politics?

Politics is the subset of human behavior that involves the use of power or influence.

Power is involved when people can't accomplish their goals without:

- Trying to influence the behavior of others.
- Trying to wrestle free of the influence of others.

Notes

Exit, Voice, and Loyalty Game

What do you do when there is a deleterious change in your environment?

- Fuel efficient cars are suddenly imported from Japan.
- The national currency drops in value.
- The Supreme Court rules that prayer in public schools is unconstitutional.
- The quality of peaches at your local fruit stand declines.
- The state decides to outlaw handguns.

These are not necessarily bad for everyone!

Notes

Exit, Voice, and Loyalty Game

Exit

- Accept that there has been a deleterious change in your environment and alter your behavior to achieve the best outcome possible given your new environment.

Voice

- Use your "voice" (complain, protest, lobby, take direct action) to try to change the environment back to its original condition.

Loyalty

- Accept the fact that your environment has changed and make no changes to your behavior.

Notes

Exit, Voice, and Loyalty Game

Figure: EVL

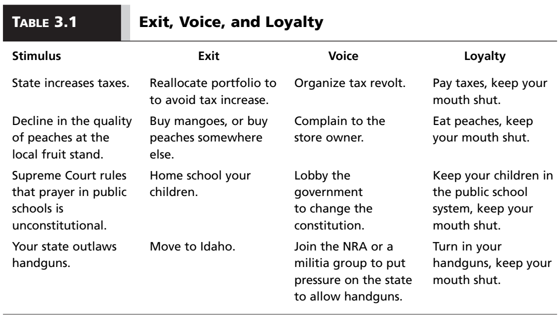


Table 3.1 **Exit, Voice, and Loyalty**

Stimulus	Exit	Voice	Loyalty
State increases taxes.	Reallocate portfolio to to avoid tax increase.	Organize tax revolt.	Pay taxes, keep your mouth shut.
Decline in the quality of peaches at the local fruit stand.	Buy mangoes, or buy peaches somewhere else.	Complain to the store owner.	Eat peaches, keep your mouth shut.
Supreme Court rules that prayer in public schools is unconstitutional.	Home school your children.	Lobby the government to change the constitution.	Keep your children in the public school system, keep your mouth shut.
Your state outlaws handguns.	Move to Idaho.	Join the NRA or a militia group to put pressure on the state to allow handguns.	Turn in your handguns, keep your mouth shut.

Notes

Exit, Voice, and Loyalty Game

Prehistory . . .

- Deleterious shock resulting in a transfer of some benefit from the citizen to the state.
- The deleterious shock might be a tax increase.

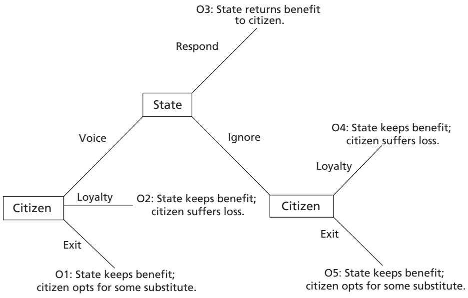
Citizen must decide whether to:

- Accept change and act the same way he or she always has – remain loyal (L).
- Accept change, change one's behavior, and exit (E).
- Try to get benefit back through use of voice (V).

Notes

Exit, Voice, and Loyalty Game

Figure: EVL Game without Payoffs



Notes

Exit, Voice, and Loyalty Game

Figure: Turning Outcomes into Payoffs

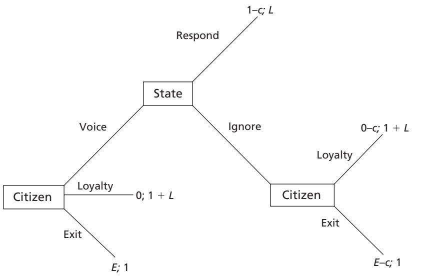
Outcome	Description	Citizen	State
O1	State keeps benefit of new situation; citizen opts for some substitute	*E*	1
O2	State keeps benefit of new situation; citizen suffers loss	0	1 + *L*
O3	State returns benefits to citizen	1 – *c*	*L*
O4	State keeps benefit; citizen suffers loss	0 – *c*	1 + *L*
O5	State keeps benefit but loses support of the citizen; citizen opts for some substitute	*E* – *c*	1

Note: *E* = citizen's exit payoff; 1 = value of benefit taken from the citizen by the state; *L* = state's value from having a loyal citizen who does not exit; *c* = cost of using voice.

Notes

Exit, Voice, and Loyalty Game

Figure: EVL Game with Payoffs



Note: *E* = citizen's exit payoff; 1 = value of benefit taken from the citizen by the state; *L* = state's value from having a loyal citizen who does not exit; *c* = cost of using voice. It is assumed that *c*, *L* > 0, and that *E* < 1 – *c*. The citizen's payoffs are shown first because she is the first player to make a choice; the state's payoffs are shown second. A semicolon separates the payoffs for the players associated with each outcome.

Notes

Exit, Voice, and Loyalty Game

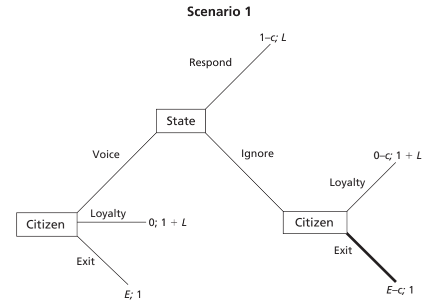
The EVL game is formally defined as:

- **Players**: The Citizen and the State
- **Terminal histories**: (Exit), (Loyalty), (Voice, Respond), (Voice, Ignore, Loyalty), and (Voice, Ignore, Exit).
- **Player function**: $P(\emptyset) = Citizen$, $P(Voice) = State$, and $P(Voice, Ignore) = Citizen$.
- **Preferences**:
  - The Citizen's preferences are represented by the payoff function u_C for which $u_C(Exit) = E$, $u_C(Loyalty) = 0$, $u_C(Voice, Respond) = 1 - c$, $u_C(Voice, Ignore, Loyalty) = 0 - c$, and $u_C(Voice, Ignore, Exit) = E - c$.
  - The State's preferences are represented by the payoff function u_S for which $u_S(Exit) = 1$, $u_S(Loyalty) = L + 1$, $u_S(Voice, Respond) = L$, $u_S(Voice, Ignore, Loyalty) = 1 + L$, and $u_S(Voice, Ignore, Exit) = 1$.

Notes

Exit, Voice, and Loyalty Game: Scenario 1

Figure: Solving the EVL Game when the Citizen has a Credible Exit Threat ($E > 0$): Step One

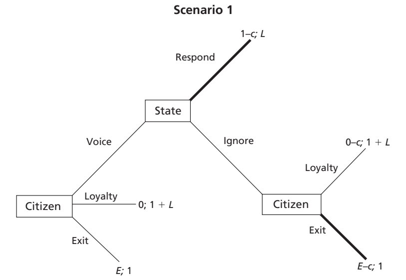


Note: E = citizen's exit payoff; 1 = value of benefit taken from the citizen by the state; L = state's value from having a loyal citizen who does not exit; c = cost of using voice. It is assumed that $c, L > 0$; $E < 1 - c$; $E > 0$.

Notes

Exit, Voice, and Loyalty Game: Scenario 1

Figure: Solving the EVL Game when the Citizen has a Credible Exit Threat ($E > 0$) and the State is Dependent ($L > 1$): Step Two

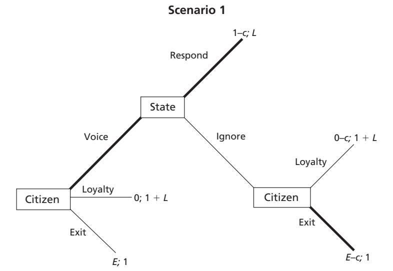


Note: E = citizen's exit payoff; 1 = value of benefit taken from the citizen by the state; L = state's value from having a loyal citizen who does not exit; c = cost of using voice. It is assumed that $c, L > 0$; $E < 1 - c$; $E > 0$; $L > 1$.

Notes

Exit, Voice, and Loyalty Game: Scenario 1

Figure: Solving the EVL Game when the Citizen has a Credible Exit Threat ($E > 0$) and the State is Dependent ($L > 1$): Step Three



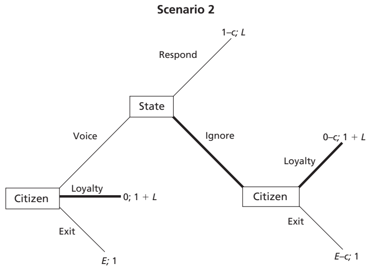
The subgame perfect Nash equilibrium is (Voice, Exit; Respond).

Note: E = citizen's exit payoff; 1 = value of benefit taken from the citizen by the state; L = state's value from having a loyal citizen who does not exit; c = cost of using voice. It is assumed that $c, L > 0$; $E < 1 - c$; $E > 0$; $L > 1$.

Notes

Exit, Voice, and Loyalty Game: Scenario 2

Figure: Solving the EVL Game when the Citizen does not have a Credible Exit Threat $(E < 0)$ and the State is Dependent $(L > 1)$



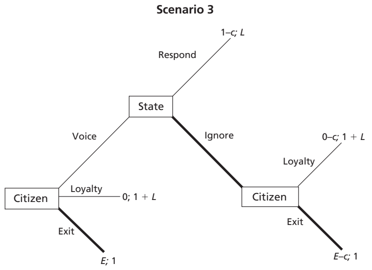
The subgame perfect Nash equilibrium is (Loyalty, Loyalty; Ignore).

Note: E = citizen's exit payoff; 1 = value of benefit taken from the citizen by the state; L = state's value from having a loyal citizen who does not exit; c = cost of using voice. It is assumed that $c, L > 0$; $E < 1 - c$; $E < 0$; $L > 1$.

Notes

Exit, Voice, and Loyalty Game: Scenario 3

Figure: Solving the EVL Game when the Citizen has a Credible Exit Threat $(E > 0)$ and the State is Autonomous $(L < 1)$



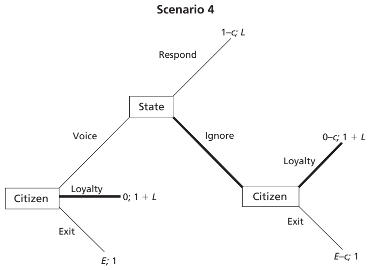
The subgame perfect Nash equilibrium is (Exit, Exit; Ignore).

Note: E = citizen's exit payoff; 1 = value of benefit taken from the citizen by the state; L = state's value from having a loyal citizen who does not exit; c = cost of using voice. It is assumed that $c, L > 0$; $E < 1 - c$; $E > 0$; $L < 1$.

Notes

Exit, Voice, and Loyalty Game: Scenario 4

Figure: Solving the EVL Game when the Citizen does not have a Credible Exit Threat $(E < 0)$ and the State is Autonomous $(L < 1)$



The subgame perfect Nash equilibrium is (Loyalty, Loyalty; Ignore).

Note: E = citizen's exit payoff; 1 = value of benefit taken from the citizen by the state; L = state's value from having a loyal citizen who does not exit; c = cost of using voice. It is assumed that $c, L > 0$; $E < 1 - c$; $E < 0$; $L < 1$.

Notes

Exit, Voice, and Loyalty Game

Figure: Summary of SPNE and Outcomes

The Citizen	**The State** **Is autonomous** **($L < 1$)**	 **Is dependent** **($L > 1$)**
Has a credible exit threat ($E > 0$)	(Exit, Exit; Ignore) Outcome 1	(Voice, Exit; Respond) Outcome 3
Has no credible exit threat ($E < 0$)	(Loyalty, Loyalty; Ignore) Outcome 2	(Loyalty, Loyalty; Ignore) Outcome 2

Notes

Evaluating the EVL Game

The state responds positively to voice only if

1. the citizen has a credible exit threat
   and
2. the state is dependent on the citizen.

Think about what this means for your life!

Notes

Evaluating the EVL Game

The state responds positively to voice only if

1. the citizen has a credible exit threat
   and
2. the state is dependent on the citizen.

Think about what this means for your life!

If the citizen does not have a credible exit threat, then she is a sitting duck!

Notes

Evaluating the EVL Game

It is sometimes difficult to draw inferences from real-world observations.

While it is always possible to infer the citizen's type by observing her actions, this is not the case with the state.

Notes

Evaluating the EVL Game

It is sometimes difficult to draw inferences from real-world observations.

While it is always possible to infer the citizen's type by observing her actions, this is not the case with the state.

Voice, or the lack thereof, cannot be taken as a straightforward revelation of citizen preferences.

Notes

Evaluating the EVL Game

Why would a dependent state ever take a benefit away from citizens with credible exit threats?

Notes

Evaluating the EVL Game

Why would a dependent state ever take a benefit away from citizens with credible exit threats?

It wouldn't!

British PM Margaret Thatcher: "Being powerful is like being a lady. If you have to tell people you are, you aren't."

Notes

Evaluating the EVL Game

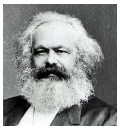
The insight that powerful people never need to use their voice poses a big problem for empirical political science.

When power is most potent, it is least likely to be used.

- Voice ≠ Power.
- Presidential vetos.

Notes

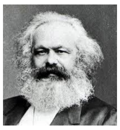
Evaluating the EVL Game



- Structural dependence of the state on capital.

Notes

Evaluating the EVL Game



- Structural dependence of the state on capital.

- Variation in treatment of economic sectors.
- Bailout, click ▸ here

Notes

Evaluating the EVL Game

The model suggests that citizens use voice only when it is effective.

But we often see states ignoring citizens who are protest. Why?

Notes

Evaluating the EVL Game

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But we often see states ignoring citizens who are protest. Why?

1. Voice may be a benefit rather than a cost.

Notes

Evaluating the EVL Game

The model suggests that citizens use voice only when it is effective.

But we often see states ignoring citizens who are protest. Why?

1. Voice may be a benefit rather than a cost.
2. Incomplete information.

Notes

Evaluating the EVL Game

The Exit, Voice, and Loyalty game reveals a lot about what politics is and how it works.

Politics is about using power to influence others while trying to avoid being influenced oneself.

"Voice" and "Exit" should be understood metaphorically here.

- "Exit" may mean emigration, but it may also mean changing industry, production processes, or political parties.
- The actual use of "Voice" might range from a ballot to a bullet.

Notes

Economic Explanations of Democracy

Most economic explanations for democracy can be linked to a family of explanations called "Modernization Theory."

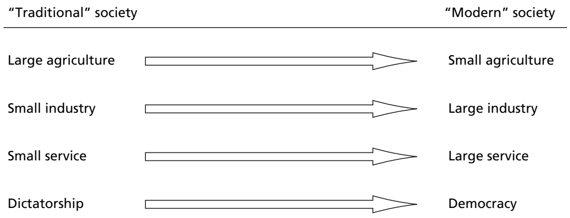
"Stage theory" of development.

- All countries pass through the same historical stages of economic development. Contemporary underdeveloped countries are merely at an earlier stage in this linear historical progress.
- In the 1950s and 1960s, Latin America, Asia, and Africa were seen as just "primitive" versions of European nations. They would eventually "develop" and come to look like Western Europe and the United States.

Notes

Economic Explanations of Democracy

Figure: Classic Modernization Theory

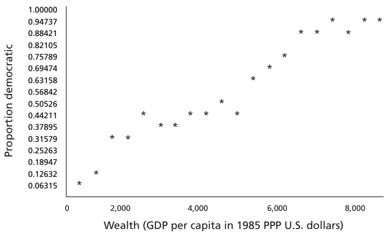


Notes

Economic Explanations of Democracy

Modernization theory predicts that as countries develop economically, they are (a) more likely to become democratic AND (b) more likely to remain democratic.

Figure: Proportion of Democracies at Various Levels of Wealth, 1950-1990



Notes

Economic Explanations of Democracy

We now look at a variant of modernization theory, which says that it is not wealth per se that encourages democratization but rather the changes in the socioeconomic structure that accompany wealth in the modernization process.

According to modernization theory, all societies move through a series of stages.

As they move through these stages, the structure of the economy changes.

Specifically, we see a shift from a focus on agriculture to a focus on manufacturing and services.

Notes

Economic Explanations of Democracy

Many scholars have argued that these structural changes occurred in early modern Europe.

Peasants moved from rural to urban areas and the gentry became increasingly involved in commercial activities in the towns.

Bates and Lien (1985) have argued that these changes played a crucial role in the creation of representative government in England.

Structural changes in the economy produced a shift in economic power away from traditional agricultural elites who controlled easily observable assets to a rising class of wool producers, merchants, and financial intermediaries who controlled assets that were more difficult to observe.

Key point: The state can really tax or predate only on those assets that they can observe (or count).

Notes

Economic Explanations of Democracy

Bates and Lien argue that the increased ability of the gentry to hide their assets from state predation changed the balance of power between modernizing social groups and the traditional seats of power such as the Crown.

The Crown, which needed money, now had to negotiate with the new economic elites to extract revenues.

In return for paying their taxes, the economic elites demanded limits to state predation.

This produced the supremacy of Parliament over the Crown.

Notes

Economic Explanations of Democracy

North and Weingast (1989) present a similar story.

Now that economic actors could hide their assets, the Crown had to find some way to credibly promise not to predate on economic elites.

One way to do this was to give Parliament the power to check the Crown.

This story helps to explain the Glorious Revolution of 1688, which saw the establishment of modern parliamentary democracy in Britain.

Bates and Lien argue that the introduction of this more limited state occurred earlier and more definitively than it did in France because of the unique structure of the economy that early modernization had produced in England.

Notes

Economic Explanations of Democracy

In the prehistory of the game, the Crown has confiscated the assets of a segment of the elite represented by Parliament.

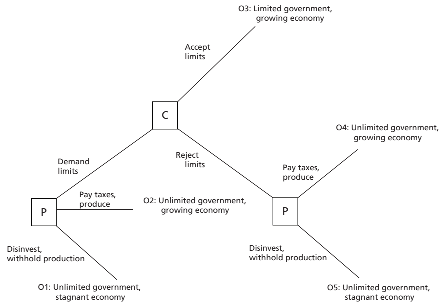
The Parliamentarians are faced with three options.

- **Exit**: Disinvest in the economy.
- **Voice**: Petition the Crown for protections against future confiscations in exchange for a promise to continue investing their assets.
- **Loyal**: Keep investing and paying taxes.

Notes

Economic Explanations of Democracy

Figure: EVL Game between Parliamentarians and Crown

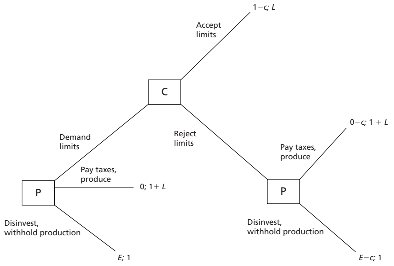


Note: C = Crown; P = Parliamentarians.

Notes

Economic Explanations of Democracy

Figure: EVL Game with Payoffs



Note: C = Crown; P = Parliamentarians; E = Parliamentarians' exit payoff; 1 = value of benefit taken from the Parliamentarians by the Crown; L = Crown's value from having loyal Parliamentarians who do not exit. c = cost of using voice for the Parliamentarians. It is assumed that $c, L > 0$ and that $E < 1 - c$.

Notes

Economic Explanations of Democracy

According to the story we have been telling, the Crown is dependent on the Parliamentarians.

- The Crown needs their money to fight wars and so on.
- This means that $L > 1$.

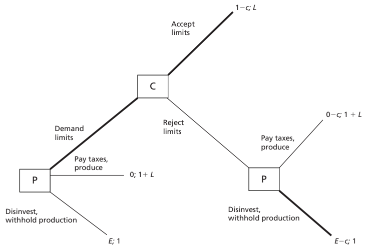
Let's assume for now that Parliamentarians have mobile assets – they can hide their assets.

- They have credible exit threats, that is, $E > 0$.
- This is England in early modern Europe.

Notes

Economic Explanations of Democracy

Figure: Parliamentarians have a Credible Exit Threat and Crown is Dependent



The subgame perfect Nash Equilibrium is (Demand limits, Disinvest; Accept limits).

Note: C = Crown; P = Parliamentarians; E = Parliamentarians' exit payoff; 1 = value of benefit taken from the Parliamentarians by the Crown; L = Crown's value from having loyal Parliamentarians who do not exit; c = cost of using voice for the Parliamentarians. It is assumed that $c, L > 0$; $E < 1 - c$; $E > 0$; and $L > 1$.

Notes

Economic Explanations of Democracy

Let's continue to assume that the Crown is dependent on the Parliamentarians.

But now, let's assume that Parliamentarians do not have mobile assets – they cannot hide their assets.

- They do not have credible exit threats, that is, $E < 0$.

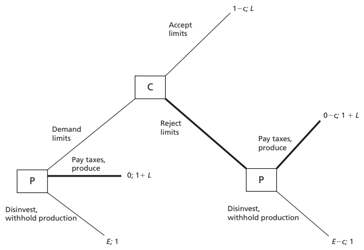
This is France in early modern Europe.

- In France, the modernization process had not gone so far. Traditional agricultural elites were still in power.

Notes

Economic Explanations of Democracy

Figure: Parliamentarians do not have a Credible Exit Threat and Crown is Dependent



The subgame perfect Nash Equilibrium is (Pay taxes, Pay taxes; Reject limits).

Note: C = Crown; P = Parliamentarians; E = Parliamentarians' exit payoff; 1 = value of benefit taken from the Parliamentarians by the Crown; L = Crown's value from having loyal Parliamentarians who do not exit; c = cost of using voice for the Parliamentarians. It is assumed that $c, L > 0$; $E < 1 - c$; $E < 0$; and $L > 1$.

Notes

Economic Explanations of Democracy

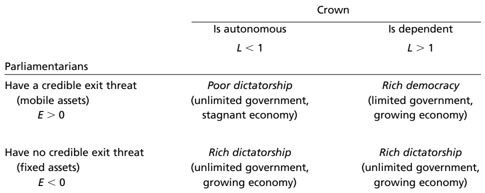
The English monarchy in early modern Europe accepted limits on its predatory behavior because it depended on elites with credible exit threats (mobile assets).

The French monarchy in early modern Europe did not accept limits on its predatory behavior because it depended on elites who did not have credible exit threats (nonmobile assets).

Notes

Economic Explanations of Democracy

Figure: Summary of Outcomes



	Crown	
	Is autonomous $L < 1$	Is dependent $L > 1$
Parliamentarians		
Have a credible exit threat (mobile assets) $E > 0$	*Poor dictatorship* (unlimited government, stagnant economy)	*Rich democracy* (limited government, growing economy)
Have no credible exit threat (fixed assets) $E < 0$	*Rich dictatorship* (unlimited government, growing economy)	*Rich dictatorship* (unlimited government, growing economy)

Notes

Economic Explanations of Democracy

We expect democracy to emerge only when (a) the state is dependent and (b) the elites have credible exit threats.

Representative government is more likely to emerge and survive when the rulers of a country depend on a segment of society consisting of a relatively large number of people holding liquid or mobile assets.

- "No bourgeoisie, No democracy" – Barrington Moore, *Social Origins of Dictatorship and Democracy*.

Notes

Economic Explanations of Democracy

Recall that Hobbes saw the creation of a strong state as a solution to the security dilemma between individuals in the state of nature.

One problem with this solution was that individuals now had to worry about being predated upon by a strong state.

The argument that we have just made suggests that, under some conditions, states will voluntarily agree to limit their predatory behavior.

- Under these conditions, no one need guard the guardian because the guardian will guard itself!

Notes

Economic Explanations of Democracy

The key to the argument is that the state must depend on a group of people with credible exit threats.

A central concept to the viability of exit options is "quasi-rents."

- A quasi-rent is the difference between an asset's value in its best case scenario usage and its value in its second best case scenario usage.
- Examples include oil wells, copper mines, and so on.

This concept allows us to generalize the argument even further.

- It's not just about the mobility of assets – it is also about the type of assets people own.

Notes

Resource Curse

All societies contain some actors who own hard-to-redeploy, or fixed, assets (no credible exit threat).

All societies also contain some actors who own easy-to-redeploy, or liquid, assets (credible exit threat).

Many studies have shown that democracy is less likely to emerge and survive in countries whose economies depend heavily on things like oil production or mineral extraction.

The **resource curse** refers to the paradox that countries with an abundance of natural resources tend to experience things like poor governance, low levels of economic development, civil wars, and dictatorships.

Natural resource curse, click here

Notes

Foreign Aid and Economic Performance

Foreign Aid

- The argument suggests that democracy is unlikely when the state is autonomous and does not depend on its citizens.
- Foreign aid can reduce the dependence of the state on its citizens.
- Numerous studies show that foreign aid to dictatorships harms the welfare of the average citizen in these countries and helps dictators hold on to power.
- Foreign aid curse, 9:39-16:48, click here

Economic Performance

- The argument suggests that democracies should produce reasonably good economic performance.
- In contrast, some dictatorships should have pretty good economic performance and some should have pretty bad economic performance.

Notes

Ultimatum Game

Bargaining over the division of a pie may naturally be modeled as an extensive form game.

Here, we analyze a very simple game that is the basis of many ‘richer’ models.

The model is so simple, in fact, that you may not initially think of it as a model of bargaining.

Notes

Ultimatum Game

Two people use the following procedure to split some amount of money $c.

First, Player 1 offers Player 2 an amount of money up to $c.

Then if Player 2 accepts this offer, then Player 1 receives the remainder of the $c.

But if Player 2 rejects the offer, then neither player receives any payoff.

We assume that each player cares only about the money that they themselves receive, and that they prefer to receive as much as possible.

Assume that the amount Player 1 offers can be any number, not necessarily an integral number of cents.

Notes

Ultimatum Game

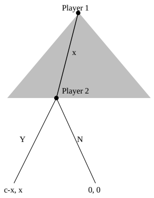
The Ultimatum Game is formally defined as:

- **Players**: Player 1 and Player 2
- **Terminal histories**: The set of all sequences *(x, Z)*, where x is a number with $0 \leq x \leq c$ (the amount of money that Player 1 offers to Player 2) and *Z* is either *Y* ("yes, I accept") or *N* ("no, I reject").
- **Player function**: $P(\emptyset) = Player\ 1$ and $P(x) = Player\ 2$ for all x.
- **Preferences**: Each player's preferences are represented by payoffs equal to the amounts of money she receives. For the terminal history *(x, Y)*, Player 1 receives $c - x$ and Player 2 receives x. For the terminal history *(x, N)* each player receives 0. Each player prefers more money to less money.

Notes

Ultimatum Game

Figure: Ultimatum Game



The continuum of possible offers of Player 1 is represented by the gray triangle, and the black lines indicate the terminal histories that start with offer x.

The game has a finite horizon, so we can use backward induction to find its SPNE.

Notes

Ultimatum Game

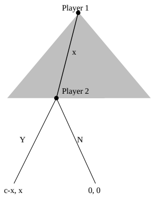


Figure: Ultimatum Game

First, consider the subgames, in which Player 2 either accepts or rejects an offer of Player 1.

For every possible offer of Player 1, there is such a subgame.

Notes

Ultimatum Game

In the subgame that follows an offer x of Player 1 for which $x > 0$, Player 2's optimal action is to accept (if she rejects, she gets nothing).

In the subgame that follows the offer $x = 0$, Player 2 is indifferent between accepting and rejecting.

Thus, in an SPNE Player 2's strategy either accepts all offers (including 0), or accepts all offers $x > 0$ and rejects the offer $x = 0$.

Now consider the whole game. For each possible SPNE strategy of Player 2, we need to find the optimal strategy of Player 1.

Notes

Ultimatum Game

1. If Player 2 accepts all offers (including 0), then Player 1's optimal offer is 0 (which yields her the payoff $c).
2. If player 2 accepts all offers except zero, then no offer of Player 1 is optimal (recall that x represents a continuum of offers)!
    - No offer $x > 0$ is optimal, because the offer $\frac{x}{2}$ (for example) is better, given that Player 2 accepts both offers.
    - And an offer of 0 is not optimal because Player 2 rejects it, leading to a payoff of 0 for Player 1, who is thus better off offering any positive amount less than $c.

We conclude that the only SPNE of the Ultimatum Game is the strategy pair in which Player 1 offers 0 and Player 2 accepts all offers.

In this equilibrium, Player 1's payoff is $c and Player 2's payoff is 0.

Notes

Ultimatum Game

There are actually many NE for the Ultimatum Game.

Indeed, there is an NE for *every* amount x that Player 1 offers.

For example, for any value of x there is a Nash equilibrium in which Player 1's strategy is to offer x and Player 2's strategy is to accept x and any offer more favorable, and reject every other offer.

Argument: Given Player 2's strategy, Player 1 can do no better than offer x. Given player 1's strategy, Player 2 should accept x.

Notes

Ultimatum Game

We can now look at the Ultimatum Game in which we have *indivisible units*.

In this case each player has finitely many actions, and for both possible SPNE strategies of Player 2 there is an optimal strategy for Player 1.

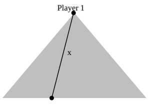
1. If Player 2 accepts all offers, then Player 1's best strategy is to offer 0, as before.
2. If player 2 accepts all offers except 0, then Player 1's best strategy is to offer one cent (which Player 2 accepts).

Thus, the game has two SPNE: one in which Player 1 offers 0 and Player 2 accepts all offers, and one in which Player 1 offers one cent and Player 2 accepts all offers except 0.

Notes

Dictator Game

Figure: Dictator Game



The Dictator Game is exactly the same as the Ultimatum Game except that Player 2 is not given an opportunity to accept or reject the offer.

It is easy to see that the optimal strategy of Player 1 in this game is to offer 0, with payoffs ($c, 0).

Notes

Experiments

Social scientists have used laboratory experiments to examine how people play the Ultimatum and Dictator Games.

The Dictator Game offers an interesting contrast to the Ultimatum Game because it allows the analyst to see if a proposer (Player 1) makes a positive offer out of a "sense of fairness" or a "fear of rejection."

Notes

Experiments

These games have been played in numerous experimental settings using students in virtually all of the industrialized democracies of the world.

Proposers nearly always make positive offers.

- Mean offer is 44 percent. Modal offer is nearly 50 percent.

Responders reject a lot of positive offers, especially if they are low.

- Offers of less than 20 percent are rejected with 40-60 percent probability.

Ultimatum Game (Numbers), click ▸ here

Ultimatum Game (Kids), click ▸ here

Notes

Experiments

Several scholars wondered whether these deviations from the theoretical predictions were evidence of a universal pattern of human behavior or whether the deviations varied with an individual's economic and cultural setting.

Do some cultures exhibit behavior that more closely resembles the theoretical predictions than others?

Notes

Experiments

Several scholars wondered whether these deviations from the theoretical predictions were evidence of a universal pattern of human behavior or whether the deviations varied with an individual's economic and cultural setting.

Do some cultures exhibit behavior that more closely resembles the theoretical predictions than others?

So, they examined 15 small-scale societies in 12 countries on 5 continents

- 3 foraging societies
- 6 slash-and-burn horticulture societies
- 4 nomadic herding groups
- 2 sedentary, small-scale agriculture societies

These societies exhibited a wide range of cultural and economic environments.

Notes

Experiments

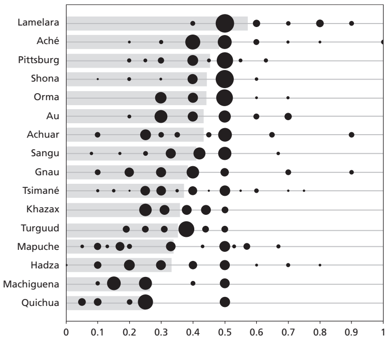
Figure: 15 Small-Scale Societies

Group	Country	Environment	Economic base
Machiguenga	Peru	Tropical forest	Horticulture
Quichua	Ecuador	Tropical forest	Horticulture
Achuar	Ecuador	Tropical forest	Horticulture
Hadza	Tanzania	Savanna-woodlands	Foraging
Aché	Paraguay	Semi-tropical woodlands	Horticulture and foraging
Tsimané	Bolivia	Tropical forest	Horticulture
Au	Papua New Guinea	Mountainous tropical forest	Foraging and horticulture
Gnau	Papua New Guinea	Mountainous tropical forest	Foraging and horticulture
Mapuche	Chile	Temperate plains	Small-scale farming
Torguud	Mongolia	High altitude desert, seasonally flooded grassland	Pastoralism
Khazax	Mongolia	High-altitude desert, seasonally flooded grassland	Pastoralism
Sangu (farm/herd)	Tanzania	Savanna-woodlands, seasonally flooded grassland	Agro-pastoralists
Orma	Kenya	Savanna-woodlands	Pastoralism
Lamelara	Indonesia	Tropical island coast	Foraging-trade
Shona	Zimbabwe	Savanna-woodlands	Farming

Notes

Experiments

Figure: Offers from an Ultimatum Game



Source: Henrich et al. 2004.

Note: The size of the bubble at each location along each row represents the proportion of the sample that made a particular offer. The right edge of the lightly shaded horizontal gray bar gives the mean offer for that group.

Notes

Experiments

All groups had mean offer of at least 25 percent.

Much greater variation in offers.

- Mean offers range from 26 to 58 percent. Modes range from 15 to 50 percent.

Rejection rates also offer more variation.

- Machiguenga rejected only one offer despite the fact that 75 percent of offers were below 30 percent.

Notes

Experiments

50 percent of offers made by Tsimane were below 30 percent. Machiguenga had mean offer of 0.26.

- Tsimane and Machiguenga rarely work together and are almost entirely economically independent at the family level.

Lamelara are whale hunters and hunt together.

- Lamelara had mean offer of 58 percent.

Notes

Experiments

Au and Gnau in PNG rejected both unfair and hyper-fair offers. Some groups rejected high offers.

- Reflects culture of gift giving in these societies. Accepting gifts commits one to reciprocate at some future time to be determined by the giver. Thus, excessively large gifts likely to be rejected.

Hadza make low offers and have high rejection rates (rejected 24 percent of all offers, and 43 percent of offers less than 20 percent).

- Reluctance to share – “tolerated theft.”

Notes

Experiments

How might we explain these results?

Notes

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Maybe it has to do with the individual characteristics of the players such as age, gender, wealth, education.

But none of these factors was found to be important.

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Experiments

How might we explain these results?

Maybe it has to do with the individual characteristics of the players such as age, gender, wealth, education.

But none of these factors was found to be important.

What about social institutions or cultural norms of fairness?

- **Payoffs to cooperation** – How important and how large is a group's payoff from cooperation in economic production with non-immediate kin?
- **Market integration** – How much do people rely on market exchange in their everyday lives?

Notes

Experiments

Payoffs to cooperation

- Machiguenga and Tsimane were lowest.
- Lamelara were ranked highest.

Market integration

- Hadza were ranked lowest.
- Orma were ranked highest – buy and sell livestock.

Higher market integration and payoffs to cooperation led to higher mean offers.

- Account for 66 percent of variance.

Notes

Experiments: An Explanation?

When faced with novel situation, they look for analogs in their daily experience, saying, “what familiar situation is this like?” and then they act in a way appropriate for analogous situation.

Culture is perhaps a shared way of playing games. Life is made up of lots of strategic situations and our culture affects how we play in these games.

Notes

Delegation

Delegation is an act where one person or group, called the **principal**, relies on another person or group, called an **agent**, to act on the principal’s behalf.

Delegation allows principals to accomplish desired ends with reduced personal cost and effort.

Delegation allows principals to benefit from expertise and abilities of others, but can be perilous since it always involves a transfer of power.

- Delegation entails the possibility of conflicting interests.
- Delegations contains the possibility of limited information.

Notes

Delegation

Table: Delegation Chain in Parliamentary Democracies

Principal	Agent
Voter	Member of Parliament
Member of Parliament	Government
Government	Cabinet Ministers
Cabinet Ministers	Civil Service
Civil Service	Civil Service Employees

Notes

Delegation Outcomes

We can think of delegation outcomes in terms of (i) agency loss or (ii) whether delegation is successful.

Agency loss is the difference between the actual consequence of delegation and what the consequence would have been had the agent been perfect.

- A perfect agent is one that does what a principal would have done had the principal been the agent.
- Agency loss describes the delegation outcomes from the principal's perspective.

Notes

Delegation Outcomes

We can think of delegation outcomes in terms of (i) agency loss or (ii) whether delegation is successful.

Delegation is considered **successful** if the delegation outcome improves the principal's welfare relative to what would have happened if the principal had chosen not to delegate.

- The principal's inaction is often called the status quo or reversion point.
- Did delegation make the principal better off compared to the SQ?

Notes

Principal-Agent Game

We're going to look somewhat informally at a simple Principal-Agent Game.

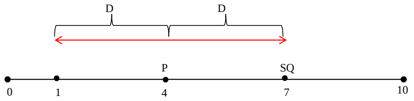
- **Players**: Agent and Principal
- **Terminal histories**: The set of all sequences *(p, Z)*, where p is a policy position i.e. a real number on a one-dimensional policy space given by the set [0, 10] and *Z* is either *Y* ("yes, I accept the policy p") or *N* ("no, I reinstate the status quo, $p_{SQ} = SQ$").
- **Player function**: $P(\emptyset) = Agent$ and $P(p) = Principal$ for all p.
- **Preferences**: Each player has single-peaked preferences indicating their ideal policy position $x_i \in \{A, P\}$ on a one-dimensional policy space given by the set [0, 10]. Player i receives his highest utility (payoff) if the policy p is equal to her ideal point x_i. The further away policy p is from her ideal position x_i, the lower is her payoff. We can represent such preferences by the following utility function, $u_i(x_i, p) = -|x_i - p|$.

To keep things simple, we will assume that the Principal chooses Y when she is indifferent between p and p_{SQ} i.e. SQ.

Notes

Principal-Agent Game

Figure: Principal-Agent Game

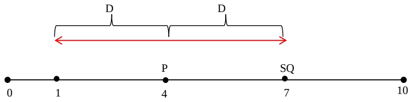


What is the range of policies p acceptable to the Principal?

Notes

Principal-Agent Game

Figure: Principal-Agent Game



What is the range of policies p acceptable to the Principal?

If D is the absolute distance between P and SQ, then the range of policies acceptable to the Principal is the set of policies from $(P - D)$ to $(P + D)$.

In this example, the set of policies that the Principal prefers to the SQ ranges from 1 to 7.

Notes

Principal-Agent Game

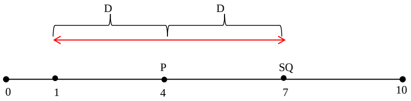


Figure: Principal-Agent Game

If the Agent proposes a policy, p, in the set [1, 7], then the optimal strategy of the Principal is Y.

If the Agent proposes a policy, p, outside the set [1, 7], then the optimal strategy of the Principal is N.

The distance between P and the policy, p, chosen by the Agent is the agency loss.

Notes

Principal-Agent Game: Scenario 1

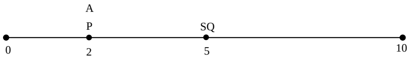


Figure: Principal-Agent Game: Scenario 1

In this example, the Principal and Agent have the same ideal point, x.

- Range of policies acceptable to the Principal: -1 to 5
- Policy proposed by Agent: 2
- SPNE: (2; Y)
- Final Policy Outcome: 2
- Agency loss: 0

Notes

Principal-Agent Game: Scenario 2a

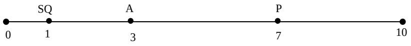


Figure: Principal-Agent Game: 2a

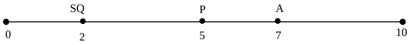
In this example, the Principal and the Agent do not have identical ideal policies, but they agree on the direction in which policy should be moved.

- Range of policies acceptable to the Principal: 1 to 13
- Policy proposed by Agent: 3
- SPNE: (3; Y)
- Final Policy Outcome: 3
- Agency loss: 4

Notes

Principal-Agent Game: Scenario 2b

Figure: Principal-Agent Game: Scenario 2b



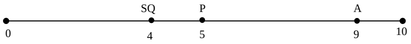
In this example, the Principal and the Agent do not have identical ideal policies, but they agree on the direction in which policy should be moved.

- Range of policies acceptable to the Principal: 2 to 8
- Policy proposed by Agent: 7
- SPNE: (7; Y)
- Final Policy Outcome: 7
- Agency loss: 2

Notes

Principal-Agent Game: Scenario 3

Figure: Principal-Agent Game: Scenario 3



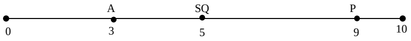
In this example, the Principal and the Agent do not have identical ideal policies, but they agree on the direction in which policy should be moved.

- Range of policies acceptable to the Principal: 4 to 6
- Policy proposed by Agent: 6
- SPNE: (6; Y)
- Final Policy Outcome: 6
- Agency loss: 1

Notes

Principal-Agent Game: Scenario 4

Figure: Principal-Agent Game: Scenario 4



In this example, the principal and the agent do not have identical ideal policies, and they do not even agree on the direction in which policy should be moved.

- Range of policies acceptable to the Principal: 5 to 13
- Policy proposed by Agent: 5 i.e. SQ
- SPNE: (5; Y) and (Anything outside acceptable range for Principal; N)
- Final Policy Outcome: 5 i.e. SQ
- Agency loss: 4

Notes

Principal-Agent Game: Overview

Power of the agenda setter is not unconditional – sometimes she has no power to move the status quo, sometimes she has unlimited power to choose her own preferred policy, other times she has only limited power.

The principal (P) suffers varying amounts of agency loss in each situation.

Notes

Information

One of the key assumptions underlying the Principal-Agent game is that of complete information.

In reality, information is often incomplete and asymmetric.

We generally assume that agents have more information than principals. Why?

Notes

Information

When principals have less information than agents, we typically have two types of problems.

1. **Moral hazard:** Actions are unobserved.
    - *Insurance policy* – people take riskier actions once they have a life insurance policy.
2. **Adverse selection:** Types are unobserved.
    - *Health insurance* – only sick people will sign up and these will pretend to be healthy
    - *Market for lemons* – car dealer is trying to sell you a bad car
    - *Public spirited candidates and corrupt candidates* – if voters only want to elect public spirited candidates, then all candidate will pretend to be public spirited. How do you tell the difference?

Notes

Moral Hazard

If there is moral hazard and principal cannot see actions of agent, then agent will always choose his own ideal point.

Knowing this, the only question the principal will ask is whether the agent's ideal point is better than the SQ.

Moral hazard can increase agency loss.

Notes

Adverse Selection

Adverse selection entails a principal lacking information about her agent's skills and preferences.

Agent might be unwilling to pursue principal's interests because she has conflicting preferences.

But an agent may also lack the resources or skills to do what the principal wants.

Principals would like to know both whether the agent is willing and able.

Notes

Institutions

Ex ante mechanisms help principals to learn about their agents before they act, typically as they select particular individuals to serve as their agents.

- These mechanisms are useful if principal anticipates adverse selection problems.

Ex post mechanisms help principals to learn about their agents actions after the fact.

- These mechanisms are useful if principal anticipates moral hazard problems.

Notes

Ex Ante Mechanisms

Screening

- Could use competition to get agents to reveal stuff about themselves to signal their willingness and ability to serve.
- But there can still be moral hazard problems if principal can't observe what agents do. Plus, if agents are uncertain about their ability, they might overstate or understate their desire for the job.
- Competition might lead to inefficiency and duplication.

Notes

Ex Ante Mechanisms

Selection

- *Signaling models* – actors might take costly actions, such as taking a firm public stance on an issue, that signals their type to the principal.
- *Education* – employer prefers to hire a skilled worker but cannot identify skill level. Skilled workers can obtain education with less effort than skilled workers. This acts as a signal to employers.

Contract Design

- Can write a detailed contract

Notes

Ex Post Mechanisms

Fire Alarms

- Rely on information from others about what the agent is doing.
- Governments sometimes hold public hearings on agency actions.
- But need to know that the third party has common interests.
- Cheaper.

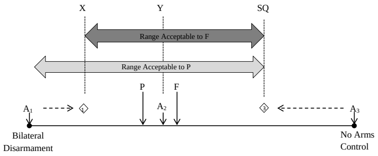
Police Patrols

- Principals can actually monitor what the agents are doing.
- Costly and can lead to bureaucratic capture.

Notes

Constraining Agents

Figure: Constraining Agents



The Principal is considering making an arms control arrangement with the leader of a foreign country.

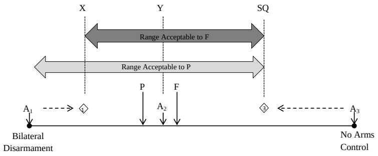
The Principal's ideal point is P, the foreign leader's ideal point is F, and the status quo is SQ.

Assume that there are three possible agents, A_1, A_2, and A_3, who are supposed to represent the interests of the Principal.

Notes

Constraining Agents

Figure: Constraining Agents



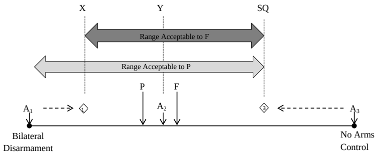
Assume that the Principal does not know F, A_1, A_2, or A_3.

Assume that each agent knows F.

Notes

Constraining Agents

Figure: Constraining Agents



Since A_1 knows F, A_1 will propose X.

But what does the Principal infer from this?

Notes

Constraining Agents

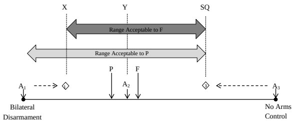


Figure: Constraining Agents

The Principal will not accept A_1's recommendation.

- If F is to the left of P, then the Principal knows that he can choose P or X.
- If F is to the right of P and to the left of SQ, then the Principal knows from A_1's recommendation that F must be close enough to P that X is acceptable.
- If F is to the right of the SQ, then no change to SQ is possible.
- So, if any agent proposes to the left of P, then the Principal knows that he can propose P.

Notes

Constraining Agents

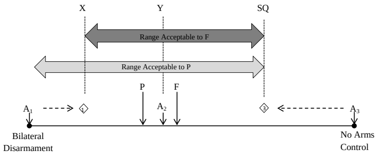


Figure: Constraining Agents

Thus, A_1 cannot fool the Principal into accepting more extreme terms than the Principal wants, even though the Principal does not know A_1's ideal point or F.

Notes

Constraining Agents

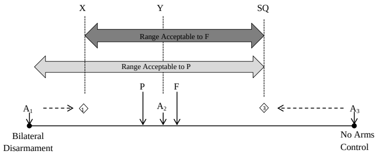


Figure: Constraining Agents

Since A_2 knows F, A_2 will propose Y.

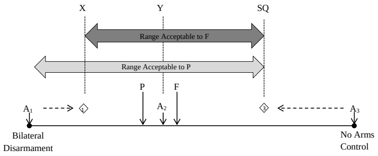
In this case, the Principal accepts A_2's recommendation.

The Principal cannot tell that A_2 has deviated from what the Principal would have done.

Notes

Constraining Agents

Figure: Constraining Agents



Since A_3 knows F, A_3 will propose SQ.

The Principal can infer that either A_3 prefers no deal to a treaty or F does not want a treaty at all.

If the cost of proposing a new treaty and having it rejected is high, the Principal will probably follow A_3's advice; if the cost is low, the Principal does not lose in proposing his ideal point, P.

Notes

Constraining Agents

This analysis reveals that agents are limited in what they can get away with even when the principal has no information other than what he is told by his agents.

A_1 cannot generate a treaty proposal that is further left than the Principal's ideal point.

A_3 cannot generate one that is further to the right than the SQ.

Only A_2 is able to generate a proposal that is not the SQ and that is neither F nor P.

It turns out that the agent in the best position to advance his own self-interest is the one whose preference overlaps that which the Principal is willing to accept.

Notes

Constraining Agents

If A_1, A_2, and A_3 were all agents of the Principal simultaneously, then the Principal would gain additional leverage even though the information conditions remain the same.

Using the recommendations from all three agents in this example, the Principal can learn about the range of treaties acceptable to the foreign leader and realize that he can successfully propose his ideal point, P.

By having redundant agents all over the map, the Principal has increased his odds of receiving reliable information that allows him to maximize his own interests.

Notes

Constraining Agents

Even if all three agents were located between P and SQ, the Principal might not realize that he can choose P but he'd choose the recommendation that was closest to his ideal point i.e. the one from A_2.

An implication from this is that the most effective advisers are those who generally agree with the principal.

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