# EC315 Topics in Microeconomics with Cross-Section Econometrics Coursework Summary

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# 1 Exam Summary

## 1.1 Cost-Benefit Analysis Summary

1. Purpose
2. Alternatives
3. Who
4. C/B Impacts
5. Lifetime Impacts
6. Monetize:
    - *Social Cost*: harm done to living organisms
    - *Revealed/Stated Preference*: willingness to pay or willingness to accept
        - Revealed: shown in behaviour
        - Stated: questionnaires etc.
    - *Time*:
        - Work vs leisure using wage rate
        - Travel time; how much people are willing to trade-off
    - *Lives*: life expectancy, pay, age, risks taken
    - *Natural Resources*: AONBs, surveys, investment, regulation
7. PV Discounts
    - Social discount rate
    - Intergenerational (more than 50 years)
8. NPV of Alternatives
9. Sensitivity Analysis
10. Recommend

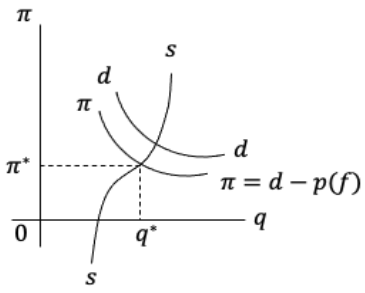
## 1.2 Program & Policy Evaluation Summary

Cause $\longrightarrow$ Intermediaries $\longrightarrow$ Effect

1. Omitted Variable Bias
    - Selection Bias: e.g. grades, income, area of ogigin
    - Selection Bias 2: e.g. effort, determination, stamina
2. Randomized Control Trial
    - Unbiased Estimator: $\bar{x} \longrightarrow \bar{\mu}$ (LLN)
    - Unbiased Estimator: randomization
    - $\sigma^2$: "how much of the result is due to chance?"
    - t-tests: causal effect; $(\bar{Y}^T - \bar{Y}^C)$
3. Regression
    - Dummy Variables: causal variable / group
    - Instrumental Variables: omitted variables ($\alpha$ corr. w/ $\varepsilon$)

## 1.3 Crime & Punishment Summary

1. Supply: $\pi_t = \pi_i - c_i - w_i - p_i(f_i)$
    - $i$ = Individual
    - $\pi_t$ = Net Total Payoff of Crime
    - $\pi_i$ = Expected Payoff Per Offense (Minus Costs)
    - $c_i$ = Cost Incurred if Caught
    - $w_i$ = Wage Rate From Non-Criminal Work
    - $p_i$ = Probability of Aprehension & Conviction
    - $f_i$ = Punishment in Convicted
2. Normal Distribution
    - Req. $\uparrow \pi$, $\uparrow \delta$, $[\bar{x} \rightarrow$ (Right of Mean)]
    - Req. $\downarrow \pi$, $\downarrow \delta$, $[\leftarrow \bar{x}$(Left of Mean)]
    - Morals, enjoyment, risk, some demand for significantly higher payoffs etc. effect decision
3. Demand: $e_i f(v_r, v_l); q$
    - $e_i$ = Expenditure on Protection
    - $v_r$ = Risk of Victimization
    - $v_l$ = Loss of Victim
    - $q$ = Total Crime
4. Derivatives
    - $\frac{\partial e_i}{\partial v_i} > 0$: Risk $\uparrow$, Expenditure $\uparrow$
    - $\frac{\partial c_i}{\partial e_i} < 0$: Expenditure $\uparrow$, Cost $\uparrow$
    - $\frac{\partial \pi_i}{\partial c_i} < 0$: Cost $\uparrow$, Payoff $\downarrow$
5. Supply / Demand

- 

- $ss$ = Supply of Crime
- $dd$ = Initial Demand
- $\pi\pi$ = Demand After Government Intervention ($T$)
- $MC$ of Catching Last Criminal $> MB$ $[\leftarrow \pi^*,\ q^*]$
- $MC$ of Catching Last Criminal $< MB$ $[\pi^*,\ q^* \rightarrow]$

## 1.4 Exam Arithmetic Summary

1. $\pi_A = x_A p_A(x_A + x_B) - x_A$
2. $J = \pi_A + \pi_B$; $\frac{\partial J}{\partial x_A} = \frac{\partial \pi_A}{\partial x_A} + \frac{\partial \pi_B}{\partial x_B}$
3. Externalities: $\frac{\partial \pi_A}{\partial x_B}$
   - $> 0$: Positive: "you do ↑, my $\pi$ ↑"
   - $< 0$: Negative: "you do ↑, my $\pi$ ↓"
4. Strategic Nature: $\frac{\frac{\partial \pi_A}{\partial x_A}}{\partial x_B}$
   - $> 0$: Complements: "you do ↑, I do ↑"
   - $< 0$: Substitutes: "you do ↑, I do ↓"
5. Grim Trigger Strategy
   - 40, 50, 30
   - $\frac{40}{(1-\delta)} \geq 50 + \frac{30\delta}{(1-\delta)}$
   - $40 \geq 50 - 50\delta + 30\delta$
   - $\delta \geq \frac{1}{2}$: cooperation possible

   Tit-for-Tat Strategy
   - 40, 50, 20
   - $\frac{40}{(1-\delta)} \geq \frac{50}{(1-\delta^2)} + \frac{30\delta}{(1-\delta^2)}$
   - $40 + 40\delta \geq 50 + 20\delta$
   - $\delta \geq \frac{1}{2}$: cooperation easy

# 2 Game Theory

## 2.1 Definitions

- *Welfare Economics*: Generalising equilibriums. Competitive markets provide an incentive for firms to produce what customers want. Markets rock in fair play.
  - Theorem 1: Every competitive economy is Pareto Efficient.
  - Theorem 2: Every Pareto Efficient allocation of resources can be achieved in competitive markets (w/ appropriate redistribution between parties).
- *Pareto Efficiency*: No additional person can be made better off without making someone else worse off. There should be no government intervention. Redistribution can take place meaning there is redistribution between parties within the economy rather than externally.
- *Prisoner's Dilemma*: Pursuing your own interests leads to inefficient markets because, using the prison example, if both people choose to confess, they get full long time each. If they both lie, they get full short time. If one lies and one confesses, the one who confesses gets reduction but the liar gets full time. This is risk. Both could deny for 2 years of the other lies (gets 10 years). But then they both risk getting 8 years. If they both deny they both get the full short time (3 years). Denying is best for them both but confessing could, but only could, be best for a single one of them.
- *Rationality*: Players will choose the option with the best payoff for themselves. But back to the Joey and Phoebe, if you are choosing the best for yourself, surely the opponent must be doing the same so can you forecast? Or will they think the same and one-up you?
  - *Common Knowledge of Rationality*: Where players don't just know they possible outcomes of their decisions, they know the possible outcomes of the other's decisions. But recall the prisoner's dilemma.
- *Game Theory*: Our actions have external consequences. They effect the environment and all things around us (smoking example).
  - *Non-Cooperative Game*: In it for your own gain and only that.
  - *Information Game*: Everyone knows they are playing.
  - *Stage Game*: May be repeated (e.g. rearranging cost agreements).

  - *Simultaneous Game* (Type 1): When players do not know the move of the opponent and move at the same time.
  - *Sequential Game* (Type 2): When players know the move of the other player and can make their decision based on the opponent's move.

- *Imperfect/Perfect Information*: Not being able to see the others' choice. Your outcome will always depend on their choice but your decision won't. Or, you have information about their decision to look at as they have make it (historic forecasting).
- *Strategic Uncertainty* (When Simultaneous): Players must base decisions on what they think the other player will play as they do not know. But then they must consider what they think the opponent's move will be but then, the opponent will surely think they will be thinking this and so make a different move and make the same prediction about their opponent... in practice usually it comes back round to them making the first decision that you predicted they would make (Joey and Phoebe e.g.) Can lead to *Strategic Payoff* where the strategic nature of their thinking pays off and they've well forecasted the other's choice.
- *Dominant Strategy*: When there is one clear winner in the strategy you use. It takes the lead the majority or all of the time when put into the matrix. This is found through *Best Response Analysis* which is found by going through each option of B and selecting the best strategy for A to choose (repeat for all columns of B). Then repeating for B (for all rows of A). The double underlined is the dominant strategy.
- *Dominated Strategy*: When the strategy a player chooses is dominated than another strategy which would make you better-off than the one you're choosing.
- *Nash Equilibrium*: When there is a clear equilibrium between the players' *Dominant Strategies*. Means you can't *Unilaterally Deviate* to become more profitable (no incentive to deviate).
  - *Unilateral Deviation*: When there is no dominant strategy.
  - *Mixed Strategies*: Players randomise strategies on unpredictable patterns (e.g. with muscular workouts).
  - *Pure Strategies*: When the player knows for sure what option they will choose.

## 2.2 Simultaneous Move Game

- Sole entrant: obtains big payoff
- Multiple entrants: perhaps lacking market space
- There exists a *First Mover Advantage*

### 2.2.1 Pure & Mixed Strategies

- *Chicken Game*: two players heading towards each other;
  - They collide and both marginally lose out
  - One swerves and loses out bigger (chicken)
- There may be two nash equilibria

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| | | Player B | |
|---|---|---|---|
| | | $E(q)$ | $N(1-q)$ |
| Player A | $E(p)$ | $-50, 100$ | $\underline{150}, \underline{0}$ |
| | $E(1-p)$ | $\underline{0}, \underline{100}$ | $0, 0$ |

  - The nash equilibria are underlined. There are two
  - Pure strategies are shown through probability as seen by entering probabilities $p$ & $q$ above
  - For Player A ($EV$ = Expected Value):

$$\begin{array}{l|l} EV_A^E = -50q + 150(1-q) & EV_B^E = -100p + 100(1-p) \\ EV_A^N = 0q + 0(1-q) & EV_B^N = 0p + 0(1-p) \\ -50q + 150 - 150q = 0 & -100p + 100(1-p) = 0 \\ \underline{q = \frac{3}{4}} & \underline{p = \frac{1}{2}} \end{array}$$

  - These are the probabilities of placing in the respective quartiles:

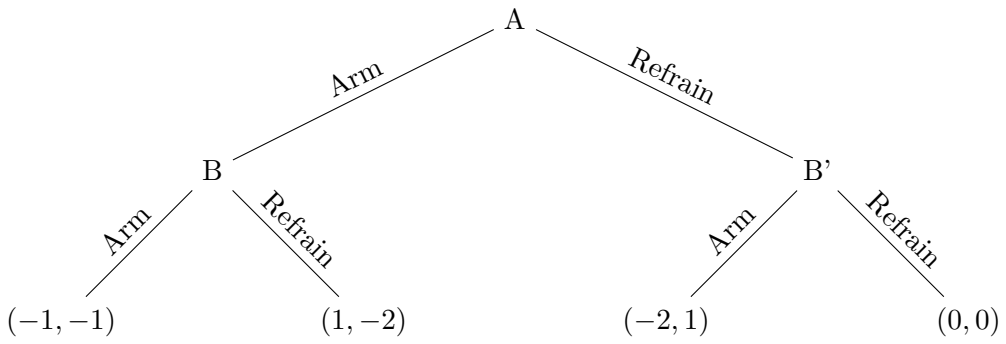
| | $E\frac{3}{4}$ | $N\frac{1}{4}$ |
|---|---|---|
| $E\frac{1}{2}$ | $\frac{3}{8}$ | $\frac{1}{8}$ |
| $N\frac{1}{2}$ | $\frac{3}{8}$ | $\frac{1}{8}$ |

  - You are trying to find the option that would make you both indifferent between choosing options

## 2.3 Sequential Move Game

- Uses *Backward Induction*
  - Games are analysed from the end through to start
- Transforms *Normal Form* to *Extensive Form*
- Transforms *Nash Equilibrium* to *Sub-Game Nash Equilibrium*
- Not subject to *Strategic Uncertainty* (imperfect information)
  - Can observe moments
  - Hence, *Perfect Information*
  - E.g. supermarket price setting
- If the first or last mover has a *Dominant Strategy*, they'll use it

### 2.3.1 Game Tree




| | | B | | | |
|---|---|---|---|---|---|
| | | (Arm, Arm') | (Arm, Refrain') | (Refrain, Arm') | (Refrain, Refrain') |
| A | Arm | $-1, -1$ | $-1, -1$ | $1, -2$ | $1, -2$ |
| | Refrain | $-2, 1$ | $0, 0$ | $-2, 1$ | $0, 0$ |

- In simultaneous games: *Strategy* = *Action*. This isn't the case in sequential games. *Actions* are a simple move; *Strategies* are plans based on the move of the first player
- A's strategies: Arm, Refrain

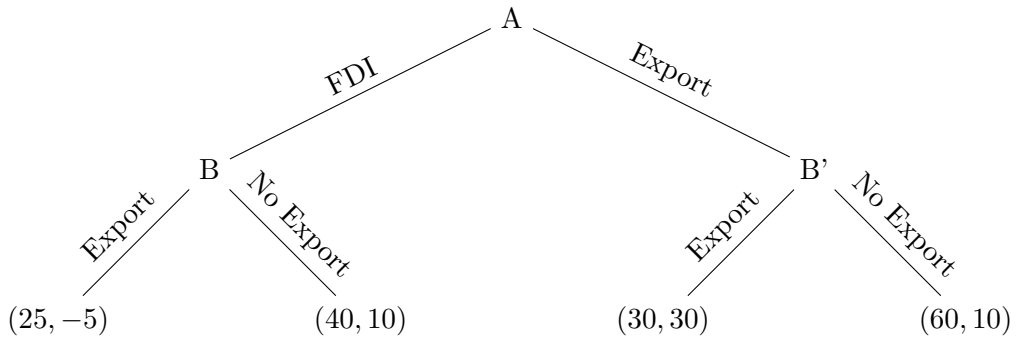
- B's strategies: (Arm, Arm'), (Arm, Refrain'). (Refrain, Arm'), (Refrain, Refrain')
- *Information Set*: don't know which two nodes you are at
- *Subgame*: the mini-looking games which B is playing under A

### 2.3.2 Choosing An Option

Normal:

| | | B | |
|---|---|---|---|
| | | (Export) | (No Export) |
| A | FDI | $25, -5$ | $40, \underline{10}$ |
| | Export | $\underline{30}, \underline{30}$ | $\underline{60}, 10$ |

Extensive:




- In *Normal Form*, (Export, Export) is the *Dominant Strategy*, but there are more options:
  - (Export, Export')
  - (Export, No Export')
  - (No Export, Export')
  - (No Export, No Export')
- If A plays FDI, will B ever export?
  - (No Export, Export') allows *Incredible Threats* to be made

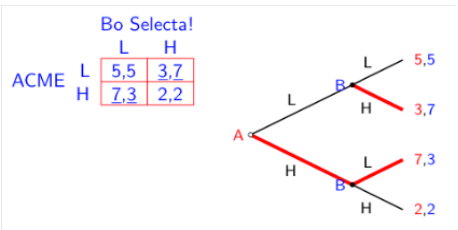
### 2.3.3 Backwards Induction

- A process used to avoid *Incredible Threats*
- If A assumes B is rational, they expect B to play $(40, 10)$ on FDI and $(30, 30)$ on Export
- *Credible Threats*:
  - Only on FDI as they could lower their payoff to punish A
  - $(25, -5)$

1. Start on that last stage of the game
2. Break down into two of A's options
3. Select these two *Subgame Nash Equilibria* for B on each A arm
   - (No Export, Export') are the best for B here
4. A now has a choice
   - FDI would be followed by B's No Export $(40, 10)$ $[> (25, -5)]$
   - Export would be followed by B's Export' $(30, 30)$ $[< (60, 10)]$
   - A plays FDI
5. *Nash Equilibrium* is made clear
   - {FDI,(Not Export, Export')}

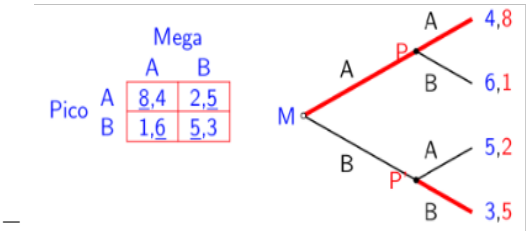
### 2.3.4 Order Advantages

- *Commitment* in first mover vs. *Flexibility* in follower
  - Commitment has greater value in simultaneous games
  - Flexibility has greater value in sequential games
- Recall that in simultaneous games there's a first mover advantage
- *First Mover Advantage* (Simultaneous):



  - B maximises on both moves and A maximises on its one move
  - A lowers B's payoff by choosing a more profitable option for them

- *Second Mover Advantage* (Sequential):



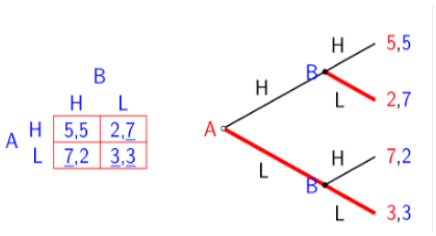

  - M goes for overall highest payoff (6) by choosing move A
  - P has the option to choose one which greater benefits them and lowers M's expected payoff

### 2.3.5 Manipulating Games

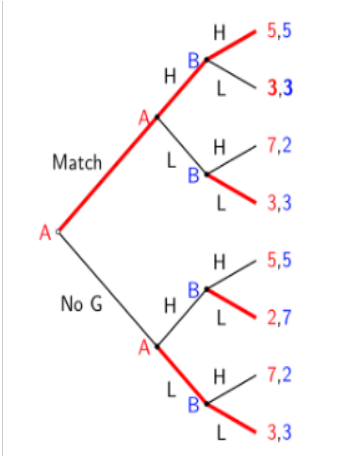
- Take actions to manipulate a game? That is, guaranteeing the outcome
- *Threats & Promises*
  - "If you attack, I'll fight..."
  - "If you enter, I'll enter too; making it less profitable for you..."
  - "If you work hard, I'll work harder..."
  - These lack credibility as they could be bluffs
- *Credibility*
  - "If you're late, I'll set off a bomb..." (*Incredible*; bluffing / not factual?)
  - "If you're late, the timed boomb will go off..." (*Credible*; more believable / factual)
  - Changes first mover's thinking

### 2.3.6 Price Matching Guarantees

Standard *Subgame Perfect Nash Equilibrium*:




Offering a *Price Match Guarantee*:




- Commitment to maintain high prices
- By committing to match low prices, A changes payoffs such that it's not beneficial for B to undercut – as bigger payoff can't be seen
- Both firms end up paying high prices
- (Pricing) *Prisoner's Dilemma*

## 2.4 Prisoner's Dilemma

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