Market Behavior
Market Structures

Master of Law and Business

Bucerius Law School

What is Game Theory?

- … helps to **model strategic behavior by agents** who understand that their **actions affect the actions of other agents**

- Applications

  - the study of oligopolies

  - the study of cartels

  - the study of externalities, e.g., using a common resource such as a fishery

  - the study of military strategies

  - bargaining

  - …

What Is a Game?

- A **game** consists of
    - a set of **players**
        - a game with just two players is a **two-player game**
    - ➢ we study only two-player games
    - ➢ each of whom can choose between two actions
    - a set of **strategies** for each player
    - the **payoffs** to each player
        - depending on the choice of strategies by each player
        - the **payout matrix** denotes the payoffs for all players in all strategies

- A game can be played **simultaneously** or **sequentially**

- A game can be played **once, several times, or infinite** number of times

Example of Two-Player Games

Introduction

- Two Players: A and B

- Player A has two actions, called "Top" and "Bottom"

- Player B has two actions, called "Left" and "Right"

- The table displays the game's payoff matrix
  - In each cell, Player A's payoff is shown first, Player B's payoff is shown second

		Player B	
		Left	Right
Player A	Top	1, 2	0, 1
	Bottom	2, 1	1, 0

Varian, H. (2019), Intermediate Microeconomics (9th Edition), Norton

Examples of Two-Player Games

Introduction

- No matter, whether B plays «Left» or «Right», A is **always better off** playing «Bottom», because:
  - 2 or 1 always better than 1 or 0

➢ «Bottom» is a *dominant strategy* for A

➢ «Left» is a dominant strategy for B (2 or 1 always better than 1 or 0)

		Player B	
		Left	Right
Player A	Top	1, 2	0, 1
	Bottom	2, 1	1, 0

Varian, H. (2019), Intermediate Microeconomics (9th Edition), Norton

Examples of Two-Player Games

Introduction

- And what would happen if this game was played?

		Player B	
		Left	Right
Player A	Top	2, 1	0, 0
	Bottom	0, 0	1, 2

Varian, H. (2019), Intermediate Microeconomis (9th edition), Norton

Nash Equilibrium

Introduction

- A play of the game where each strategy is a best reply to the other is a **Nash equilibrium** (NE): So, each player's strategy is the optimal response to the other player's strategy (and no one has an incentive to deviate)

- This example has two Nash equilibria: *(T, L)* and *(B, R)*

		Player B	
		Left	Right
Player A	Top	2, 1	0, 0
	Bottom	0, 0	1, 2

Varian, H. (2019), Intermediate Microeconomis (9th edition), Norton

Market Structures

- **Market Structure**: Refers to the **organizational** and **other characteristics** of a market. These characteristics influence how firms operate, how prices are set, and the level of competition.

- **Importance**: Market structure plays a crucial role in determining:
  - The behavior of firms (whether they can influence market prices, how they compete).
  - **Efficiency** of the market (how well resources are allocated).
  - **Variety** of products available to consumers.

- **Four Main Types:**
  - Pure Competition
  - Monopolistic Competition
  - Oligopoly
  - Pure Monopoly

Pure Competition

1. **Many Small Firms**: Many firms produce identical products, which makes it impossible for any single firm to influence the market price.

2. **Identical Products**: The products offered by all firms are homogeneous (no product differentiation).

3. **Price Takers**: Firms have no control over the market price. They accept the market price determined by the forces of supply and demand.

4. **Free Entry and Exit**: No significant barriers prevent new firms from entering or existing firms from leaving the market.

Because of these conditions, each firm faces a **perfectly elastic demand curve**, meaning it can sell all it produces at the market price, but not a unit more if it raises its price.

Example:

- **Agricultural Markets**: Farmers growing wheat, corn, or rice. Each farmer produces a small fraction of the total output, and none of them can influence the price of the product on their own.

Pure Competition

Graphical Illustration
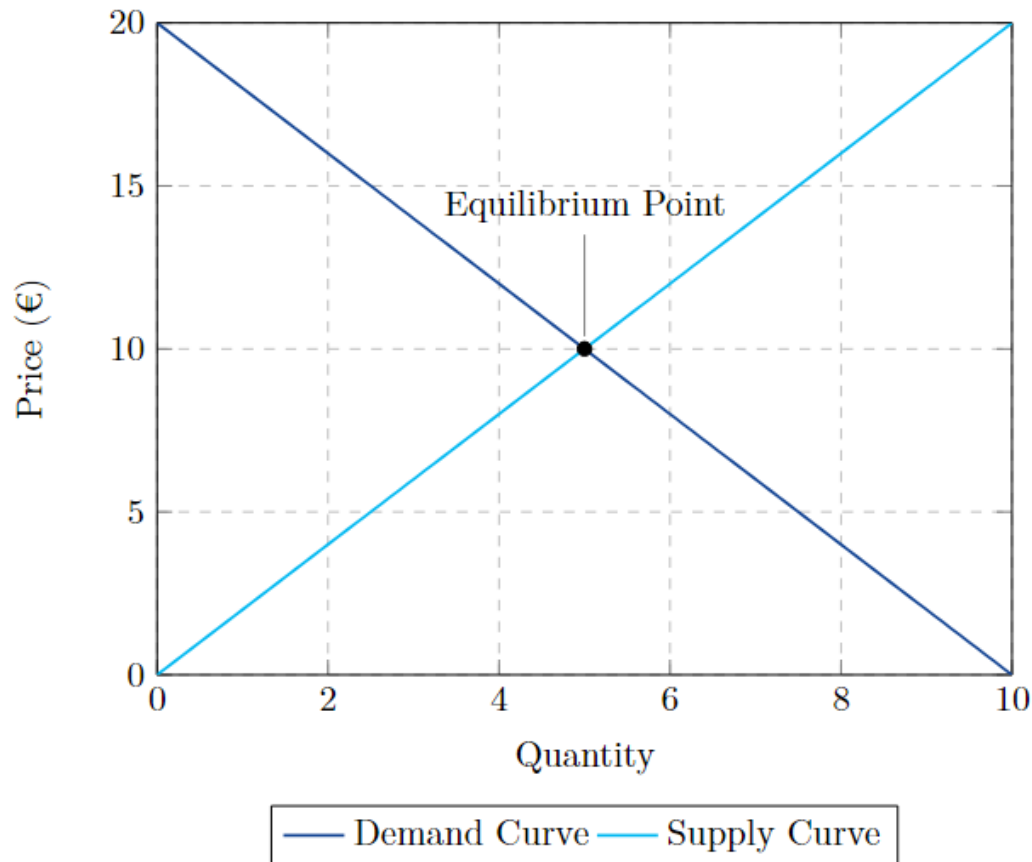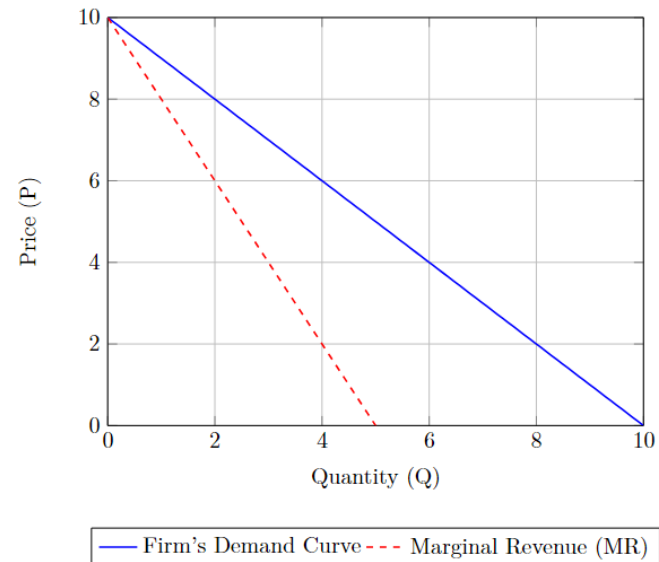
Monopolistic Competition

Key Features

1. **Many Firms:** There are a large number of firms in the market, but each firm has some market power.

2. **Differentiated Products:** Firms sell similar but not identical products. This product differentiation gives each firm some control over its price.

3. **Some Price Control:** Because products are differentiated, firms have the ability to set prices slightly higher without losing all customers.

4. **Relatively Free Entry and Exit:** Firms can enter or exit the market easily, though not as freely as in perfect competition.

Monopolistic Competition

A Firms Demand Curve

- **Pricing Power:** Unlike in perfect competition, firms in monopolistic competition can raise prices and still retain some customers because they offer differentiated products. This gives them some control over pricing.

- **Product Differentiation:**
  - "Can you think of products where firms compete but still manage to set higher prices because of branding or quality differences?"

Product Differentiation

What is Product Differentiation?

Firms in monopolistic competition offer products that are similar but not identical. They compete based on non-price factors like:

- Quality
- Branding
- Customer service
- Location
- Product features

Impact of Differentiation: Differentiation gives firms pricing power, allowing them to charge slightly higher prices without losing all customers. Consumers are willing to pay more because they perceive additional value in differentiated products.

Oligopoly

1. **Few Large Firms**: The market is dominated by a small number of large firms that produce either homogeneous or differentiated products.

2. **Interdependence of Firms**: Firms are highly interdependent. The actions of one firm directly affect the others.

3. **Barriers to Entry**: There are significant barriers to entry, such as high startup costs, which prevent new competitors from entering the market easily.

4. **Price Rigidity**: Prices tend to be relatively stable. Firms may avoid price wars due to potential retaliation by competitors.

Example: **Airlines or Smartphone Manufacturers**

- A small number of major players dominate the market: For example, in the smartphone industry, Apple and Samsung are key players, and their decisions (such as pricing or features) strongly affect each other.

Collusion & Competition

What is Collusion?: When firms in an oligopoly cooperate to set prices or limit production to maximize joint profits.

- **Why Do Firms Collude?**: To avoid **price wars** and ensure higher profits for all involved firms.
- **Cartels**: An example of formal collusion is a cartel, where firms explicitly agree to control supply and fix prices.

What is Competition?: When firms in an oligopoly compete on price, product features, or marketing to gain a larger market share.

- **Why Do Firms Compete?**: To capture more customers by lowering prices or improving products. However, aggressive price competition can lead to **lower profits** for all firms.
- **Non-Price Competition**: Firms often engage in **non-price competition** (advertising, innovation, and branding) to avoid destructive price wars while still competing.

Collusion vs. Competition:
In an oligopoly, firms must constantly decide whether to **collude** and keep prices high or **compete** and risk driving down profits.

Case: Military Hand Granades

Oligopoly

Participants: Diehl (€1.2 million fine) and RUAG (immunity for revealing cartel).

Market: Military hand grenades within the European Economic Area (EEA).

Collusive Agreement: The two firms split national markets across the EEA and agreed that only one manufacturer would be allowed to sell in certain territories during a 14-year period.

Infringement:

- The firms agreed not to compete in each other's allocated territories, creating an anti-competitive environment where prices could be kept higher.

- This allocation of markets and restricting competition over the years was considered illegal under EU antitrust laws.

Fines:

- Diehl was fined €1.2 million for its involvement in the cartel.

- RUAG was not fined because they revealed the cartel under the European Commission's Leniency Program, which grants immunity to the first firm that reports cartel activity.

Economic Impact of Collusion

Oligopoly

- Collusion **drains value from consumers**: Estimated loss of up to **€320 billion** over 12 years in cartelized markets (equivalent to over **3% of euro-area GDP in 2012**).

- **Misallocation of Resources**: When firms collude, competition is restricted, leading to a **misallocation of resources**. This shrinks the economy's "pie," blocking opportunities for innovation and efficiency.

Harm to Consumers and the Economy:

- **Higher Prices**: Direct impact on consumers as collusion leads to **higher prices** for goods and services.

Economic Impact of Collusion

Oligopoly

Ripple Effect: If collusion occurs further up the supply chain (e.g., raw materials), downstream firms suffer, increasing prices, reducing production, or even forcing firms out of the market.

- **Example**: Collusion in cement markets could make infrastructure projects (like roads, schools, or hospitals) **unaffordable** due to inflated input costs.

Lost Incentives for Innovation:

- Without competition, firms lose the **dynamic incentive to improve** efficiency, innovate, and outperform rivals. This stagnation negatively impacts overall welfare and long-term economic growth.

Collusion: Is a Cartel Stable?

Market Structures – Oligopoly

- Does one firm have an incentive to cheat on the other?

- If one firm sticks to the agreed quota it is profit maximizing for the other firm to breach the agreement and produce a larger quantity

➢ Profit-seeking cartels in which firms cooperatively set their output levels are fundamentally unstable (example: OPEC)

➢ If a collusion is repeated several times, then there is an opportunity to **punish** a cheater (example: DeBeers flooded the market with diamonds when one producer tried to leave the cartel)
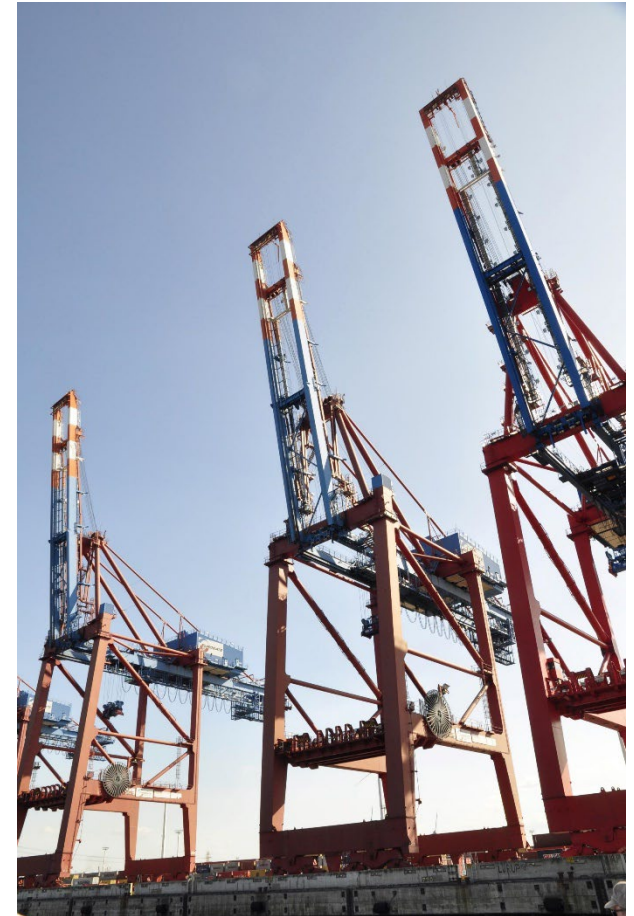
Is a Cartel Stable?

Market Structures - Oligopoly

	Firm 2 Colludes	**Firm 2 Competes**
Firm 1 Colludes	(2304, 2304)	(1728, 2592)
Firm 1 Competes	(2592, 1728)	(2048, 2048)

Game Theory in Oligopoly

Oligopoly

- **Nash Equilibrium in Oligopoly**:
  - **Nash Equilibrium**: The point where no firm can improve its payoff by changing its strategy unilaterally, often leading to a competitive outcome even though collusion could have been more profitable.
  - **Real-World Relevance**: Oligopolistic firms often end up in a **Nash Equilibrium** where both compete rather than collude, even though collusion would yield better joint profits.

Prisoners Dilemma

Introduction

- Here, we call Player A **Bonnie**, and Player B **Clyde**

- Is the equilibrium efficient?

  - "Pareto-preferred" (i.e., no player can improve without making at least one player worse off)

		Player B	
		Confess	Deny
Player A	Confess	−3, −3	0, −6
	Deny	−6, 0	−1, −1

Varian, H. (2019), Intermediate Microeconomis (9th edition), Norton

Prisoners Dilemma: Equilibrium

Game Theory - Introduction

- The Nash equilibrium is (Confess, Confess)
  - Nobody can improve by deviating
  - But: it would be "better", if players cooperated and chose (Deny, Deny)
  - For the prisoner's dilemma, the Nash equilibrium is *inefficient*
  - ➤ *"the rational individual decision is not optimal for the group outcome"*
  - ➤ Both players can achieve strictly larger payoffs than in the NE **by coordinating** with each other on another pair of action

Pure Monopoly

Key Features of a Monopoly

1. **Key Features of a Pure Monopoly**: **One Firm Dominates the Market**: The entire market is controlled by a single firm, which faces no competition.

2. **Significant Control over Prices**: The monopolist sets prices without concern for competitors, often leading to **higher prices** for consumers.

3. **High Barriers to Entry**: New firms find it nearly impossible to enter the market due to exclusive control over resources or legal barriers.

Example: **De Beers Diamond Monopoly** (Late 19th to 20th Century)

- De Beers controlled about 85% of the world's diamonds, restricting supply and keeping diamond prices artificially high.

- They enforced their monopoly through exclusive control of mines and aggressive tactics against competitors.

- **Effect on Consumers**: Higher diamond prices and limited availability hurt consumers while the company profited.

Question: **Why Are Monopolies Sometimes Bad for Consumers and Society?**

Natural Monopolies

What is a Natural Monopoly?

- A natural monopoly exists when one firm can supply the entire market more efficiently than multiple firms.

- This often happens in industries with **high fixed costs** and significant **infrastructure investments** (e.g., utilities).

Key Features:

- **High Barriers to Entry**: The initial cost of infrastructure is so high that new firms find it difficult to enter the market.

- **Economies of Scale**: As output increases, the firm's **average cost** decreases, making it inefficient for more than one firm to operate.

Natural Monopolies

What is a Natural Monopoly?

Example: **Public Utilities** (Water, Electricity, Gas)

- It wouldn't make sense to have multiple water pipelines or electrical grids. One firm can provide the service at a lower cost due to economies of scale.

Why Aren't Multiple Firms Allowed?

- Competition would result in **duplicated infrastructure**, which increases costs without increasing efficiency.

Regulation & Monopolies

Why Regulate Monopolies?

Prevent Abuse of Power: Monopolies can exploit their market position to charge higher prices and reduce output.

Protect Consumers: Regulation ensures fair pricing and prevents monopolies from providing poor-quality service or reducing innovation.

Types of Regulation:

- **Price Regulation**: Governments may set price caps to prevent monopolies from charging excessively high prices.

- **Service Requirements**: Monopolies may be required to maintain a certain level of service or invest in infrastructure to improve quality

Regulation & Monopolies

Why Regulate Monopolies?

Example: Microsoft Antitrust Case (1990s)

- The U.S. government sued Microsoft for abusing its monopoly power in the PC operating system market. The company was accused of stifling competition by bundling its Internet Explorer browser with Windows, hurting competitors like Netscape.

- **Question: When Should the Government Intervene?**
  - Should governments regulate monopolies only when they are harmful to consumers, or should monopolies always face some level of oversight?

Comparing Market Structures

Overview

Market Structure	# of Firms	Control Over Price	Product Differentiation	Barriers to Entry	Examples
Pure Competition	Many	None	None	Low	Agricultural Products
Monopolistic Competition	Many	Some	Yes	Low	Restaurants, Clothing
Oligopoly	Few	Some	Sometimes	High	Airlines
Monopoly	One	Significant	Not needed	Very High	Local Utilities

Team Incentives and Free-Riding

For organizations, the following is generally true:

Different individuals must contribute (provide inputs) for the organization's success.

These individual contributions (inputs) result in a **collective output**. This is often referred to as **team production**.

- **The Cooperation Problem:**
    - Individual contributions are often **difficult to measure**.
    - How can each team member be incentivized to provide the necessary effort and performance?
- The following analysis will focus on this question and explore ways to solve the **cooperation problem** in team production.

Cooperationproblems in Teams

Example: Prisoners' Dilemma

- Two agents i=1,2 decide whether to be lazy $e_i = 0$ or to work $e_i = 1$

- Every agent has individual effort costs $c_i(e_i) = 5 \cdot e_i$

- Individual efforts are unobservable, only the team out can be observed

- Agent's efforts are substitutes $W(e_1, e_2) = 8 \cdot (e_1 + e_2) + 2$

- Assumption: Team output is shared equally among both; individual efforts of one increase utility of the other

	Agent 2 lazy	work
Agent 1 lazy	(1,1)	(5,0)
work	(0,5)	(4,4)

(Payoff 1, Payoff 2)

The Free-Rider Problem in Teams

Definition & Intuition

When multiple economic agents contribute to a team outcome and the individual contributions cannot be measured, the free-rider problem arises when the team result is divided among the team members. The efforts exerted will be lower than the efforts that would maximize value collectively.

Intuition:

- Each individual agent bears the **marginal cost** of their effort alone.

- However, the **marginal benefit** is divided among the **n members** of the team.

- Therefore, the marginal benefit everyone receives from their effort is smaller than that of the entire team.

- Agents who are only interested in their own well-being will exert less effort than the **first-best effort**.

- The larger the team, the more severe the problem becomes.

How can we foster cooperation?

Cooperation

An experimental study: Public Goods Game

- The Public Goods Game can be seen as a continuous version of the (binary) Prisoner's Dilemma Game with more than two players.

- **Payoff function for each group member i:**

$$\pi_i = y_i - c_i + \alpha \cdot \sum_{j=1}^{n} c_j$$

- y_i: income of individual i

- c_i: i's contribution to the public good

- $\sum_{j=1}^{n} c_j$: Sum of all contributions

- α: „marginal per capita return" (MPCR)

Decline of Cooperation

- Cooperation starts around 40-60% (of full cooperation) and declines over time
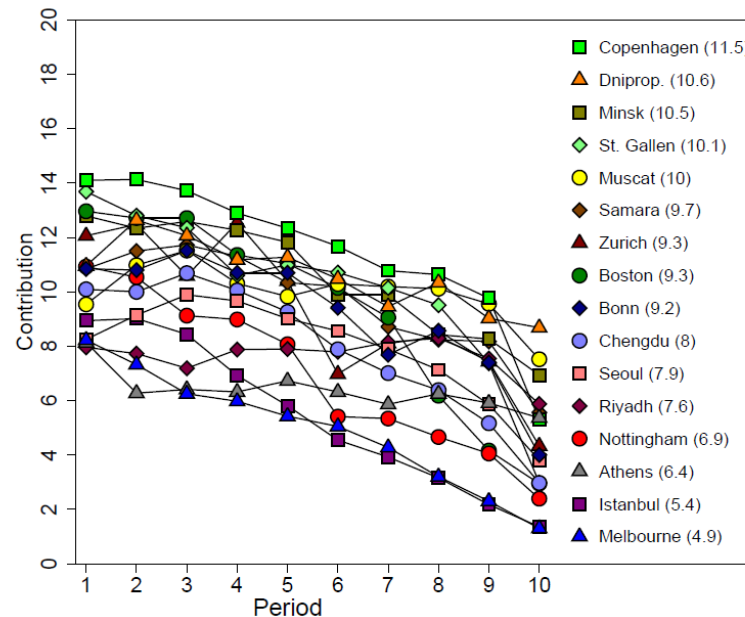- Free-riding most frequent choice in final periods

Figure: Herrmann et al. (2008)

Punishment & Cooperation

Fehr and Gächter (2000) study the role of peer-punishment on cooperation

- Idea: Public goods game with two stages:
    - **Contribution stage:** group members decide on contribution to public good (as before).
    - **Punishment stage:** group members can punish other group members at own costs.
- Does the opportunity to punish change the prediction?

Punishment & Cooperation
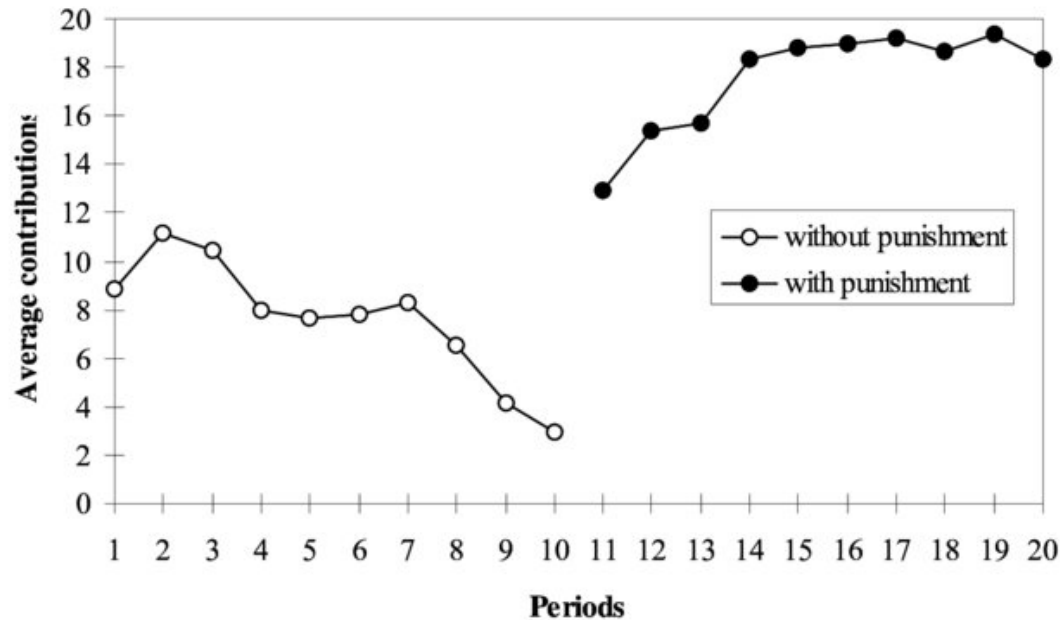
- Punishment is very frequent (contrary to standard prediction).

- The less a player contributes (relative to others), the more she is punished.

- With punishment, cooperation is stable or even increases over time (contrary to the typically observed decline in cooperation without punishment).

Fairness, Motivation, & Incentives

(Neoclassical) Economic Logic Suggests the Following Mechanism:

- Individuals are motivated by **self-interest**.

- **Performance-based pay** works because employees, acting in their own interest, will work harder as they directly benefit from increased effort.

However, Modern Behavioral Economics Highlights:

- People are **not solely self-interested** (and not all people act purely out of self-interest).

- Many individuals have preferences for:
  - *Fairness*
  - *Reciprocal behavior* (responding positively to kindness or fairness).

Could There Be a Simpler Approach?

- **Treat and pay employees generously**.

- If employees value fairness and reciprocity, could you **generate motivation** without complex incentive systems? By fostering a fair work environment, it's possible that **intrinsic motivation** may flourish, reducing the need for, performance-based incentives.

Fairness and Motivation

Equity Theory by Adams (1965)

Core Idea: Individuals strive for **fair exchange relationships**.

People evaluate the ratio of their own **outcomes** (what they receive) to **inputs** (what they contribute) and compare this ratio to that of a **reference group** (e.g., colleagues).

Subjective Balance:

* A person feels a sense of equity or balance when their **outcome/input ratio** is equal to that of their reference group.

Key Components:

* **Outcomes**: salary, bonuses, promotions, or recognition.

* **Inputs**: effort, working hours, skills, or experience.

Preferences for Fairness:

* Individuals prefer situations where the ratios are **equal**—if everyone is contributing similarly, they expect similar rewards.

* **Perceived inequality** (either being over- or under-rewarded) leads to **dissatisfaction** and motivates the individual to restore equity.

Fairness and Motivation

Equity Theory by Adams (1965)

Reactions to Perceived Inequity:

1. **Change in Inputs**: People may reduce effort or hours worked if they feel under-rewarded.

2. **Cognitive Adjustments**: Re-evaluating the importance of their inputs or the value of their outcomes to justify the imbalance.

3. **Change of Job**: In cases of persistent inequity, employees may seek a new job where they perceive the exchange to be fairer.

Implications:

- Managers need to ensure that compensation and rewards are perceived as fair, not just in absolute terms, but relative to the contributions of others in the organization.

- Perceived inequity can have significant impacts on employee motivation, satisfaction, and turnover.

Preferences for Equity

Contributions Fehr & Schmidt (1999) and Bolton & Ockenfels (2000)

- While individuals have a fundamental interest in their **own well-being**, they also derive utility when others around them achieve **similar income levels**.

- Fehr und Schmidt (1999) propose a utility function:
Income x_i of individual i (and the reference individual is j)

$$u_i(x_i, x_j) = x_i - \alpha_i \cdot \underbrace{\max\{x_j - x_i, 0\}} - \beta_i \cdot \underbrace{\max\{x_i - x_j, 0\}}$$

α_i: Measures how much individual i suffers from **disadvantageous inequality** (i.e., **envy**). This reflects how strongly the individual dislikes earning less than others.

- **Higher α_i** implies that the individual experiences more disutility when others earn more.

β_i: Measures how much individual i suffers from **advantageous inequality** (i.e., **compassion** or guilt). This reflects discomfort when the individual earns more than others.

- **Higher β_i** means the individual feels more uncomfortable about earning more than others.

Preferences for Equity

Contributions Fehr & Schmidt (1999) and Bolton & Ockenfels (2000)

Key Assumptions:

- $\alpha_i > \beta_i$ People are generally more sensitive to **envy** (when others earn more) than to **guilt** (when they earn more than others). This reflects that people dislike being at a disadvantage more strongly than they feel discomfort when they are at an advantage.

- $\beta_i < 1$: Even though individuals feel discomfort with advantageous inequality, they still value having higher income and are not fully willing to reduce their advantage to achieve complete equality.

Implications:

- **Behavioral Impact**: These preferences lead individuals to engage in behaviors that reduce perceived inequalities. For instance, they may:
  - Be willing to sacrifice part of their income to achieve more **equity** in their social or professional environment.
  - Feel dissatisfaction or reduce their effort in situations where income distributions are perceived as unfair.

Reciprocity & Motivation

Tendency for Reciprocal Behavior:

- People have a fundamental tendency to **respond to friendly behavior** with friendly actions of their own.

- Conversely, **negative reciprocity** also exists: Unfriendly behavior is punished, even if it comes at a personal cost (→ "revenge").

- The **intentionality** behind others' actions has an impact on how we respond (i.e., the **intention** behind the action matters).

- **Consciously friendly actions** can be strategically used to influence others' behavior.

Important to note:

- This contrasts with **neoclassical economic theory**, where only the **outcome** of an action is considered important for an actor's evaluation (→ **consequentialism**).

Fair-Wage-Effort Hypothesis

Akerlof (1982)

With **higher wages ex-ante**, employees put in more effort, even if they don't earn any additional money ex-post as a result.

Explanation through Inequity Aversion:

- **Inequity** arises in favor of the employee when the employer offers **generous wages**.

- Inequity-averse employees feel motivated to **give something back** through higher performance to reduce this inequality.

Explanation through Reciprocity:

- Employees want to **reciprocate** a generous action (higher wages) with greater effort.

Evidence from Experiments:

- Numerous lab experiments (e.g., Fehr et al. (1997)) show a **positive correlation** between wages and effort in the **gift exchange game**:

- The principal chooses a **fixed wage** (α), with no variable compensation.

- The agent chooses their **effort level** (e), which comes at a **cost c(e)** to the agent.

Fair-Wage-Effort Hypothesis

Experimental Evidence

Study by Gneezy and List (2006)

- **Objective**: Recruit students to digitize the inventory of a library.

- **Recruitment**: Students were hired through posters, offering them 6 hours of work at a rate of **$12 per hour**.

Two Experimental Groups:

1. **Experimental Group**: Before starting, they are informed that they will receive **$20 per hour**.

2. **Control Group:** They receive the originally announced **$12 per hour**.

Fair-Wage-Effort Hypothesis

Experimental Evidence