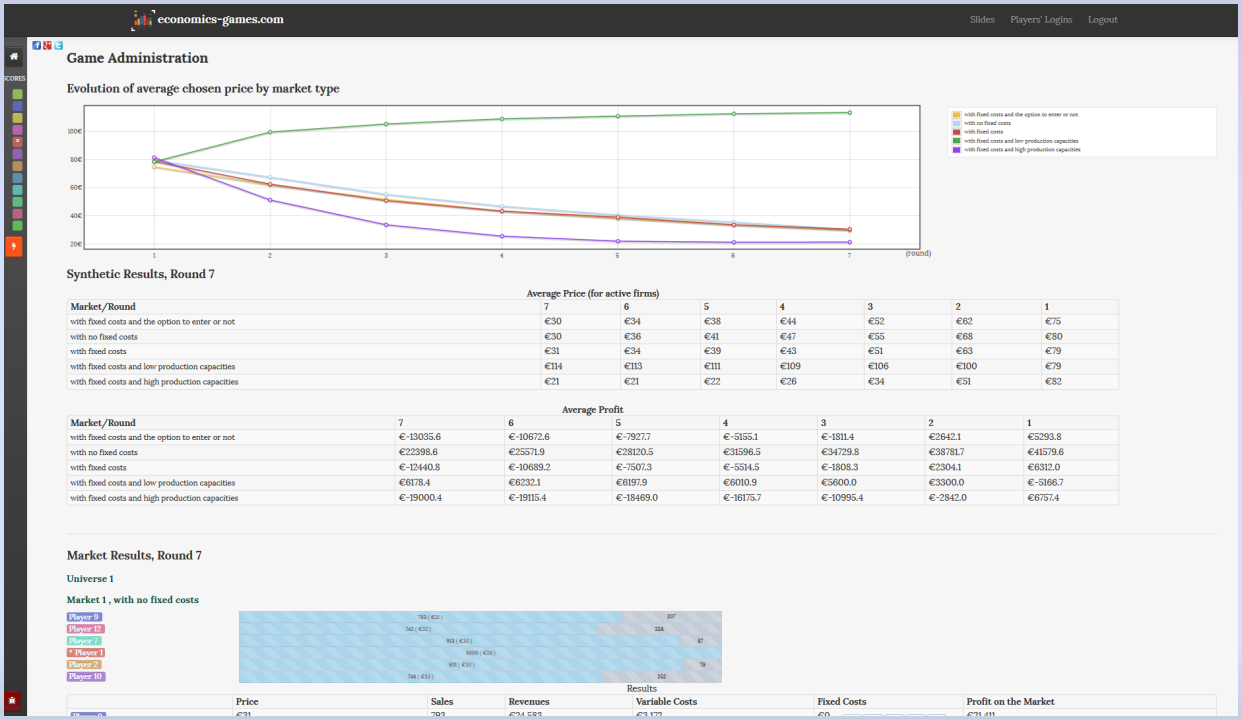
5 Market Games For Teaching Economics

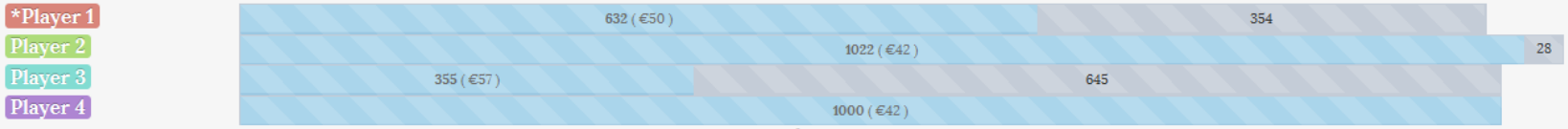


Progression

- 5 Market Games from website economics-games.com
- To be played separately or as a sequence:
  - Market Game 1: Sunk costs, monopoly, and introduction to the next games
  - Market Game 2: Impact of fixed costs and capacity constraints on price and profits, with differentiated goods
  - Market Game 3: Impact of the number of competitors on price and profits
  - Market Game 4: Price and quantity competition and CO2 environmental policies (quotas, taxes and emission permits)
  - (Market Game 2b is a variant of market game 2, with homogenous goods)
- **Demand is identical in all of these games** (proportionally to the number of players on the markets), except game 2b.

Market 1 , "Benchmark (Region 1)"

Total: 4036 / Unsold: 1027 goods



Results

	*Player 1	Player 2	Player 3	Player 4
Price	€50	€42	€57	€42
Sales	632 / 986	1022 / 1050	355 / 1000	1000 / 1000
Sales at "halftime"	327	520	179	487
Total Production	986	1050	1000	1000

	*Player 1	Player 2	Player 3	Player 4
Revenue over the Round (excluding CO2 and exceptional)	€31,600	€42,924	€20,235	€42,000
Fixed Costs over the Round (excluding CO2 and exceptional)	€14,790	€15,750	€15,000	€15,000
CO2 Fixed Costs over the Round	€0	€0	€0	€0
Variable Costs over the Round	€2,528	€4,088	€1,420	€4,000
CO2 emissions (tons)	493	525	500	500
Profits over the Round (excluding CO2, slots and exceptional)	€14,282	€23,086	€3,815	€23,000
Profits over the Round with CO2 (excluding exceptional)	€14,282	€23,086	€3,815	€23,000

Market 2 , "Unit tax (Region 1)"

MARKET GAME 1:

SUNK COSTS, MONOPOLY, AND INTRODUCTION TO THE OTHER GAMES

Objective

- Very short game (5 minutes), intended to:
  - Introduce student to the demand function that will be used in the following games.
  - Introduce a monopoly benchmark that will be useful to compare with the competition situations later.
  - Have students understand the impact of sunk costs on the ranking of alternatives.

Description

- Players are in a monopoly position on 2 identical markets: On each market,
  - the marginal cost of production is constant and equal to 4€.
  - Players can sell up to 1000 goods on each market.
  - What differs is that on the second market, there is a sunk cost equal to 35000€.
- Repeated

Why is this game interesting?

- This game can seem obvious, but it is very effective as an introduction to sunk costs and monopoly pricing.
  - If players do not realize from the start that the optimal price is the same on both markets, they will come to understand this easily by tatonnement.
  - By changing their price by tatonnement from one round to the other, they find themselves in a situation where marginal reasoning is perfectly natural.
  - This game provides a monopoly benchmark for later games (monopoly price ~€96, monopoly profit net of sunk costs: ~€40680).
  - Even if this is not so fun, players will do it carefully in order to prepare for later multiplayer games and get accustomed to the demand function (provided it does not last too long).

Demand

Price	40	45	50	55	60	65	70	75	80	85	90
Sales (average)	762,02	727,39	694,46	663,34	632,6	603,52	575,3	548,04	521,74	496,55	471,26

Price	95	100	105	110	115	120	125	130	135	140	145
Sales (average)	446,95	423,24	400,1	377,49	355,37	333,63	312,39	291,51	270,74	250,8	231,28

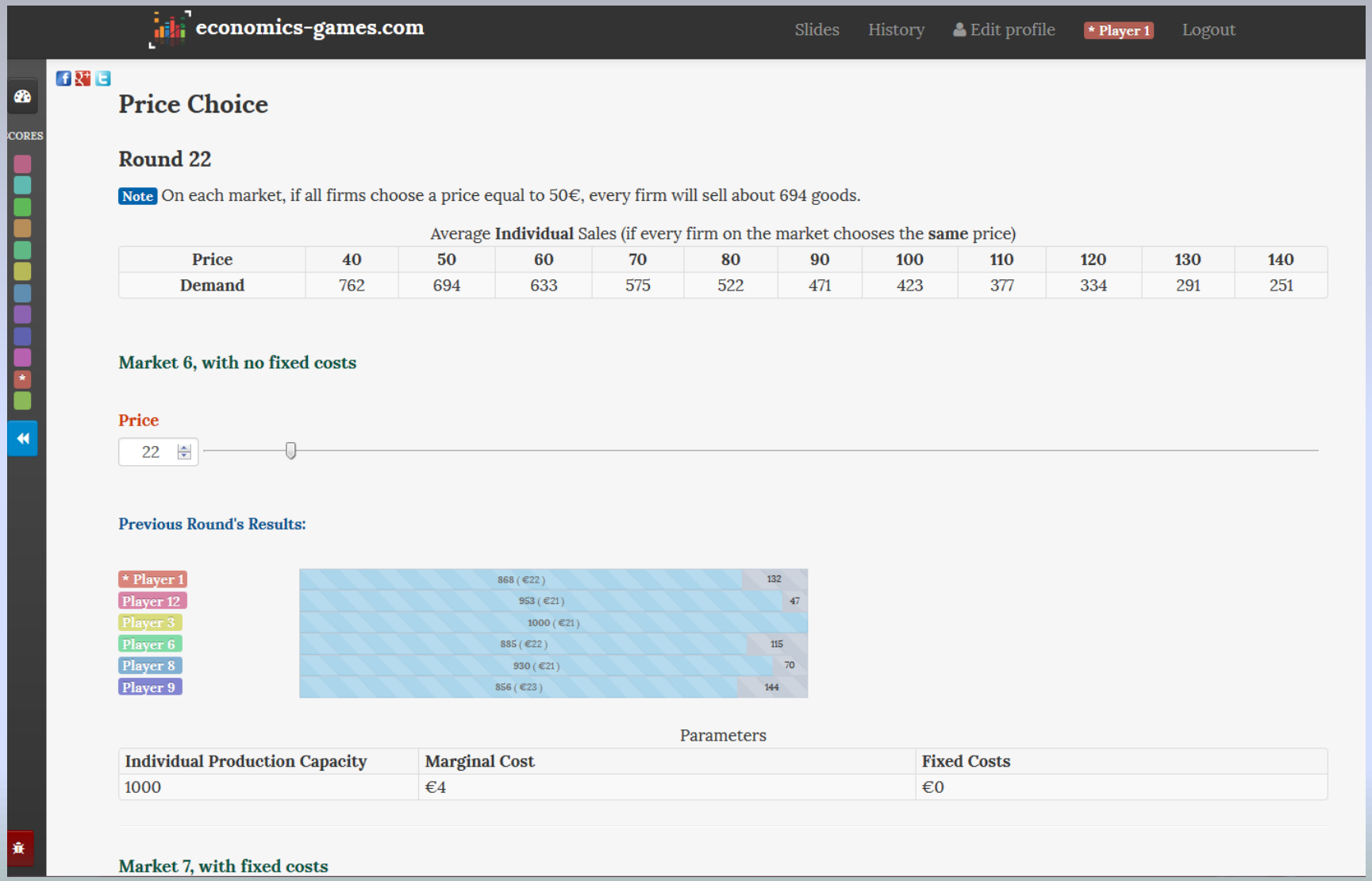
Possible Theoretical debriefings

- Impact of sunk costs on the ranking of alternatives.
- Marginal Revenue, decreasing marginal revenue and marginal cost.
- Illustrates the interest of marginal reasoning through the search for the monopoly price (possible debriefing with demand data).
- Cost pass-through (monopoly price with €4 marginal cost is ~€96, revenue maximizing price is ~€94)

MARKET GAME 2:

IMPACT OF FIXED COSTS AND CAPACITY CONSTRAINTS ON PRICE AND PROFITS (DIFFERENTIATED GOODS)

The interface, Decisions



Objective

- Longer game (45 minutes – 1h), intended to:
  - Explain the logic behind competition.
  - Compare oligopoly with monopoly.
  - Have students understand the impact of sunk costs on prices.
  - Have students understand the impact of avoidable fixed costs on prices.
  - Have students understand the impact of capacity constraints on prices and profits.

Description

- Players compete against the same other players on 5 identical markets:
- What differs is that on some markets there are avoidable or unavoidable fixed costs, and on others not. Production capacities also differ from one market to another.
- Demand is the same as in game 1 (proportionally to the number of competitors on the markets).
- Repeated game

Description

- Parameters on the 5 different markets:

	Marginal Cost	Fixed Costs?	Capacity constraints
Market 1	4€	No	1000
Market 2	4€	Sunk Costs, 35000€	1000
Market 3	4€	Sunk Costs, 35000€	400
Market 4	4€	Sunk Costs, 35000€	2000
Market 5	4€	Avoidable Costs, 35000€	1000

Remark 1: Demand

- Demand is based on a logit model.
  - There is a number of potential customers « arriving » one after the other on the market, and then considering buying one unit of good to one of the firms that still have something to sell.
  - The reservation value of each customer is randomly drawn…
  - … Along with another random draw (to capture unmodeled « horizontal » differences between the goods), this determines who he buys from, if he buys from someone (this is the only difference with game 2b, in which a customer always buys from the cheapest firm that still has goods to sell when he arrives on the market).
- In all our games, in order to facilitate comparison, demand is proportional to the number of firms on the market:
  - 5 teams on each market →5 times as many potential customers as in the monopoly game presented before.

Market game 2b

- Market Game 2b is identical to Market Game 2, except that goods are perfectly homogenous:
  - The reservation value of a customer is randomly drawn, as in game 2…
  - … but there is no random draw to determine which firm he buys from:
  - He always buys from one of the the cheapest firms that still have goods to sell when he arrives on the market.

Remark 2: Parameters calibration

- M 3: Production Capacity 400 → Total production capacity is close to the monopoly quantity.
- M 1, 2, 5: Production Capacity 1000
  - → Price decrease is slower on markets 1-2-5 than in market 4, because of weaker incentives to choose a very low price (In market 4, players can expect much higher sales when they have the lowest price, since their production capacity is more important).
  - → In Game 2b, with non-differentiated demand:
    - Production capacity of 1000 limits short run competition, above the marginal cost.
    - Prices remains higher than in market 4, and usually, all firms eventually sell up to their capacity.
- The level of fixed cost on markets 2 to 5, €35000, is such that:
  - If there are 5 or 6 players by market, one or two of them should decide to stay out of the market 5.
  - Profits on markets 2 and 4 will be negative, and the best players can do is to accept that and try and accomodate the situation (and not base their price on average cost!).

Recommended Settings

- Split players across separate “universes”:
  - Players from one universe only interact with other players from the same universe (yet compete with every other player for the highest score)
    - This is useful to limit over-aggressive strategies
    - Balance between competition and cooperation
- Recommended settings:
  - More than 1 universe
  - if possible, 1 universe for 5-6 players

The interface, Results

economics-games.com | Slides | History | Edit profile | * Player 1 | Logout

SCORES

Competition Result

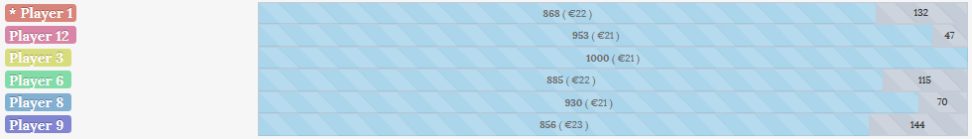
Round 21

Note Reminder: On each market, if all firms choose a price equal to 50€, every firm sells about 694 goods.

Average **Individual** Sales (if every firm on the market chooses the **same** price)

Price	40	50	60	70	80	90	100	110	120	130
Demand	762	694	633	575	522	471	423	377	334	291

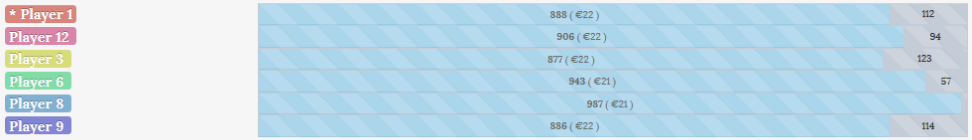
Market 6, with no fixed costs



Results

	Price	Sales	Revenue	Variable Costs	Fixed Costs	Profit on the Market
* Player 1	€22	868	€19,096	€3,472	€0	€15,624
Player 12	€21	953	€20,013	€3,812	€0	€16,201
Player 3	€21	1000	€21,000	€4,000	€0	€17,000
Player 6	€22	885	€19,470	€3,540	€0	€15,930
Player 8	€21	930	€19,530	€3,720	€0	€15,810
Player 9	€23	856	€19,688	€3,424	€0	€16,264
Average	€22 (avg choice)					€16,138

Market 7, with fixed costs



Possible Theoretical debriefings

- Comparison between monopoly and oligopoly (price and profits).
- What drives competition?
  - Residual demand and marginal revenue.
  - Price elasticity of demand and the sales/margin trade-off
  - The prisoner's dilemma
- Capacity constraints as limits to price competition, keeping prices and profits above the unconstrained level.
  - First evocation of short run vs long-run competition (more about that in the last game)
  - Analogy « capacity constraints / increasing marginal costs »

Possible Theoretical debriefings

- Impact of sunk costs (for one-shot interactions):
  - On best response functions.
  - On equilibrium prices if every player is rational and believes that every other player is rational

  More advanced:
  - On players' strategies if players are rational and expect that some of their competitors will not be rational and will increase their price
    - → Possible discussion about Bertrand competition with differentiated goods and capacity constraints, prices as strategic complements, etc.
    - → The role of expectations
    - → Possible presentation of the notion of Nash Equilibrium.
    - → Possible discussion about what can happen if the process is iterated and about the stability of Nash equilibria.

Possible Theoretical debriefings

- Impact of avoidable fixed costs
  - When it does not drive any firm out of the market (=sunk cost)
  - When it drives some of the firms out of the market (higher price and profit, but through less competition)
- Price in the short run determined by avoidable costs AND demand AND capacity constraints (and…)

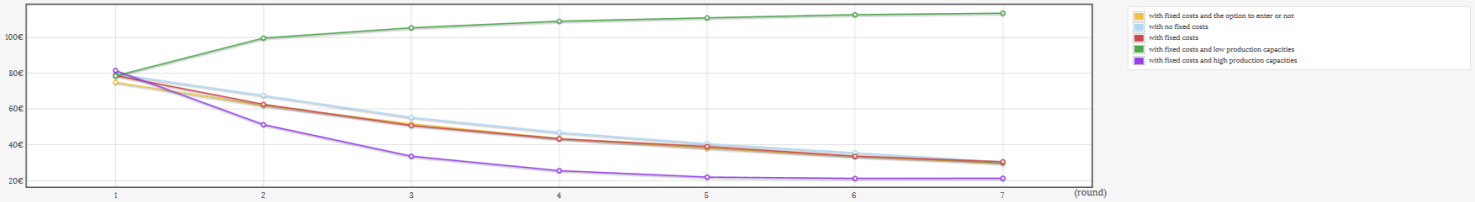
Instructor's Interface

economics-games.com

Slides Players' Logins Logout

Game Administration

Evolution of average chosen price by market type



Synthetic Results, Round 7

Average Price (for active firms)

Market/Round	7	6	5	4	3	2	1
with fixed costs and the option to enter or not	€30	€34	€38	€44	€52	€62	€75
with no fixed costs	€30	€36	€41	€47	€55	€68	€80
with fixed costs	€31	€34	€39	€43	€51	€63	€79
with fixed costs and low production capacities	€114	€113	€111	€109	€106	€100	€79
with fixed costs and high production capacities	€21	€21	€22	€26	€34	€51	€82

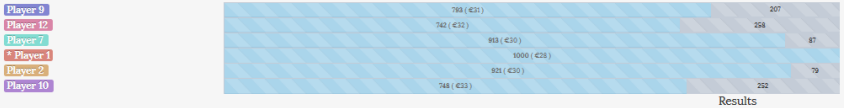
Average Profit

Market/Round	7	6	5	4	3	2	1
with fixed costs and the option to enter or not	€-13035.6	€-10672.6	€-7927.7	€-5155.1	€-1811.4	€2642.1	€5293.8
with no fixed costs	€22398.6	€25571.9	€28120.5	€31596.5	€34729.8	€38781.7	€41579.6
with fixed costs	€-12440.8	€-10689.2	€-7507.3	€-5514.5	€-1808.3	€2304.1	€6312.0
with fixed costs and low production capacities	€6178.4	€6232.1	€6197.9	€6010.9	€5600.0	€3300.0	€-5166.7
with fixed costs and high production capacities	€-19000.4	€-19115.4	€-18469.0	€-16175.7	€-10995.4	€-2842.0	€6757.4

Market Results, Round 7

Universe 1

Market 1 , with no fixed costs



Results

	Price	Sales	Revenues	Variable Costs	Fixed Costs	Profit on the Market
	€31	793	€24,583	€3,172	€0	€21,411

More

- More on this game and on how to use the site:

https://economics-games.com/sunk-cost-competition

Possible Extensions to study collusion with market game 2

- Have the students play again with new parameters:
  - Anonymous players on some universes, and not on others?
  - Encouraging communication or not?
  - More or less uncertainty about the end of the game?
  - Only allow price changes once every 2 or 3 rounds, on some of the markets?
  - On some markets/universes, you can invite students to declare a price on the blackboard (non-binding declaration)
  - …

MARKET GAME 3:

IMPACT OF THE NUMBER OF COMPETITORS ON PRICE AND PROFITS

Objective

- Short game (15 minutes), intended to:
  - Explain the logic behind competition.
  - Compare oligopoly with monopoly.
  - Have students understand the impact of the number of competitors on the competition intensity.

Description

- Players compete against other players on 2 markets with a different number of competitors:
- Demand is proportional to the number of competitors.
- Repeated game
  - Recommended setting: 2-players markets for the first experiment (i.e. n/2 universes), and 2 big universes with half of the players for the second experiment.
  - Avoid having only 1 universe to avoid over-aggressive strategies.

Possible Theoretical debriefings

- Comparison between monopoly and oligopoly (price and profits).
- What drives competition?
  - Residual demand and marginal revenue.
  - Price elasticity of demand and the sales/unit-price trade-off.
  - The prisoner's dilemma.
- Collusion and repeated games (+ impact of the number of competitors on collusion)

MARKET GAME 4:

PRICE AND QUANTITY COMPETITION, AND CO2 ENVIRONMENTAL POLICIES (QUOTAS, TAXES AND EMISSION PERMITS)

Objective

- Longer game (1h30 - 2h), intended to:
  - Introduce a few basic environmental policy tools: taxes, subsidies, quotas, permits and explain how/why they work.
  - Highlight the importance of marginal reasoning and opportunity costs.
  - Have students realize the dangers of misusing average costs.
  - Show the impact of marginal cost on price.
  - Show how quantity competion in the long-run articulates with price competition in the short-run.
- Can be played after market games 1 and 2, or on its own.
  - In this case, I would recommend having the students play this game as a monopoly, first.

    →get accustomed to the demand function.

    →get accustomed to the environmental policies .

    →provides a useful benchmark for the multiplayer game.

Description

- Impact of environmental policies in a setting with quantity precommitment followed by price competition.
- Players repeatedly take price and quantity decisions on four markets subject to different environmental policies for CO_2 emissions:
  - no policy benchmark,
  - unit taxes,
  - quotas
  - permits
- Production costs and demand are the same on all markets (same as in other games)
- Detailed Rules are available here:
  https://economics-games.com/resources/site/manual/environmental-economics-games.pdf

Technology on all markets

Unit production cost	Unit distribution cost	CO2 emissions (tons) per good produced
€15	€4	0.5

Note Each good produced now will cost €15 and emit 0.5 tons of CO2, even if it is not sold. It will also cost €4 if it is sold.

Market 1 , "Benchmark (Region 1)" (Your competitors: Player 2 Player 3 Player 4)

Note On this market, there is no environmental policy

Goods (by round)	Production Cost (€)	Production + Distribution Cost (€)	CO2 emissions (tons) by Round
986	14790	18734	493.000

Last Year Capacities and Sales

Round 1 (Total 4036 / Unsold : 1292 goods)

Profit on the market (excl. CO2 cost)

*Player 1	€17,870
Player 2	€15,668
Player 3	€14,946
Player 4	€17,200

Round 2 (Total 4036 / Unsold : 1027 goods)

Profit on the market (excl. CO2 cost)

*Player 1	€14,282
Player 2	€23,086
Player 3	€3,815
Player 4	€23,000

Market 2 , "Unit tax (Region 1)" (Your competitors: Player 2 Player 3 Player 4)

Note On this market, you will pay a €40 tax for each ton of CO2 emitted (which amounts to €20 by good)

Goods (by round)	Production Cost (€)	Production + Distribution Cost (€)	CO2 emissions (tons) by Round
910	13650	17290	455.000

cores

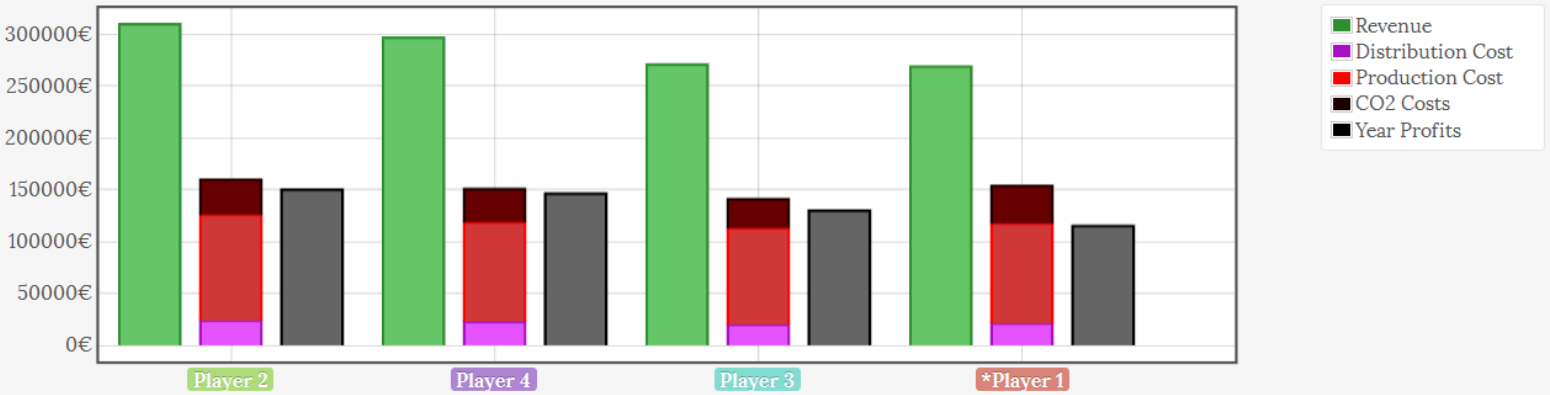
€200,014
€196,258
€179,865
€165,053

Year 1. Results

Over the Year

Ranking	Team	Year Profits	Average Price	Sales	Production	Sales/Production	CO2 emissions (tons)	CO2 Costs
1	Player 2	€150,014	€52	5,939	6,800	87.4 %	3,400	€34,000
2	Player 4	€146,258	€53	5,641	6,400	88.2 %	3,200	€32,000
3	Player 3	€129,865	€54	4,975	6,200	80.3 %	3,100	€28,000
4	*Player 1	€115,053	€51	5,235	6,432	81.4 %	3,216	€36,400

	Production	Average Price	Year Profits	Sales	CO2 emissions (tons)
Total	25,832	€53	€541,190	21,790	12,916 tons
Total over one market of type 1	8,072	€48	€129,867	5,753	4,036 tons
Total over one market of type 2	6,520	€53	€44,332	5,529	3,260 tons
Total over one market of type 3	4,800	€60	€199,200	4,800	2,400 tons
Total over one market of type 4	6,440	€50	€167,791	5,708	3,220 tons



Next

Costs and Policies

- Costs:
  - A firm must pay €15 for each good produced, and then €4 for each good sold.
  - Each good produced «emits» 0.5 tons of CO_2
- Environmental policies:
  - Market 1: benchmark market, no environmental policy.
  - Market 2: €40 tax by ton of emitted CO_2
  - Market 3: (non-tradable) quotas, 300 tons of CO_2 by round
  - Market 4: CO_2 emissions permits. Each firm receives 600 permits for free (or 300 permits by round).
    - With a permit, a firm can emit one ton of CO_2 at no cost.
    - If a firm emits more CO_2 than it has permits, it will buy permits at a price of €40 for each exceeding ton of CO_2.
    - If it emits less CO_2 than it has permits, it will sell unused permits at a price of €40 each.
- Remark: for a €40 unit tax, producing 1000 goods costs €(15+0.5*40)*1000, i.e. €35000
  - → If all firms decide to produce 1000 goods, they will find themselves exactly in the same situation as in market 2 of the second market game.

€50,000
€50,000
€50,000
€50,000

Technology on all markets

Unit production cost	Unit distribution cost	CO2 emissions (tons) per good produced
€15	€4	0.5

Note Each good produced now will cost €15 and emit 0.5 tons of CO2, even if it is not sold. It will also cost €4 if it is sold.

Market 1 , "Benchmark (Region 1)" (Your competitors: Player 2 Player 3 Player 4)

Note On this market, there is no environmental policy

Goods (by round)	Production Cost (€)	Production + Distribution Cost (€)	CO2 emissions (tons) by Round
1012	15180	19228	506

Market 2 , "Unit tax (Region 1)" (Your competitors: Player 2 Player 3 Player 4)

Note On this market, you will pay a €40 tax for each ton of CO2 emitted (which amounts to €20 by good)

Goods (by round)	Production Cost (€)	Production + Distribution Cost (€)	CO2 emissions (tons) by Round
720	10800	13680	360

Market 3 , "Quota (Region 1)" (Your competitors: Player 2 Player 3 Player 4)

Note On this market, you are limited by (non tradable) quotas: You cannot emit more than 300 tons of CO2 by round (or 600 tons of CO2 by year). This amounts to a maximum production of 600 goods (by round). Unused quotas are not kept for later.

Goods (by round)	Production Cost (€)	Production + Distribution Cost (€)	CO2 emissions (tons) by Round
600	9000	11400	300

Market 4 , "Permits (Region 1)" (Your competitors: Player 2 Player 3 Player 4)

Note On this market, you are limited by tradable emissions permits: You have enough permits to emit 300 tons of CO2 by round (or 600 tons of CO2 by year). This means that you can produce up to 600 goods (by round) for free. However, it is possible to produce more if you want, by buying extra permits for €40 each (hence, each good produced above 600 will cost you €20). If you produce less than 600 goods (by round), you will get €40 for each unused permit, by selling it. Buying and selling permits will be done by the game automatically.

Goods (by round)	Production Cost (€)	Production + Distribution Cost (€)	CO2 emissions (tons) by Round
[illegible]	12600	15960	420

	*Player 1	Player 2	Player 3	Player 4
Fixed Costs over the Round (excluding CO2)	€9,000	€9,000	€9,000	€9,000
CO2 Fixed Cost over the Round	€0	€0	€0	€0
CO2 emissions (tons)	300	300	300	300
CO2 emissions by good (tons)	0.5	0.5	0.5	0.5

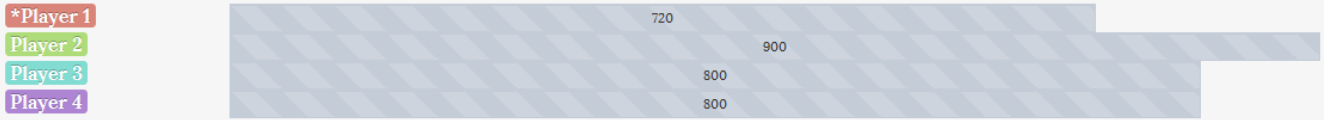
Market 4 , "Permits (Region 1)"

Price

67

Click here for last round's decisions

Total: 3220 / Remaining: 3220 goods



	*Player 1	Player 2	Player 3	Player 4
Available Goods	720	900	800	800
Distribution Unit Cost (variable, not paid yet)	€4	€4	€4	€4
Production Unit Cost (fixed, already paid)	€15	€15	€15	€15

	*Player 1	Player 2	Player 3	Player 4
Fixed Costs over the Round (excluding CO2)	€10,800	€13,500	€12,000	€12,000
CO2 Fixed Cost over the Round	€0	€0	€0	€0
CO2 emissions (tons)	360	450	400	400
CO2 emissions by good (tons)	0.5	0.5	0.5	0.5

Possible Theoretical debriefings

- « Average cost of CO_2 emissions » vs « marginal cost of CO_2 emissions ».
- Opportunity costs and emissions reduction subsidies (or permits resale)
- Impact of the 3 environmental policies on CO_2 emissions, prices and profits. Differences in practice.
- Windfall profits and quotas.
- …

Possible Theoretical debriefings

- …
- How and to what extent are taxes (or marginal cost changes) passed through to prices. Comparison with the impact of sunk costs on prices.
- How some variable costs in the long-run turn into sunk costs in the short-run.
  - What would happen in the short-run if a sudden, unexpected and severe demand crisis happened?
- Cournot and Bertrand equilibria

Many other games on:

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