The Potato Market Game with Externalities[1]

I. The Problem Context

A. Introduction

In the problem analyzed in the watersheds, asymmetries are identified both in the production processes (land, resources, etc.) and in the marketing processes, which, in general, generate social losses for people that have less possibilities of negotiation within the market.

The competitive market game with externalities is used so that the participants, immersed in a context of producers and buyers who seek to maximize their personal well-being through the purchase and sale of a private good -in this case the potato-, recognize the effect of externalities (environmental).

Based on the experience within a market without externalities and with externalities, participants will be able to observe the effects of individual maximization strategies on social welfare efficiency and the impossibility of the existing market institution being able to correct social losses derived from the externalities.

B. Purpose of the Game

This game must be played after making the x rounds of the game of the potato market. The purpose is that, now, the participants become familiar with the concept of externality, and discover to what extent an externality - even generated by other agents within the production of potatoes – can affect all people.

C. Economic Model of Analysis

The economic model of analysis for this game is the same as the model of the original potato market game. The variation in this case is that all players must assume a cost for the externality generated during the production of potatoes, expressed via a decrease in profits according to the amount of potato sacks marketed per round. The cost of the externality generated by each bag is $50, and this cost must be borne by each player according to the amount of sacks marketed during each round.

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[11] Translated from Juan-Camilo Cardenas and Pablos Andres Ramos (2006) Manual de juegos economicos para el analisis del uso colectivo de los recursos naturales, Centro Internacional de la Papa https://economia.uniandes.edu.co/files/profesores/juan_camilo_cardenas/docs/Archivos%20para%20descargar/MANUAL_JUEGOS_CARDENAS_RAMOS.pdf

II. Game Assembly or Experiment

A. Experimental Design

Potato Market					
40 players = 20 producers + 20 buyers					
		Demand ($)	Offer ($)	Income ($)	Income ($)
Player	Sacks	Willingness to pay (WTP)	Production Costs (PC)	Buy	Sell
20	1	33.550	24.450	4,550	4,550
19	2	33.400	24.600	4,400	4,400
18	3	33.250	24.750	4,250	4,250
17	4	33.100	24.900	4,100	4,100
16	5	32.950	25.050	3,950	3,950
15	6	32.800	25.200	3,800	3,800
14	7	32.650	25.350	3,650	3,650
13	8	32.500	25.500	3,500	3,500
12	9	32.350	25.650	3,350	3,350
11	0	32.200	25.800	3,200	3,200
10	11	32.050	25.950	3,050	3,050
9	12	31.900	26.100	2,900	2,900
8	13	31.750	26.250	2,750	2,750
7	14	31.600	26.400	2,600	2,600
6	15	31.450	26.550	2,450	2,450
5	16	31.300	26.700	2,300	2,300
4	17	31.150	26.850	2,150	2,150
3	18	31.000	27.000	2,000	2,000
2	19	30.850	27.150	1,850	1,850
1	20	30.700	27.300	1,700	1,700
1	21	30.550	27.450	1,550	1,550
2	22	30.400	27.600	1,400	1,400
3	23	30.250	27.750	1,250	1,250
4	24	30.100	27.900	1,100	1,100
5	25	29.950	28.050	950	950
6	26	29.800	28.200	800	800
7	27	29.650	28.350	650	650
8	28	29.500	28.500	500	500
9	29	29.350	28.650	350	350
10	30	29.200	28.800	200	200
11	31	29.050	28.950	50	50
12	32	28.900	29.100	-100	-100
13	33	28.750	29.250	-250	-250

14	34	28.600	29.400	-400	-400
15	35	28.450	29.550	-550	-550
16	36	28.300	29.700	-700	-700
17	37	28.150	29.850	-850	-850
18	38	28.000	30.000	-1,000	-1,000
19	39	27.850	30.150	-1,150	-1,150
20	40	27.700	30.300	-1,300	-1,300

The values that are within the columns called Buy and Sell are the net gains expected by buyers and sellers if negotiated at the equilibrium price of the game ($ 29,000). These rents are decreasing from top to bottom until they are negative, and it is at this point that it is expected that no further transactions will take place.

B. Sample Size (suggested minimum)

The design presented here has 40 players who must be randomly divided into two equal groups of buyers and sellers/producers. If the number of participants is smaller, the way in which the game adapts is very simple: players shown in the previous table must be eliminated from player number 20 downwards; that is, the first and last ones will be eliminated until the number of players present is reached.

It is suggested that the game is played with at least 20 players (10 buyers and 10 producers), for which the previous table is substantially reduced. However, with fewer players, additional changes must be made to the table. Note that for 10 buyers and 10 sellers, the curves will even intersect one or two units after the potential 0 units. One option to reduce the number of players is to increase the slope of the curves, that is, to make it such that the production costs in the previous table will go up at a higher rate and that the resale prices of buyers will decrease at a higher rate.

C. Session Design (N Players, T Rounds)

It is necessary that each group consist of an even number of players (maximum 40 people), so that half (20) are buyers and the other half (20) producers. The game consists of 10 rounds, but you can play fewer or more rounds, dependent upon the time constraints.

In our example, the game consists of 10 rounds or market days, in which each player and buyer must sell or buy up to two bags of potatoes, producers with a minimum sale price according to production costs and prices and buyers with a maximum purchase price determined by the value at which they sell each potato sack to the retailers.

Time: the time for each round (each market day) must be five minutes. The moderator is in charge of announcing the round that is being played - "The first day of the market opens" - and

announcing in advance the end of the round - "There is one minute to close the second day of the market" -.
After this, the moderator will announce to the group how many bags were marketed and the amount that should be deducted from their profits.

D. Type of Participants

All kinds of people can participate in this game; in the case of watersheds, better results would be obtained if persons dedicated to the same type of production system were to play, but this is not a strict rule.

E. Estimation of the Pay Incentive for Participants

Table of points established on the basis of the total winnings, according to the maximum possible gain for a player.

Income ($)	Possible Payment in US Dollars
60,000-70,000	15
50,000-59,999	14
40,000-49,999	13
30,000-39,999	11
20,000-29,999	9
10,000-19,999	7
0-9,999	5

III. Tools, Logistics

A. Room Layout

The experiment must be carried out in a room that offers an environment in which the participants can move freely in order to be able to look for someone to negotiate with.

B. Field Team

For this game you need a moderator to explain the instructions of the exercise and an assistant to help answer the questions of the group in addition to coordinate the times between each round.

The roles of the moderator are:

Show and explain to the group the purpose and operation of the game and answer any questions that the players have.

The roles of the assistant are:

Help the moderator with distributing things when needed as well as moderate the time.

IV. Necessary Formats to Carry out the Game

A. For the Explanation of the Game Instructions

Format of the Contract

Number of the day of the Market:
Buyer Code:
Producer Code:
Agreed Price: $

Format for the Producers

	Week	1	2	3	4	5	6	7	8	9	10
First Sack of Potatoes	Retail price that you negotiated (value for you)										
	Your cost of production (cost for you)										
	A) Net Gain (value – cost)										
Second Sack of Potatoes	Retail price that you negotiated (value for you)										
	Your cost of production (cost for you)										
	B) Net Gain (value – cost)										
Earnings for round (A + B) :											
Total number of sacks sold in the region (the monitor will announce this):											
(C) Additional cost to bring water =											
Net gains per week (A + B – C) = (Net gain for the sale – Cost of water)											
Total Earnings: $_____											

Format for the Buyers

	Week	1	2	3	4	5	6	7	8	9	10
First Sack of Potatoes	Resell Price (value for yourself)										
	Price paid for the potatoes (cost for yourself)										
	A) Net Gain (resell price – price paid)										
Second Sack of Potatoes	Price of Resell (value for yourself)										
	Price paid for the potatoes (cost for yourself)										
	B) Net Gain (resell price – price paid)										
Earnings for round (A + B) :											
Total number of sacks sold in the region (the monitor will announce this):											
(C) Additional cost to bring water =											
Net gains per week (A + B – C) = (Net gain for the sale – Cost of water)											
Total Earnings: $_____											

B. For those in charge of Facilitating the Game

For the Moderator

The instructions for this game are the same as those of the previous game; The difference is that a new context is introduced. It reads the following:

You keep selling or buying potatoes at the same sale prices that you had. However, the high mountains from where the water comes for the cultivation of potatoes can be affected, depending on the total amount of potatoes produced in the microbasin. The problem is that if the high mountains are affected, the producers must bring the water from more distant sources, which generates an additional cost for the time they must use to transport the water.

Everyone in the micro-watershed, whether they sell or not, buy or not, suffer the effects of water reduction due to alterations in the high mountains. Depending on how much potato is grown in the micro-basin, everyone will have to assume additional environmental damage, represented by the cost of going to collect water to more distant places or to buy it from those who have it.

Some experts have estimated that for each sack of potatoes produced and sold in the microbasin, each family of buyers or producers have to use an additional wage to pay for water at a cost of $50 per sack.

For example, if 5 bags of potatoes are sold in total, each person must subtract 5 x $ 50 = $ 250 from their earnings. Once the market day ends, the sacks sold will be counted and the total will be announced, so that each participant (seller or buyer) calculates the additional costs for water and subtracts them from their individual earnings.

Sequence of the Experiment

1. Introductions of the Field Team/Facilitators
2. Introductions of the Participants
3. Instructions Lecture
4. Explanation of the Experiment
5. Examples
6. Play the Game (10 Rounds of 5 minutes each)
7. Payment to the participants
8. Comments

Examples

MERCADO COMPETITIVO DE LA PAPA

HOJA DEL MONITOR (Registrar TODOS los contratos acordados en cada día, anotando el precio)

Fecha: 11 / 21 / 09 Lugar: Unn. Javeriana Monitor: Daniel Castillo

Unidades	Día 1	Día 2	Día 3	Día 4	Día 5	Día 6	Día 7	Día 8	Día 9	Día 10
1	30000	29700	29500	29500	29700	29650	29570	29600	29700	29000
2	30000	29700	29650	29650	29500	29650	29570	29700	29600	29700
3	29500	29600	29650	29600	29500	29600	29650	29700	29650	29700
4	29500	29700	29700	29600	29600	29600	29650	29600	28000	29600
5	29700	29700	29600	29600	29600	29700	29700	29600	29500	
6	29900	29600	29600	29600	29650	29600	29650	28000		
7	29500	29600	29700	29650	29650	29600	29600			
8	29700	29700	29600	29700	29550	29700	29400			
9		29750	29650	29500	29550	29600				
10		29500	29650	29400	29600	29700				
11		29400	29500	29500	29700	29700				
12		29400	29550	29500	29700	29570				
13		29500	29600	29600	29600	29570				
14		29700	29500	29650		29650				
15		29700	29500	29650		29650				
16		29600	29000			29700				
17			29500			29650				
18			29500			29600				
19						29400				
20										
Total de unidades transadas	8	16	19	15	13	19	8	6	5	4
Promedio de precios	29725	29686	29558	29580	29608	29626	29599	29033	29290	29500
Costo adicional x exter.	400	800	950	950	650	950	400	300	250	200

Microsoft Excel - datosjuegoclasedaniel

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Arial 10

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	A	B	C	D	E	F	G	H	I	J	K
1		1	2	3	4	5	6	7	8	9	10
2	1	30000	29700	29500	29500	29700	29650	29570	29600	29700	29000
3	2	30000	29700	29650	29650	29500	29650	29570	29700	29600	29700
4	3	29500	29600	29650	29600	29500	29600	29650	29700	29650	29700
5	4	29500	29700	29650	29600	29600	29600	29650	29600	28000	29600
6	5	29700	29700	29700	29600	29600	29700	29700	27600	29500	
7	6	29700	29600	29600	29600	29650	29600	29650	28000		
8	7	29900	29600	29600	29650	29650	29600	29600			
9	8	29500	29700	29700	29700	29550	29700	29400			
10	9		29750	29600	29500	29550	29600				
11	10		29500	29650	29400	29600	29700				
12	11		29400	29650	29500	29700	29700				
13	12		29400	29500	29500	29700	29570				
14	13		29500	29550	29600	29600	29570				
15	14		29700	29600	29650		29650				
16	15		29700	29500	29650		29650				
17	16		29600	29500			29700				
18	17			29000			29650				
19	18			29500			29600				
20	19			29500			29400				
21	Precio promedio	$ 29.725	$ 29.616	$ 29.558	$ 29.580	$ 29.608	$ 29.626	$ 29.599	$ 29.033	$ 29.290	$ 29.500
22	Cantidad Total	8	16	19	15	13	19	8	6	5	4
23	Volumen venta	$ 237.800	$ 473.850	$ 561.600	$ 443.700	$ 384.900	$ 562.890	$ 236.790	$ 174.200	$ 146.450	$ 118.000
24	Desv estandar+1	$ 29.930	$ 29.724	$ 29.707	$ 29.659	$ 29.675	$ 29.695	$ 29.686	$ 29.914	$ 29.938	$ 29.792
25	Min.Precio	29500	29400	29000	29400	29500	29400	29400	27600	28000	29000
26	Max.Precio	30000	29750	29700	29700	29700	29700	29700	29700	29700	29700
27											

Vrs_Inducidos PreciosMercado Tarjetas valores

Listo NUM

Inicio 06:03 p.m.

V. Presentation of the Results

The data to present to the group are:

- Quantity of potato sacks negotiated each round
- Average price per round
- The externality price each round, and the relationship between this price and the decrease of transactions

In this game, it is important to make comparisons when assuming the costs of an externality. In this case, it was evident that the costs were economic and very close in time, because the discounts were made in each round after the market day; in real life, this externality could be related to the reduction or contamination of water for human consumption, or to diseases associated with water quality, which also affect the entire community.

VI. Materials to Photocopy

The material to be photocopied is:

- Account sheet for producers and buyers (on green paper)
- Contract cards (on yellow paper)

The transaction prices for each one are the same as they were in the original Potato Market Game.

Potato Market with Externalities **Date___/___/___** **Buyer Code_____**

You are a potato buyer: You keep buying potatoes at the same resale prices that you had. However, depending on the total amount of potatoes produced in the micro-basin, the high mountains from where the water comes for use on your farm may be affected. The problem is that if the high mountains are affected, you will have to get the water from more distant sources, which will generate an additional cost for the time you must dedicate to go get the water. A group of experts has estimated that for each sack of potatoes produced and sold in the region, each family of buyers or producers must use an additional wage at a cost of $ _____

Even if you did not buy potatoes, the cost of water continues to exist - you have to transport it, either way - and you must calculate it even if you obtain negative profits.

	Week	1	2	3	4	5	6	7	8	9	10
First Sack of Potatoes	Resell Price (value for yourself)										
	Price paid for the potatoes (cost for yourself)										
	A) Net Gain (resell price – price paid)										
Second Sack of Potatoes	Price of Resell (value for yourself)										
	Price paid for the potatoes (cost for yourself)										
	B) Net Gain (resell price – price paid)										
Earnings for round (A + B) :											
Total number of sacks sold in the region (the monitor will announce this):											
(C) Additional cost to bring water =											
Net gains per week (A + B – C) = (Net gain for the sale – Cost of water)											
Total Earnings: $_____											

Potato Market with Externalities **Date___/___/___** **Producer Code_____**

You keep producing potatoes at the same production costs that you had. However, depending on the total amount of potatoes produced in the high mountains, the micro-basin from where the water comes for use on your farm may be affected. The problem is that if the high mountains are affected, you will have to get the water from more distant sources, which will generate an additional cost for the additional time you must use to get the water. A group of experts has estimated that for each sack of potatoes produced and sold in the region, each family of buyers or producers must use an additional wage at a cost of $ _____.

Even if you did not sell potatoes, the cost of water continues to exist - you have to transport it either way- and you must calculate it even if you made a negative profit.

	Week	1	2	3	4	5	6	7	8	9	10
First Sack of Potatoes	Retail price that you negotiated (value for you)										
	Your cost of production (cost for you)										
	A) Net Gain (value – cost)										
Second Sack of Potatoes	Retail price that you negotiated (value for you)										
	Your cost of production (cost for you)										
	B) Net Gain (value – cost)										
Earnings for round (A + B) :											
Total number of sacks sold in the region (the monitor will announce this):											
(C) Additional cost to bring water =											
Net gains per week (A + B – C) = (Net gain for the sale – Cost of water)											
Total Earnings: $_____											

Contract Cards and Value Cards for the Buyers and Producers

Number of the day of the Market:
Buyer Code:
Producer Code:
Agreed Price: $

Number of the day of the Market:
Buyer Code:
Producer Code:
Agreed Price: $

Number of the day of the Market:
Buyer Code:
Producer Code:
Agreed Price: $

Number of the day of the Market:
Buyer Code:
Producer Code:
Agreed Price: $

Number of the day of the Market:
Buyer Code:
Producer Code:
Agreed Price: $

Number of the day of the Market:
Buyer Code:
Producer Code:
Agreed Price: $

Number of the day of the Market:
Buyer Code:
Producer Code:
Agreed Price: $

Number of the day of the Market:
Buyer Code:
Producer Code:
Agreed Price: $

Number of the day of the Market:
Buyer Code:
Producer Code:
Agreed Price: $

Number of the day of the Market:
Buyer Code:
Producer Code:
Agreed Price: $

Number of the day of the Market:
Buyer Code:
Producer Code:
Agreed Price: $

Number of the day of the Market:
Buyer Code:
Producer Code:
Agreed Price: $

Number of the day of the Market:
Buyer Code:
Producer Code:
Agreed Price: $

Competitive Potato Market

Sheet for the monitor (to register all of the agreed contracts for each day, noting the price)

Date:_____ Place:_____ Monitor_____

UNITS	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
16										

17										
18										
19										
20										
Total Units Traded										
Average Price										
Additional Cost of Externalities										