Case Study - FAME trial

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Abstract

We report on a classroom experiment with network externalities at the Scottish Experimental Economics Laboratory in Aberdeen. While we acknowledge idenfication problems in assessing the effectiveness of teaching methods, we believe that teaching classroom experiments is a way forward. We use the resources of the Economics Network, Institute for Learning and Research Technology, University of Bristol. We reflect on how we used the resources and how the resources might be used in supporting student learning. We also report results from the three classroom sessions. The trial has been presented to the economics department, University of Aberdeen.

1 Network Externalities

1.1 Background

Home video consoles are sold by Sony Computer Entertainment (PLAYSTATION (PS3)), Microsoft (Xbox 360), Nintendo (Wii). Figure 1 shows a picture of Microsoft's product.

1.2 Experiment: Warm-up discussion

Students from three tutorial groups at the University of Aberdeen were invited to come to the Scottish Experimental Economics Laboratory for participation in classroom experiments with network externalities. We started with a warm-up class discussion with the claim - **Home video consoles are not washing machines**. Almost every student who does not live in a dormitory owns a washing machine. Most young people have or had a home game console. Everyone knows the brand of her own washing machine, but almost no one knows the type of washing machine of others. Almost everyone who has a game console knows the make of their friends' game consoles. We asked: "Who owns a PS3 and who owns Xbox 360? Why did you buy one (or the other)? Which features of the consoles tempted you to buy?" The question generated a lively discussion of the pros and cons of the products. The most frequent answers were: the price of the Xbox 360 is lower, quality of Microsoft's controller is higher, habit ("I always buy Sony's consoles"), PLAYSTATION because I can exchange games with friends. We observed that the valuation of a consoles varies considerably across students - some just don't care you owning a console, some students play every day and do not want to go without. We noticed that students notice that the valuation depends on what others buy and use. The market prices or consoles in May 2009 in

Figure 1: Microsoft's home game console

the UK are: Xbox 360 Console (60 GB) £159.96, PS 3 Console (80 GB) £289.99. There seems to be very little price disperson across stores and cities. There is no reliable information on production costs but rough estimates of cost of producing a PS3 is $400. You can think of home game consoles as small computer. The manufacturers (Microsoft, Sony and Nintendo) source the hardware components from outside suppliers. For instance the PLAYSTATION's machine, the cell processor, is produced at IBM's New York microchip production facility.

Worldwide sales for a PLAYSTATION are PS3 21.3 million as of December 31, 2008 and 360 27.93 million for a Microsoft Xbox as of January 24, 2009. The PLAYSTATION PS3 offers an online gaming service: It is called PlayStation Network. This service allow the players to be connected, it is free, and it supports multiplayer gaming. Microsoft's online gaming service is similar. It is called Xbox live. Currently, it is the only gaming service on home consoles that charges users a fee to play multiplayer gaming. In the UK, current prices are £4.99 per month and £34.99 per year.

In the business press, it is widely reported that companies subsidies the consoles. Hence, we closed the discussion with the questions about the rationality of the manufacturer's business strategy: "Do you think the low price strategy of Sony and especially Microsoft is a good strategy? What are the pros and cons of selling a product under production cost?"

2 Classroom experiments - Enhancement of teaching?

I do not know whether there is a reliable way to assess the effectiveness of teaching methods. In an ingenious way, the caricature flashes out the statistical problem. So, well, we will need to try out the effectiveness of classroom experiments - one experiment at a time.

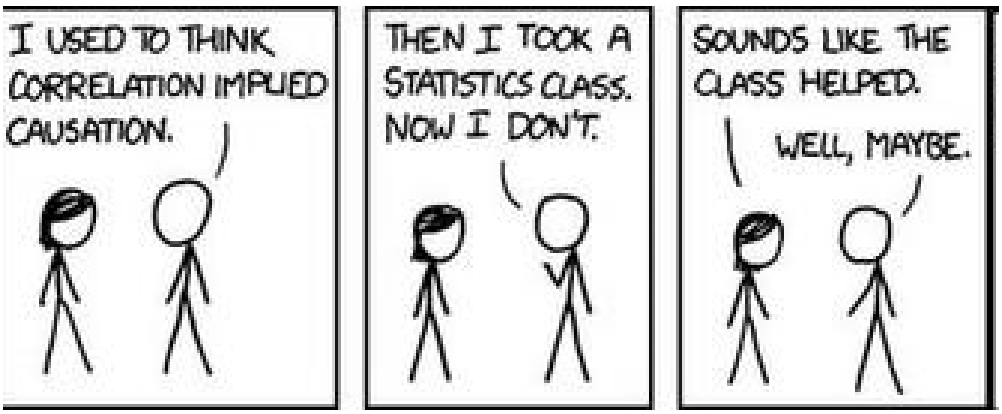

Figure 2: The problem.

3 Classroom experiments

The motivation for classroom experiments is best summarized in a quote from some experienced teachers: "We got tired of it. Lecturing to sleepy students who want to "go over" material that they have already highlighted in their textbooks so that they can remember the "key ideas" until the midterm. We wanted to engage our students in active learning, to exploit their natural curiosity about economic affairs, and to get them to ponder the questions before we try to give them answers. We found that conducting experiments in class, with discussions before, during, and after the experiments is an effective and enjoyable way of moving from passive learning to active learning." A Note to Teachers, The Experiment with Economic Principles, Miller and Bergstrom

Here we are told about the best practise for classroom experiments: before coming to the session, students need to work through some assignment, there need to be a warm-up discussion before play starts, and one hopes to generate a lively discussion during the experiment and after conclusion of play. Students in classroom experiments are participants in the markets as well as the scientific observers who try to understand the results. If experience is any guide students like to take part in experiments and enjoy interacting with each other. We tried a computerized **group participation** experiment, by pretending that students are original participants in a real session. Students indeed participated willingly (only one out of 23 students was not interested at all and just punched in some numbers).

4 Network Experiment - Discussion

I have not used the discussion below. This discussion is too advanced for the local students. However, I provided intuition for the following steady-states: pessimistic expectations equilibrium; middle equilibrium; high equilibrium.

One should only buy the good if the expected value of the actual value is above the price: $E[nV] \geq p$ where n is the proportion of others buying the good. There are multiple equilibria. One equilibrium has no one buying the good. If no one buys a fax a machine, then you shouldn't buy a fax machine $E[0*V] < p$ for all V. In the first part, the price is £2.40 and the private values are uniformly distributed in the

interval [£0.00, £10.00]. There is another equilibrium with a positive n. Those deciding to buy the good have should have V such that $E[n]V \geq p$. In words, they buy if for private values above a common threshold value $V = \frac{p}{E[n]}$. What should that value be? The proportion of others who buy is $\frac{10-V}{10}$, so each consumer is indifferent between buying and not buying when $\frac{10-V}{10}V = 2.4$. Solution is: 4.0 and 6.0. When $V = 4$, this is the success equilibrium where $E[n] = \frac{10-4}{10} = 60\%$ of the consumers buy the good.

When $V = 6$, it is in an unstable equilibria, which one could call the "tipping point". If people with values of **5.9** start buying it then, the object would be a hit, that is, it will go to the equilibrium with $V = 4$. This is because the proportion of those buying it is now $\frac{10-5.9}{10} = 0.41$ and $\frac{p}{0.41} = \frac{2.4}{0.41} = 5.85$. So those with values above **5.85** will start buying the good. Repeating this calculation (an infinite number of times) one will arrive at $V = 4$. In another setup, the price is £2.10 and the private values are uniformly distributed in the interval [£0.00, £10.00]. Solution is: 3.0, 7.0. In another setup, the price is £2.10 and the private values are uniformly distributed in the interval [£0.00, £8.00]. In the second part, the price is £1.50 and the private values are uniformly distributed in the interval [£0.00, £8.00]. Solution is: 2.0, 6.0.

In a future experiments, I will provide a homework assignment for students and have a discussion in the tutorial after the session.

5 Data analysis

The results are summarized in the table below.

Part 1 price 2.40 [0 10]	Maximum Value	Frequency	Part 2 price 1.50 [0 8]	Maximum Value	Frequency
	1.54	2		0.02	2
	1.77	3		2.2	9
	2.51	11		3.38	14
	3.34	11		3.85	17
	3.9	8		4.03	22
	6.95	22		4.12	22
	8.41	22		5.06	23
	8.91	23		5.24	22
	9.19	23		6.34	22
	9.3	23		7.56	22

By and large, the results points out that students took the experiment seriously.

Theory (the prediction is the high equilibrium) is a good guide when looking at the data.

6 Improvements

Exeter's gaming software is very good. The instruction's are very clear and there is really no need to re-write the instructions. The experiment can be conducted in any room with computer that have access to the web. The experiment can follow the results live. This feature can help with discussions during and after the play. A shortcoming is that students can not follow the results. There needs to be a way

in which they are also scientific observers. After each round, all they are informed about are the number of buyers.

My suggestions for improvement of the resources are:

- Could the instructions, the equilibrium analysis and the analyis of dynamics be simplified by using a small set of discrete values for the valuations?
- How could we let participants move sequentially? Could we observe a rush to buy?
- Could we introduce another type of player, a seller who sets the price of the good?
- We need a good structured follow-up discussion and follow-up homework assignment. We need to write exam questions and dissertation topics.

7 Appendix

The instructions are adopted from Exeter's game site. I have made modifications and added material here and there. However the instructions provided by Exeter's site are short and good.

Network Experiment - Instruction

Part 1 Instructions

This is an experiment in two parts. This part of the experiment consists of 10 rounds. In each round, you will have to decide whether or not to buy a commodity. The price of the commodity is the same for everyone taking part in the experiment, whereas its value to each person is different. The **price** of the commodity for everyone is £**2.40** throughout this part of the experiment. The **value** of the commodity to you in a given round is determined by two things: its **maximum value to you** and the **number of people** other than you that buy it. The maximum value of the commodity to you is chosen randomly at the start of each round, with all values in the range £**0.00** to £**10.00** being equally likely. This maximum value is private to you and it is not shown to anyone else. Similarly, you cannot see the others' maximum values, which are different to yours. The **actual value** of the commodity to you is equal to its maximum value multiplied by the proportion of people other than you that buy it. So the actual value is always lower than the maximum value unless everyone else buys the commodity. The actual value is zero if no one else buys the commodity.

At the start of each round, you are told the commodity's price and its maximum value to you for that round. You must then make a decision: **Do Not Buy** or **Buy**. After everyone has decided, you will be told how many people bought the commodity and hence its actual value to you. You will also be told your profit for the round, calculated as follows.

Profit (Do Not Buy)

If your decision is Do Not Buy, there is no purchase and your profit is zero.

Profit (Buy)

If your decision is Buy, the purchase is made and your profit is equal to the actual value of the commodity to you, minus its price.

Example Profit Calculation

Suppose that you decide to buy the commodity when it has a price of £2.40 and a maximum value to you of £7.50. If 14 of the 19 other people also decide to buy, your profit from the purchase is 3.1263: $\frac{14}{19} * £7.50 - £2.40$.

Positive and Negative Profits

Since you do not know the actual value of the commodity prior to deciding whether or not to buy it, it is possible that the actual value of the commodity to you will be less than its price, in which case you will have made a negative profit from the purchase. Negative profits will be subtracted from your total profit, whereas positive profits will be added.

Total Profit

At the end of each round, the computer will display your Total Profit, which is the cumulative total of your profits from the current round and all previous rounds.

Test Questions

Before the experiment begins, there will be some multiple-choice test questions, to test your understanding of the rules.

Test Question 1 of 2

Suppose that the commodity has a price of $£P$ and a **maximum value** to you of $£M$ for a particular round. What is the actual value of the commodity to you if three quarters ($\frac{3}{4}$) of the other people buy it?

$(a) £0$, $(\mathbf{b}) \frac{3}{4} * £M$, $(c) £M$, $(d) £P$

What is the **actual value** of the commodity to you if no one else buys it?

$(\mathbf{a}) £0$, $(b) \frac{3}{4} * £M$, $(c) £M$, $(d) £P$

What is the **actual value** of the commodity to you if everyone else buys it?

$(a) £0$, $(b) \frac{3}{4} * £M$, $(\mathbf{c}) £M$, $(d) £P$

Test Question 2 of 2

Suppose that the commodity has a price of $£P$ and a maximum value to you of $£M$ for a particular round. What is your **profit** if you do not buy the commodity?

$(\mathbf{a}) £0$, $(b) £ - P$, $(c) £M$, $(d) £M - £P$

What is your **profit** if you buy the commodity but no one else buys it?

$(a) £0$, $(\mathbf{b}) £ - P$, $(c) £M$, $(d) £M - £P$

What is your **profit** if you buy the commodity and everyone else buys it?

$(a) £0$, $(b) £ - P$, $(c) £M$, $(\mathbf{d}) £M - £P$

Summary

If you decide to buy, your profit is equal to the actual value of the commodity minus its price. The actual value of the commodity to you is equal to its maximum value multiplied by the proportion of people other than you that buy it. The maximum value of the commodity is different for each person and known only by the person themself. The price of the commodity (£2.40) is the same for everyone.

Here are results from actual play:

Rd	Your Decision	Max. Value	Other Buyers	Actual Value	Price	Profit	Total Profit
1	Buy	£3.50	15	£2.76	£2.40	£0.36	£0.36
2	Do Not Buy	£1.77	11	£1.02	£2.40	£0.00	£0.36

Part 2 Instructions

This part of the experiment consists of 10 rounds. In each round, you will have to decide whether or not to buy a commodity. The price of the commodity is the same for everyone taking part in the experiment, whereas its value to each person is different. The price of the commodity (for everyone) is **£1.50** throughout this part of the experiment. The value of the commodity to you in a given round is determined by two things: its maximum value to you and the number of people other than you that buy it. The maximum value of the commodity to you is chosen randomly at the start of each round, with all values in the range **£0.00** to **£8.00** being equally likely. This maximum value is private to you and it is not shown to anyone else. Similarly, you cannot see the others' maximum values, which are different to yours. The actual value of the commodity to you is equal to its maximum value multiplied by the proportion of people other than you that buy it. So the actual value is always lower than the maximum value unless everyone else buys the commodity. The actual value is zero if no one else buys the commodity.

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Profit (Buy)

If your decision is Buy, the purchase is made and your profit is equal to the actual value of the commodity to you, minus its price.

Example Profit Calculation

Suppose that you decide to buy the commodity when it has a price of £1.50 and a maximum value to you of £6.00. If 14 of the 19 other people also decide to buy, your profit from the purchase is $£2.92 = \frac{14}{19} * £6.00 - £1.50$.

Positive and Negative Profits

Since you do not know the actual value of the commodity prior to deciding whether or not to buy it, it is possible that the actual value of the commodity to you will be less than its price, in which case you will have made a negative profit from the purchase. Negative profits will be subtracted from your total profit, whereas positive profits will be added.

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Summary

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Here are results from actual play:

Round 1 of 10
The price of the commodity is £2.10.
The maximum value of the commodity to you for this round is £2.20.
You decided to buy the commodity.

Not counting you, 14 of 19 other participants decided to buy the commodity, so its actual value to you for this round is £1.62, calculated as follows: actual value = $\frac{14}{19}$ *£2.20 = £1.62. Since you yourself decided to buy the commodity, your profit from the purchase is £1.62 - £1.50 = £0.12.

8 References

http://en.wikiversity.org/wiki/Economic_Classroom_Experiments/Network_Externalities

A Note to Teachers, The Experiment with Economic Principles, Miller and Bergstrom
http://zia.hss.cmu.edu/miller/eep/ntt.html