

# The Effects of Search Costs on Prices and Price Dispersion: A Web-Based Classroom Game

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## Abstract

Information Systems students often have difficulty understanding the market forces behind Internet prices. This paper describes a web-based classroom game used to demonstrate the effects of reduced search costs on price levels and price dispersion as well as the possible benefits to both buyers and sellers. The game is available for free and does not require any specialized hardware or software; all that is needed is a computer connected to the internet running a standard browser. The game takes less than 20 minutes and students may participate simultaneously or separately.

**Keywords:** Classroom Game, Search Costs and Information Systems Economics

### 1. INTRODUCTION

With the growth of the Internet and electronics commerce, potential buyers now have easy access to an unprecedented amount of product and price information. The addition of search engines, infomediaries and shopbots further reduces buyer search costs and makes comparison shopping possible on scales never before imagined.

However, while students seem to have a vague notion that prices are somehow lower on the Internet, they often have difficulty understanding the market forces behind these prices. Students also have difficulty recognizing any positive effects of reduced search costs for online sellers. This paper describes a classroom exercise that demonstrates the effects that reduced search costs can have on price levels and

price dispersion as well as the possible benefits to both buyers and sellers.

### 2. BACKGROUND

Economists have widely anticipated that readily available price and product information coupled with reduced search costs will cause Internet markets to display pricing consistent with the textbook case of the "law of one price" (Baye et al. 2001). As Bakos (1997) explains, economists have long known that search costs (i.e., costs incurred by the buyer to locate an appropriate seller and make a purchase) add inefficiencies to markets and allow sellers to extract higher prices. Such market inefficiencies include the opportunity cost of time spent searching as well as expenditures such as driving, telephone calls, computer fees, magazine subscriptions, etc. The Internet makes obtaining product

information and comparison shopping easier. Bakos shows that this lowering of search costs increases seller competition, which leads to lower prices and increased buyer surplus.

While this effect is most pronounced in commodity markets, it is also significant in differentiated markets, where lower search costs reduce seller monopoly power, which leads to lower prices for the buyer and lower profits for the seller. In related work, Bakos (1998) notes that Internet-based electronic marketplaces leverage information technology to match buyers and sellers and facilitate the exchange of information, goods, services and payments associated with market transactions. He explains that Internet marketplaces perform these functions with increased effectiveness and reduced transaction costs, resulting in more efficient, "friction-free" markets. He further notes that the dynamics of friction-free markets are not attractive for sellers who had previously depended on geography or consumer ignorance to insulate them from low-cost sellers in the market.

If the "friction-free markets" hypothesis is correct, electronic markets would not only have lower prices, but also less price dispersion (i.e., persistent price differences for the same product) and more competition than traditional markets. Internet pricing and price dispersion have been widely investigated by Information Systems, economic and marketing researchers (e.g. Bakos 1997; Brynjolfsson et al. 2000; Clay et al. 1999; Lal and Sarvey 1999).

### 3. ONLINE CLASSROOM GAMES

The goal of this exercise is to demonstrate the effects of reduced search costs on prices and prices dispersion. The exercise does not attempt to prove or disprove any theory, but is only meant as a teaching tool to help students gain an understanding of the effects of reduced search costs on markets.

The exercise utilizes a freely available Sequential Search game written by economist Charles Holt and made possible by a multi-year, interdisciplinary National Science Foundation Grant, "Game Theory and Social Interactions: A Virtual Collaboratory for Teaching and Research" (Holt 2005). The

site has more than 40 experimental and teaching-related programs that are played online and do not require either the instructors or the students to download any additional software. Each of the programs allows users to run a particular type of market, game, or decision-making situation. The games are fully documented and are flexible in terms of treatments, scale and payoffs that can be specified or randomly determined.

Each game has a set of participant instructions that are automatically customized according to the options the instructors have selected. An "admin results" page collects and displays participants' decisions, along with earnings, averages, and theoretical predictions for the parameters the instructor selected. The instructor can then print, save, or project these results pages for class discussion. Most of the results pages also provide a link to a graphical presentation of the data and the associated theoretical predictions for the setup the instructor specified (Holt 2005).

The graphs include intuitive controls that can be customized to show results for the entire session or for one round at a time. An additional helpful feature is the ability to hide or display theoretical predictions (Holt 2005).

We have found the program's graphing capabilities to be quite advanced and the outputs easily imported into PowerPoint for use in our slides or into MS Excel for further exploration by the students. To make this easier, there is also a link from the results page to an unformatted block of data that is designed to be copied and pasted into Excel or another spreadsheet or statistical program (Holt 2005).

One of the nice things about all of the games that Charles Holt has created is that they do not require any specialized hardware. All that is needed to run any of these games are one or more Internet-connected computers running a standard browser. Holt mentions that the displays are basic, involve minimal graphics, and load quickly. He also notes that the experiments even run smoothly on wireless hand-held PCs running Pocket Internet Explorer.

#### 4. PRIOR TO THE GAME

In the weeks before the exercise, instructors thoroughly introduce students to search engines via class lectures, their textbook (Parsons and Oja 2005) and a homework assignment based on the work of Graham and Metaxas (2003). In the class meeting immediately preceding the exercise meeting, instructors introduce students to shopbots and Internet price comparison sites and discuss the possible implications of these tools on market prices. The instructors also discuss the upcoming exercise and inform students where they can find instructions they will need for the exercise.

Student schedules and limited lab facilities at our school force us to run the exercise in waves. However, if these restraints were lifted all students could run through the exercise at once. However, we make sure that all students take part in the exercise on the same day simply because we want to discuss the results in the next class meeting. Besides our arbitrary schedule, there is no reason that the students must participate in the exercise at the same time or even on the same day.

#### 5. GAME SET UP

The Sequential Search game, like each of the other games on the site, allows the instructors or facilitators to customize the parameters for the exercise. In order to use the many games available on the site, the instructors must first obtain a session name. To do this, select the Experiment Selection Admin Menu link on the Computer Programs for Classroom Games page. There are 40 games in eight categories, plus user instructions, activity logs and several survey programs on this page.

Obtaining a Session Name is one of the User Instruction items. Selecting the User Instruction link and then the Register On-Line and Obtain a Free Session Name link on the following page will take users to the Session Name Instruction page. The instructions note that the session name also serves as a personal data storage area for the site. Session Names can be obtained either by following the link and registering online or by emailing [holt@virginia.edu](mailto:holt@virginia.edu).

The instructions request that instructors include three initials, their full name, and their school affiliation with the request, so that the administrators can provide an easy-to-remember session name. Participants need the session name, so that they can participate in the correct exercise and so that their decisions will be captured in the correct database for your experiment. It is important to remember that each time a session name is used, the data from all previous experiments is erased.

Once the instructors or facilitators obtain a session name, they can begin customizing the parameters for the exercise. Sequential Search is one of the Decision games. Selecting the Decision link will allow the instructors to view a brief introduction to the game, view data from completed experiments or to view the parameters used and start the exercise. Once the instructor selects SR Start, they will be asked to enter the session name that they obtained earlier and to create an admin password for their session. They will also be asked to provide an operational description of the exercise and to select the number of treatments; two is the default setup. For our exercise, we use three treatments \$10.00, \$2.00 and \$0.00. Next the instructors should select the Proceed to Set Parameters button to set the remaining parameters.

It is important to select the number of participants carefully. For this exercise, there is no penalty for specifying too many players. However, if you specify fewer players than you need, some participants will be frozen out of the exercise and unable to participate. Next, instructors must select the initial payment; we use \$50.00 for this exercise. There is also an option for administering a short ex post demographic survey.

Instructors must then choose the number of rounds per treatment (i.e., 10) and the upper and lower bounds for each treatment (i.e., 100 and 300). Finally, the cost per search and the maximum number of draws are entered (i.e., 10, 2, and 0). The default places no limit on the number of draws or searches participants are allowed during each round.

Selecting the Submit Parameter Choices button saves the parameters. The setup is now complete and the experiment is ready to begin.

## 6. GAME INSTRUCTIONS

We like to email the instructions to students or place them on the class web or drive space. The complete instructions are included in Appendix A. This allows students to select the link on the bottom of the instructions to obtain the correct web site. Students are told to imagine that they are a fisher attempting to get the best price for their catch. There are three ways that the fishers can discover the prices that merchants are willing to pay for their catch: 1) physically carry the fish to the merchant and ask in person. 2) call the merchant on their mobile phone or 3) use an onboard computer which allows the fisher to log onto each merchant's page one by one and discover their willingness to pay. The cost of searching for these three methods is \$10, \$2 and \$0. Students complete 30 rounds of the exercise – 10 rounds for each of the three search scenarios.

To begin the exercise, students must first create a user account. They do this by visiting the Participant Login page. To reduce confusion, we provide participants with a link to this page in the instructions. On the Participant Login page, subjects can logon to the experiment for the first time or re-join an experiment that they had previously started. To logon to the experiment, students will need the session name the instructor obtained for the exercise. After entering the session name, participants must set up an account by entering their name and creating a user password. Participants are assigned an ID number that they will use in the experiment instead of their name. Participants will need to remember their ID and password if they want to logon at a later time to check results or to continue with the exercise.

After students have created their account, they can read the Online Game's Instructions that have been automatically personalized based on the instructor-set parameters. A copy of these instructions with the

parameters described above is included in Appendix B. After participants have finished reading the instructions, they are ready to begin the game.

At this point, we normally, tell the participants not to start the game until the instructors give them the go-ahead, so the instructors can conduct a short question-

## 7. THE EXERCISE

The price that each merchant is willing to pay is operationalized as a random draw between \$100 and \$300. Students are shown a price that the merchant is willing to pay, which students have the opportunity either to accept or reject and search again. To ensure that participants do not mistakenly select the wrong button, after they select each price, participants are asked to confirm their choice. Once the student has rejected a price, there is no way to accept the price at a later time. Once the subject has accepted a price, that round is over and the game displays a breakdown of participants' earnings and search costs for the round, as well as their earnings for the game.

Participants' earnings for each round are the price that they accept minus all search costs they have incurred. For example, in the \$10 search setting, if a subject is offered \$289.51 after two searches and accepts the offer, he or she would earn  $\$289.51 - 2 * \$10.00 = \$269.51$ .

When a new treatment begins (i.e., in round 11 and again in round 21 in our case), participants learn of any parameters that have changed in the game. At the conclusion of the game, participants' total profits are displayed and if the instructor has chosen to have participants answer demographic questions, they will be displayed at this time. It is also at this time that any payment or reward, if part of the game, is distributed.

Finally, students are instructed to write a one-page summary of the experiment and to explain the effects that the different search costs had on the prices they obtained and on their search strategies.

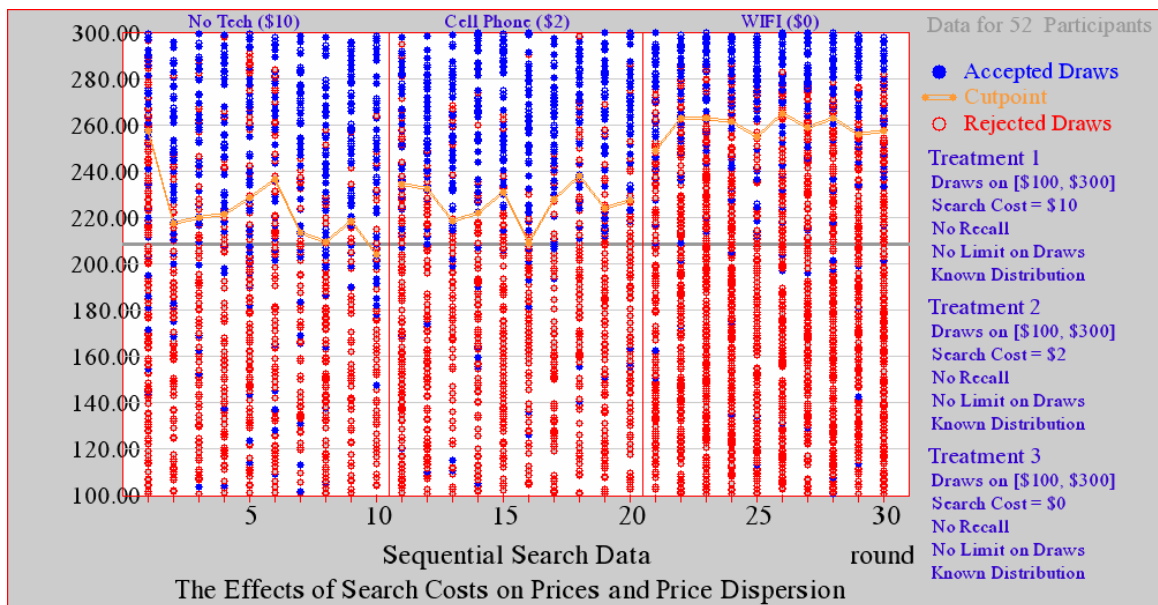


Figure 1.

## 8. SUMMARY

Figure 1 shows the results from 52 undergraduate students enrolled in a 100 level Information Systems course at a large public university in the Midwest. In the lecture session following the experiment, we discuss the impact of varying search costs on both the price levels and the dispersion of prices in each treatment. This allows us to demonstrate that reduced search costs not only allow fishers to receive higher prices for their catches, but that the range of prices obtained is also smaller.

In the classes where we have conducted this exercise, students tell us that they enjoyed the game and found it worthwhile. Reviewing the assigned summaries suggests that the exercise helps the students to understand the impact that reduced search costs have on prices, price levels and search strategies.

## 9. CONCLUSIONS

As experimental economics has gained prominence in recent years, the idea of using classroom experiments or games to facilitate teaching has also grown in popularity. As Holt and McDaniel (1996) explain, classroom games are short, interactive exercises designed to facilitate understanding of key economic ideas. While not

as common in Information Systems teaching yet, in classes with economic content, IS instructors may want to explore classroom games as an additional tool to help students master abstract economic theory. For example, Wolf and Myerscough (2005) describe a classroom game used to teach IS students about the impact of reputations in markets with asymmetric information.

While Information Systems instructors and students may not be familiar with classroom games, they are well acquainted with other classroom activities that promote learning through doing. In the same way that writing computer code, assembling network components or configuring software allow IS students to experience technical topics first hand, economic classroom games, like the one described in this paper, allow students to experience the economic incentives and forces that shape information-systems-related economics first hand. In effect, these exercises allow students to produce the data that can allow them to discover relevant economic principles for themselves (Holt and McDaniel 1996). In this paper, we have described an exercise that demonstrates the impact of technology-related search cost reduction on markets. While the subject of this exercise is a seller, in follow-up classroom lectures, we explain that classes can apply

the same basic premises to a buyer looking for the lowest price for an item.

In addition, while we normally discuss the exercise in a lecture session on a day following the exercise, since the exercise can be completed in less than 20 minutes, there is no reason that a discussion on the exercise and search costs couldn't immediately follow the completion of the game. Likewise, instructors may want to run the game additional times, altering the parameters to explore additional topics or simply to reinforce learning.

Holt (1999) notes that classroom games provide an important connection between theories and key features of the markets and institutions being studied. As there are a wide range of IS-related economic and decision-making topics that could be presented via classroom games, it is our hope that this paper will spur other Information Systems educators to develop classroom games and exercises that help students make these important connections.

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## **Appendix A**

### **Instructors Instructions for Students**

Imagine that you are a fisher and you have spent the morning fishing. Now, you are heading back to shore to sell your catch. There are many merchants on the shore. Your objective is to get the highest price for your fish.

In the exercise, the price the merchant is willing to pay is operationalized as a random draw. All other merchants will offer you a price between \$100 and \$300 for your catch.

If you are not happy with the price offered for your catch, you may try another merchant.

There are three methods of searching for the best price.

The first method involves no technology. The fisher simply brings their catch to the merchant and asks the price the merchant is willing to pay. If the fisher does not like the price, they may carry their catch down to the next merchant and ask the price the merchant is willing to pay. Since the fish must be physically carried, and the catch is much too large for the fisher to carry, they must hire helpers to move the fish to the next merchant. Each search costs \$10. Rounds 1-10 will use this method.

The next method involves using cell phones to find the best price and then pulling the boat right up to the merchant offering the best price. Each cell call to a merchant costs \$2.

Rounds 11-20 will use this method.

The final method involves the use of an onboard computer which allows the fisher to log onto each merchant's page and discover the price that they are willing to pay. Each new search is costless. Rounds 21-30 will use this method

Following round 30, you will be asked to complete a short questionnaire. This questionnaire consists of 15 questions, and should take less than 5 minutes to complete.

After selecting the link below, you will need to login using your first and last name and a password – you get to pick the password.

Your login session name is: xxxxxx

After you log in, you will be given a few pages of instructions, please read the instructions carefully. Now, select the link below and begin the exercise.  
<http://veconlab.econ.virginia.edu/login.htm>

## Appendix B

### Online Game's Instructions for Students

These instructions incorporate the instructor-selected parameters and are automatically generated by the game

- **Search Procedure:** In this experiment, you will be able to see a series of randomly determined money amounts, but you can only keep one of these amounts.
- **Search Cost:** Some of the money amounts will be higher than others. If the first money amount you see is acceptable, you may decide to stop there. If the first amount seems too low, you may request to see another amount. Each time you are shown a new amount, you will have to pay a search cost. When you decide to stop searching, your earnings will be the amount that you end up with, minus the search cost, i.e. the search cost times the number of random amounts that you saw in the sequence.
- **Search Sequence:** You can only claim one of the amounts that you see in a "search sequence." You must pay the search cost for each amount that you see, including the first one. You may decide not to search at all (and earn 0), you may stop after seeing the first amount, or you may continue searching as many times as you wish.
- **Random Draws:** The money amounts will be greater than or equal to **\$100.00** and less than or equal to **\$300.00**. Any penny amount in this interval is equally likely. Imagine a roulette wheel with stops marked \$100.00, \$100.01, \$100.02, ... \$299.99, \$300.00. Then a random draw is like spinning the roulette wheel, with each money amount being just as likely as any other, regardless of whether the previously observed amount was relatively high or low.
- **Search Cost:** Your search cost will be **\$10.00** for each amount that you observe. This cost will not change during a search sequence, and any changes will be announced in advance.
- **Recall:** Each time you see an amount, you may either accept it and stop searching, or you may reject it and search again. Once an amount is passed up, you are **not** permitted to go back later and claim that amount if you change your mind. Thus when you stop a search sequence, you may end up accepting an amount



that was not the highest of the random amounts that you have encountered.

- **Earnings:** You begin the experiment with an amount of money, \$50.00. There will be a number of search sequences, and each one offers a chance to add to your earnings.
- **Gains and Losses:** Earnings for a search sequence will be positive if the amount you accept is greater than the total search cost for that sequence, calculated as the number of amounts observed times the cost \$10.00 per draw. Thus earnings may be positive or negative.
- **Total Earnings** The computer program starts you with \$50.00, and it adds gains and subtracts losses. After each search sequence, your earnings for that sequence and your total earnings up to that point will be displayed.

**To summarize:**

- There will be a number of search sequences.
- In each sequence, you will have the option to observe one or more randomly determined numbers or "draws."
- Each random draw will be an amount of money on the interval from **\$100.00** to **\$300.00**.
- Each penny amount in this interval is **equally likely**.
- You will pay **\$10.00** to see the first draw (and any subsequent draw) in a search sequence.
- You may stop the sequence at any time and accept the **most recently observed amount**.
- There is **no limit** on the number of draws that you may take.
- You begin with an initial balance of **\$50.00**. Positive earnings will be added and negative earnings will be subtracted.