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Understanding Patenting Decisions: A Classroom Experiment

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Market Report	Yr Ago	4 Wks Ago	11/23/07
Livestock and Products, Weekly Average			
Nebraska Slaughter Steers, 35-65% Choice, Live Weight.	$87.64	$92.27	$94.91
Nebraska Feeder Steers, Med. & Large Frame, 550-600 lb.	117.70	117.62	120.35
Nebraska Feeder Steers, Med. & Large Frame 750-800 lb.	105.73	114.29	113.71
Choice Boxed Beef, 600-750 lb. Carcass.	141.76	143.66	147.63
Western Corn Belt Base Hog Price Carcass, Negotiated.	61.49	55.14	49.02
Feeder Pigs, National Direct 50 lbs, FOB.	57.72	48.73	48.22
Pork Carcass Cutout, 185 lb. Carcass, 51-52% Lean.	66.51	60.40	58.15
Slaughter Lambs, Ch. & Pr., Heavy, Wooled, South Dakota, Direct.	*	*	90.50
National Carcass Lamb Cutout, FOB.	252.36	264.88	264.70
Crops, Daily Spot Prices			
Wheat, No. 1, H.W. Imperial, bu.	4.74	7.58	7.80
Corn, No. 2, Yellow Omaha, bu.	3.44	3.43	3.77
Soybeans, No. 1, Yellow Omaha, bu.	6.56	9.22	10.31
Grain Sorghum, No. 2, Yellow Dorchester, cwt.	5.57	6.41	6.79
Oats, No. 2, Heavy Minneapolis, MN , bu.	2.71	*	2.72
Hay			
Alfalfa, Large Square Bales, Good to Premium, RFV 160-185 Northeast Nebraska, ton.	135.00	155.00	135.00
Alfalfa, Large Rounds, Good Platte Valley, ton.	87.50	97.50	87.50
Grass Hay, Large Rounds, Good Northeast Nebraska, ton.	82.50	*	*

* No market.

Innovations are crucial to the future success of firms, with most products having only a limited life cycle. When innovations occur, the firm must decide the best way to protect their intellectual property; this essentially comes down to keeping the innovation a trade secret or filing for a patent. Teaching students the basics of intellectual property protection is not difficult. Most are familiar with the general concept of patent protection and have some understanding as to why patents are an important tool available to firms and individual innovators. However, an in-depth analysis of the patenting decision making process can be less straightforward. There are several major decisions firms or innovators face that students must contemplate. Among the key ones are:

> When should an innovator select to patent instead of using trade secrecy?
>
> What are the differences between narrow and broad patents, and what are the factors affecting the innovator's patent breadth decision?
>
> What is the best response if a patent is infringed: invoke a trial, accommodate entry, or license the innovation?

Understanding the implications and risks that go into a firm's patenting decisions and the interdependence that exists between these decisions can give students a more complete understanding of the patenting process. Through the determination of the optimal patenting decisions, students can learn how patents affect the ability of innovators to recoup their research and development (R&D) costs and capture the returns from their innovations. To help students understand these issues and the complex nature of the patenting decisions, an economic experiment was developed where the students themselves were placed in the position of an innovating firm and needed to decide how to best protect their innovations. The use of an economic experiment provides a more complete way of teaching students patenting decisions, due to the limited usefulness of patent data. Specifically, with patent data one can only observe the ex-post decisions (i.e., whether the innovation has been patented or not; licensed or not; whether a trial has taken place or not) and thus, it is difficult to analyze the actual decision-making process. The experiment developed allows for

analysis of the decision making process without such problems. Furthermore, the design has the additional benefits of emphasizing the profit-maximizing goal of firms and providing lessons on risk and uncertainty.

The experiment was designed for use in two upper level courses: a course on the economics of technology and a course in agribusiness management. Typical enrollment for these courses is from 20 to 45 students, primarily juniors and seniors. The experiment would be appropriate for any course where patent or other intellectual property rights (IPR) issues are discussed. Courses where decisions under risk and uncertainty are explained, such as intermediate micro, could also be considered. In these, discussion of patent issues could be minimized and the experiment could be viewed primarily as a lesson in risk, with some context to increase student interest. For the primary application where patents are the focus, basic information is given prior to the experiment. The major issues covered are the requirements for patents, the reasons the government is willing to grant them, and what the innovator and society gain from them. This discussion sufficiently prepares students for understanding the upcoming experiment. Instructions are given to students during the previous class to allow them time to further consider the issues and plan their strategy. A key issue with experiments is the incentive. This experiment has been run using extra credit points, usually for the next exam, based on student earnings.

The experiment consists of 20 periods, each representing one year a patent would be in effect, and places each student in the role of a firm or innovator that has developed a novel product. The first decision they need to make is whether or not to patent their innovation or keep it a trade secret. Their next decision would be the scope of the patent: narrow or broad. During each period there is a probability that the innovation will be reverse engineered, as in the trade secret case, or that the patent will be infringed upon. In the case of infringement, students who choose the patenting option have to further choose whether to legally defend their patent by invoking an infringement trial. Once students indicate their decision in the corresponding box on their record sheets it can not be changed. The probabilities for all possible events each period are selected based on a combination of estimated actual likelihoods and numbers that would allow the comparisons to be relatively straightforward for the students (see Table 1).[1] The experiment was designed so that the most profitable choice would be the broad patent, followed by the narrow patent, with the trade secret being the least profitable choice (see Tables 1 and 2).

At the conclusion of the experiment a short survey is handed out. The purpose of the survey is to encourage students to think about and justify their decisions. It also gives them an opportunity to "change their mind," by explaining how they might choose differently if given the chance. These can be used during the post-experiment discussion or could be handed in for the instructor to summarize.

[1]For each period where a final outcome hasn't been reached or until twenty periods have passed, the student draws a poker chip from a bag designed for the probabilities they face (a full set includes five bags representing all the possible probabilities needed: Trade Secret, Narrow Patent, Broad Patent, Narrow Court Case and Broad Court Case). For example, a student who chose trade secrecy as a means of protecting their innovation would draw from a bag with seven white chips and three red chips (representing the 30 percent chance their innovation will be reverse-engineered) until they drew a red chip or they had drawn 20 times.

Table 1. Summary of Probabilities Used in Experiment

Protection Selected	Event	Probability
Trade Secret		
	Reverse Engineered	**30%**
Narrow Patent		
	Infringed	**10%**
	Court Invalidates Patent	**20%**
Broad Patent		
	Infringed	**40%**
	Court Invalidates Patent	**50%**

Students found the ranking of some of the strategies in terms of their profitability harder than others, as is evident from the combined results of running four sessions of the experiment in classes in 2006 (presented in Table 3 on next page). Most students (89%) chose the more profitable strategy of patenting their innovation, to the inferior strategy of keeping it a trade secret (11%). However, those that chose the patenting option had trouble determining the optimal breadth of their patent, with more than half the students choosing the narrow patent option (53.5%) to the more profitable broad patent option (46.5%). On the other hand, the vast majority chose to invoke a trial under infringement (98 percent of those that chose a narrow patent and 100 percent of those that chose a broad patent), which, given the assigned cost, return and probability values, clearly dominated the option to not legally defend the patent.

Interestingly, most students came to understand the correct ranking of the strategies through their participation in the experiment, despite the fact that they might not have known the exact differences in the profitability of the various outcomes. This became evident when students were asked immediately after the experiment whether or not they would choose a different strategy if they were given the opportunity to participate in the experiment again, and why. These percentage results are also reported in Table 3. Specifically, the majority of those who had chosen trade secrecy stated that they would patent (78%) with less than 17 percent of these stating they would choose a narrow patent, and over 83 percent stating they would choose a broad patent. This indicated that the experiment was highly effective in helping students better identify the optimal strategy. No student that selected a patent indicated a desire to switch to trade secrecy. The fewest students wanting to change were in the optimal strategy category of the broad patent.

It is also common to have students who understood that the broad patent choice had the highest expected value, select a narrow patent instead. This is very useful for guiding the class into a more detailed discussion of risk and uncertainty using the patent choice as context. This helps show that there is more to an innovator's decision, and that differences in risk tolerance levels can affect decisions. In past experience, some students will even self-identify themselves as risk-averse and consider the uncertainty aspect crucial in their patent selection.

At the time the experiments were run, the government was considering the Patent Reform Act of 2007. The bill proposed

several important changes, with the ones most relevant to the experiment being changes in how damage awards are calculated in infringement cases, and streamlining the process for challenging patents. As an assignment, students could be asked to write up their recommendations for how they would address the issues and concerns of the current patent system. Having been in the place of an innovator will give them an extra level of insight into the debate that would not otherwise have been possible.

Note: This article is based on the article "Understanding Patenting Decisions: A Classroom Experiment" by John Bernard and Amalia Yiannaka, currently under review in the Journal of Economic Education.

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Table 2. Summary of Costs and Returns Used in Experiment

	Protection Selected		
Costs/Returns	**Trade Secret**	**Narrow Patent**	**Broad Patent**
Patenting Cost	**NA**	**$100,000**	**$100,000**
Infringement Trial Costs	**NA**	**$1,000,000**	**$1,000,000**
Returns if not reversed engineered, not infringed or trial is won under infringement	**$1,000,000/period**	**$1,000,000/period**	**$2,000,000/period**
Returns if reversed engineered, infringed and no trial or trial is lost under infringement	**$100,000/period**	**$100,000/period**	**$100,000/period**
Damages awarded when trial is won	**NA**	**$900,000**	**$1,900,000**

Table 3. Summary of Results of Experiment Sessions for Students in 2006/07

	Students					Percent Change to:[2]	
Choice	**Number**	**Percent**	**Average Period Infringed[1]**	**Percent Invoking Trial**	**Percent That Would Change**	**Narrow**	**Broad**
Trade Secret	**14**	**11.11**	**3.54**	**na**	**78.57**	**16.67**	**83.33**
Narrow Patent	**60**	**47.62**	**8.23**	**98.33**	**20.00**	**na**	**100.00**
Broad Patent	**52**	**41.27**	**2.42**	**100.00**	**15.38**	**100.00**	**na**

[1] Infringed or reverse-engineered, as appropriate.
[2] No students wanted to change to trade secrets.