Examining the Economic Effects of Pharmaceutical Intellectual Property Research Paper

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Abstract

The project attempts to examine the effects of intellectual property systems on the pharmaceutical industry from an economic standpoint. The goal is to discover what forms of intellectual property are the most effective economically. This topic is a major issue today since the intellectual property laws of the United States are a contentious issue, especially in relation to the violation of these laws by pharmaceutical companies in developing nations. Despite the widespread discussion of this issue from sociological, medical, business, and political standpoints, almost no research with an economic focus exists. Moreover, Sugarscape provides a unique system for testing the economic viability of various property laws, due to its decentralized nature and ability to simulate many of the influential factors using real-world data.

Keywords: agent, Sugarscape, economics, pharmaceutical industry, intellectual property

1 Introduction

Intellectual property systems are being criticized across the world. Increasingly, there has been discussion over the forms that intellectual property should take - and if it should exist at all. One of the main areas of contention is the pharmaceutical industry. In developed nations such as the

United States, intellectual property laws often grant pharmaceutical companies long lasting, exclusive rights to any drugs that they develop. In exchange, these laws require independent government agencies to regulate the drugs that these companies produce. Companies often spend large amounts of money to develop new drugs; in order to recoup the costs, they charge high prices. Consumers protest these high prices, especially the poor in developing nations that could benefit enormously from these drugs. For this reason, Third World nations often ignore the patents held by these companies and instead produce the drugs in question illegally, charging a far lower price.

This situation has set off a firestorm of protest around the world. Pharmaceutical corporations claim that these measures amount to theft and rob their of their rightful revenue. Advocates of these plans aruge that the prices are unaccetable and must be lowered so that the impoverished people who need these drugs have access to them. While sociological and moral concerns are involved, one of the main issues is the economic situation created by these laws. Many who are opposed to intellectual property laws say that these laws create unfair monopolies that allow the corporations to engage in price-gouging, since the demand is fairly inelastic. Proponents reply that these laws are necessary to encourage innovation. However, this discussion has largely consisted of rhetoric and debate rather than concrete research. This project attempts to fill that gap.

The goal of this project is use a combination of real-world data, econometrics, and theoretical economics to create an accurate economic simulation of intellectual property laws. In order to achieve this, the project will use an adapted version of Sugarscape, a well-known agent-based modeling simulation. This provides a unique perspective within the field of economics, where most research is done through analysis of existing data. Instead, this project will focus on replicating the environment in which pharmaceutical companies exist through agent-based modeling. The mechanisms of the simulation will be strongly influenced or determined by real world data from a variety of years.

This project will focus on a number of specific states of intellectual property by altering the mechanics of the simulation to reflect the changes. This can be done easily due to the layout of agent based modeling simulations, specifically, their system of gridding. The project will focus on America's system of intellectual property, where patents last for roughly 20 years, Food and Drug Administration approval is necessary to sell the drug and applies many regulations, lawsuits are used extensively, and the healthcare system

is heavily regulated. The project will also measure the effect of reforms on the intellectual property system, such as reductions in the length of patents and loosenings in the FDAs approval process among others. Lastly, the simulation will attempt to assess a system where no intellectual property laws exist.

2 Methodology

This projects uses a modified version of Sugarscape in MASON. In this system, agents exist on a grid of locations. Each location is a separate pharmaceutical idea for a drug. Each idea can produce a certain product, and ideas are grouped together based on their product. Ideas can also be patented, so only the original discoverer can use it. The length of the patent, the costs of it, and the initial investment necessary will all be changed in order to measure different IP laws. Many ideas are left black - they cannot be used in any way. Strategic placement of these can be used create a more realistic process of research, where inventions can often depend on past inventions or innovations and are more linear or pyramidal in nature. Ideas can also be placed in the open domain, where they are available to any corporation that wishes to use them. It requires an investment of sugar in order to patent an idea. Once an idea is patented, it can be leased to other corporations for a price at the choice of its owner.

Products exist in a supply and demand market for that product. The price and consumption of the product is determined by market forces. This data is influenced with real world data, which determines the innate supply and demand for products from each idea. In addition, the real world data is used to simulate a degree of market irrationality and boom-bust cycles. Products produced by an idea are sold for sugar at a selected price. It costs sugar to produce a product, which means that some ideas can be unprofitable if they are produced.

Agents occupy ideas in order to produce products. These products are bought and sold with sugar, the wealth of this world. Agents can manage a product using their metabolism, which represents their efficiency at producing the idea. They choose the price and quantity of the product that they will produce based on their metabolism-altered analysis of the product market. In addition, metabolism goes into the productivity of the square. With their vision statistic, they can see surrounding squares, and if they find

it advantageous, expend sugar in order to move to another square. Their vision also helps them determine whether moving would be profitable; lower vision makes their estimates less accurate. The agents work to gain the most sugar possible. However, their metabolism and vision help determine how much sugar they require every turn. If the agent runs out of sugar, then the agent will quit.

Corporations loosely control these agents. They hire and fire them through an agent job market and manage the agents' patents. They maintain legal teams which can be used when agents try to move into a square patented by another company. This results in a lawsuit, a match up between the two legal teams. The corporation that originally owned the square receives a greater weighting depending on how long they have owned it. In addition, ownership of nearby squares has an influence in proceedings, as does the skill of the legal team which is accounted for in the corporation's statistics. The corporations take a stipend from their agents and help provide investments. If an agent is not making a profit on his square, a corporation must provide him with enough sugar to make up the deficit or he will quit. In addition, corporations can buy out agents from other corporations if they are offered a greater consumption factor than their current one. Corporations have their own vision statistic which is used to gauge profits. In addition, they have an efficiency statistic that determines their administrative process, which consumes sugar each turn. Corporations must spend sugar to maintain their legal statistic and can increase it by increasing the sugar they spend on it. Corporations can attempt to buy corporations' patents and can allow other corporations to go on their locations in exchange for royalty payments. They are made to seek ways to increase profits by engaging in monoploy tactics by cornering favorable ideas in a product market. If a corporation runs out of sugar, it must decrease costs without decreasing revenue, such as by selling patents or firing agents, or it may soon go out of business and be forced to release all of its agents and patents to the open domain.

3 Development

The project began using a version of Sugarscape coded in MASON. This version of Sugarscape was very large and contained many components which were unnecessary for the project. I worked to identify and remove these while learning how the program functioned. Eventually, I discovered that it already

had a modular system where components could be turned off based on the inputs. I abandoned by my removal work and started my true development.

I worked on adding the necessary functions, such as group functionality, the lawsuit procedure, and the profit estimations for movement. In addition, I made many changes to the basic traits of the agents, namely in the vision and metabolism traits. Group functionality was implemented through creating a new Java file that shared many characteristics with Agents. The Corporations were given another thread process and at the end of every turn, it would run through every corporation which would run through each of its agent, exchanging data between the two. It was here that wealth was transferred to and from the corporation and agents' biological functions were moved. The agent thread was now used solely for agent actions, which happened second on the threading list. Lawsuits and profitable estimates orginated out of an existing file called WelfareEstimation. Its original intent was to guage the gain in sugar for agents, though it was adapted for a more long-term view and for only one move a turn. If an agent and his corporation found it advantageous to engage another company in a lawsuit, they would move there and the lawsuit would take place in the movement file. The lawsuit gives a heavy weight to how long the patent had existed and lawsuit would only be possible if it was new. Other influences would be the number of surrounding squares each corporation owns and the value of each corporations' legal stat. [INSERT EQUATION HERE!!]

After these large changes, I tried to compile the program. Unfortunately, this did not work. It seems there were a number of errors in the code that had been added over the past month or two and that some of the original code and side functions were completely outdated. It took over three months to untangle this mess of errors and outdates, which consumed a large chunk of the alloted time. In order to bug fix it, I used a number of methods, such as commenting entire functions and additions out to isolate problems and piecing through the advanced bug feed from the javac compiler.

After this was completed, significant brainstorming was done on the economic side. The product market was particularly troublesome. In order to properly express the economic side, there needed to be some mechanism for supply and demand. It was necessary to consult with the economics teacher, Mr. Torrence, to discover a solution. He had the idea of tying the simulation to real world data which would give it economic authenticity and realism. During this brainstorming period, I also completed the corporate profit estimation, which was mostly a direct copy from Welfare Estimation, and agent

job market, which grabbed fired agents and quitting agents and allowed them to enter the pool that other corporations could choose to hire from. This required an implementation of drop-agents, where new agents were essentially dropped on the grid at the location of choice for the corporations, for an amount of sugar. I then added the patent parts of the idea, which were partly contained in Welfare Estimation, since in Sugarscape, agents couldn't occupy each others squares. The patents were stored in corporate object arrays and when agents moved, they were made to check all object arrays for reference. In addition, patents were made such that there had to be an agent on the idea in order to keep it patented. This is to ensure that the corporations must continue to pay to protect a patent from being covertly ignored by another company. Unlike during the last coding sequence, frequent compiling was done in order to prevent a repeat of the three-month debug.

The final part of the project that was needed was the product market. I created another thread for this market that would run before any other thread. It would evaluate the supply and demand, compare them to buying and selling habits and change the suppy/demand accordingly. In addition, they would use the supply and demand to determine the optimal price. Agents and corporations were made to have their vision determine their accuracy as far as estimating the price and quantity at which they could sell their product. At this point, I realized that my program was running far too slowly with this many threads. The work done in the first quarter paid off as I used it to cut out many extraneous functions, which optimized it considerably. Most of the product mechanisms were finished and I had started adding the influence of real world data when time ran out for the project.

4 Results

Unforunately, the project was not fully completed, so no results were obtained. However, the project did result in a nearly complete generic economic simulator with a focus on intellectual property. The combination of real world data and agent-based modeling is a legitimate tool for economic research, though projects outside of intellectual property would need to change the purpose of the location grid. Intellectual property is the best use of it, since this project's use of the location grid to mimic the progression of innovation is wholly unique. Other fields of intellectual property such as the music industry, financial patents, software patents, and creative works in

general could be effectively modeled using this simulation. It would only be necessary to change the locations' patent related characteristics and the addition of real world data related to these fields.

Real world data is difficult to work with. It is very hard to guage the influence that it should have on various parts of the simulation. With knowledge of advanced econometrics, it can be done in each case from a theoretical standpoint. However, the only true way to confirm it is to run the simulation and compare the results to real world data. If it can match the real world data for a variety of simulations, then the real world data is influencing the simulation in the proper manner. However, I did not have the time to do such a comprehensive test of this real world data and did not have knowledge of the econometrics required to discover it analytically. In addition, this situation had many variables in which real world data could have an influence on, such as the original allocation of stats and placement of agents. This meant that advanced econometrics are virtually required in order to properly assess the authenticity of the simulation. Thus, I was probably unable to create a simulation as realistic as I would have hoped.

In the future, I would like to redo this project from the ground up. The project has grown past Sugarscape in many ways and would be better served by coding from the ground up. More importantly, the MASON version that I'm using is huge; this size has been a major obstacle for me throughout the project. I also realized that I have trouble becoming familiar with code that I have not written unless I have large blocks of time to pore over the code. Unfortunately, my time was fairly spread out over the year, which inhibited my attempts to learn the program in depth. A recoding of the project would create a small, more efficient, and more familiar version. In addition, I would try to learn more complex econometric tools that I could use to simplify the implementation of real world economic data. I think this could be an effective Information Systems and Economics combination project since I think I will major in those two fields at Carnegie Mellon.

References

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