

THE ECONOMICS COLLECTION

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Game Theory

*Anticipating Reactions
for Winning Actions*

Mark L. Burkey



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Thank you for checking out my book! Chapter 7 is attached, as well as the table of contents. Below is a brief description of what each chapter covers. If you are a faculty member wanting to consider my book for adoption, please click the link at gametheory.burkeyacademy.com. Feel free to email me at mark@burkeyacademy.com with questions. Cheers! -Mark L. Burkey

Chapter 1: Definition of game theory and simplifying assumptions of games: One shot, payoffs, perfect information

Chapter 2: Nash Equilibria and Dominant Strategy Equilibria of 2x2 matrix games

Chapter 3: Looking at standard types of games to see patterns of behavior: Prisoner's Dilemma, hawk-dove, stag hunt, chicken, coordination games, zero and fixed sum games. Also, how to change the game you are playing, thinking outside the box.

Chapter 4: Larger games and iterated dominance, weak dominance, focal points, and an intuitive version of the trembling hand refinement.

Chapter 5: Sequential games, backward induction, and subgame perfection, first and second mover advantages. The centipede game is covered. Maximin strategies are discussed, along with cases where your opponent might not be rational (just out to get you).

Chapter 6: Repeated games. Rate of time preference (patience), grim trigger, Robert Axelrod's *The Evolution of Cooperation*, and how to change a bad one shot game into a long-run repeated game are discussed.

Chapter 7: Introduction to Information theory: Adverse Selection and Moral Hazard, Signal jamming.

Chapter 8: Adverse selection and moral hazard with customer relations, insurance markets, price discrimination, and the durable goods problem.

Chapter 9: Adverse selection and moral hazard with employees: Signaling and screening, education, negotiations and bargaining (with discussions of Schelling's work).

Chapter 10: Games between firms: Quantity and price competition, location games, advertising.

Chapter 11: Cooperation and working in committees and teams. How incentives make working and consuming in groups difficult to do efficiently, and some ideas for improvement.

Chapter 12: Games against yourself: Commitment problems and self-control.

Game Theory: Anticipating Reactions for Winning Actions

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CHAPTER 7

The Theory of Contracts

Introduction to Moral Hazard and Adverse Selection

In the first half of the book we usually assumed that the players had perfect information: everyone had all of the information available about the choices and payoffs. Similarly, in most basic economics courses we assume the same thing: We all know the quality of the products, the prices everyone is charging, and the productivity of our employees. However, there are many real-world situations where we do not know these things. Many of these complications are discussed in an area of economics called “principal–agent models,” or sometimes the “theory of contracts.”

The way we will explore this material is to set out the basic framework in this chapter and give a few examples. Then, in the next two chapters we will focus on two specific areas in which information games are often played: business–customer relations and firm–employee relations. In this chapter, I will set up our basic framework using a combination of the way I think about it, and some insights given to me by game theorist Eric Rasmusen.¹

7.1 Hidden Information Versus Hidden Actions

The process of contracting can be simplified into four steps in the following order:

1. I write a contract and advertise the terms of the contract
 - A. Then certain people respond and want to contract with me

¹Author of *Games and Information*, a textbook on Game Theory.

2. I sign the contract with someone or several people
 - B. Then while the contract is in effect, people might change their behavior

Because the actions 1 and 2 can cause the very different types of reactions A and B, we often study these sorts of issues in game theory. Let's discuss these ideas one at a time.

1. "Writing a contract" can mean a lot of different things. It can mean offering to buy or sell a car, offering car insurance, life insurance, or health insurance, trying to hire an employee, or looking to get your car fixed. Any kind of situation where things are being bought and sold is really a transaction involving some sort of contract. This stage might involve putting an ad in the newspaper offering to hire someone to do a job, or to sell them insurance or a product.
 - A. Who responds to the contract? Are they qualified employees, or not? Are they bad drivers who want auto insurance, or old, sick people wanting health insurance? If the kinds of people who respond to your contract are a bad (adverse) kind (selection), we call this problem *adverse selection*. So, if it is mostly the "wrong" people (from the standpoint of the one making the contract) showing up in response to your ad, you stand to lose money! There are two things to note here:
 - i. This problem occurs *before* the contract is signed. It involves who shows up, not necessarily that you actually agree to contract with them.
 - ii. The real problem here is that the people responding have *hidden information* (sometimes called *asymmetric* information since they know something you don't).

Adverse selection occurs when there is a problem at point A. Other examples are:

- Used cars on the market are more likely to be cars that people want to get rid of. The best cars will be kept, not sold!
- Unemployed people looking for jobs are more likely to be less productive people. Why? Firms are more likely to get rid of

less productive or less trustworthy employees, and work hard to keep the very best ones.

- Young, healthy people will be less likely to want life or health insurance.
- Who wants dental insurance? People with bad teeth!
- Who wants flood insurance? People who live in flood zones in big houses!

George Akerloff won a share of the Nobel Prize in Economics in 2001 for describing what we call the “Lemons Problem.” A car is a “lemon” if it is a car with a hidden problem. If people who are selling a good know more about its quality than we do, then we stand to lose no matter what price we pay. For example, if I offer \$10,000 for a used car, it is logical only for those with cars worth *less than* \$10,000 to agree to sell them to me. If I lower my price to \$5,000, this won’t help, because the cars I will be offered will be worth *less than* \$5,000. So, if we can’t fix this problem, many markets could dry up because people will fear losing whenever they participate.

A similar example in an insurance market is dental insurance. In my home state, government employees can purchase optional dental insurance for \$32.64 per month (which only covers the employee, and only a portion of expenses). Who should sign up? Only those whose cost (\$32.64 per month, or \$392 per year) is far less than their expected benefits. I don’t sign up because my expected dental expenses are under \$100 per year. So, if the company gets \$392 per customer, and these people all need far more \$392 in covered benefits per year, how will they make money?

The real question is, how do we fix these *adverse selection* problems? The key is to learn as much information about these cars, people, or houses so that we can price the good or contract appropriately. Charging everyone the same price is simplistic, bad policy, and unfair. People who have fewer dental problems shouldn’t be charged a high price, just as people should not expect to pay the same amount for good quality and poor quality used cars. So, businesses should do background checks, get references, health records, or hire people on a probationary basis until you get to know them better. Also, sellers of goods can offer warranties and

rely on their reputation to convince people that they are not selling junk, or allow people to have cars examined by an expert before purchasing.

2. Sign the contract with some people. Hopefully you were able to screen out some of the “bad apples,” or by learning information about them you were able to pay less for the bad employees and cars, and charge more for the high-risk drivers. Then, other problems can occur.

B. People can change their behavior after they enter into a contract. After all, everyone dresses better for the job interview than they will after they are hired. After someone has a job, they might become lazy or careless. Of course, this is actually *rational* if people are not rewarded for hard work! Two things to note, just for clarity:

- i. This problem occurs *after* the contract is signed.
- ii. The real problem here is that people might be making *hidden (or unobservable) actions* that are not in your best interests.

Moral hazard is the term we use for problems that occur at point B, after the contract is signed. Common examples are:

- After you have life insurance, you start skydiving, or commit suicide.
- After you have homeowner’s insurance, you stop locking your doors.
- After a professor gets a 20-year contract, he stops putting forth much effort to teach class or do research.
- After you get married, your spouse might change!
- Your employees might steal from you.
- Your salespeople might not actually go on sales calls, if you pay them anyway.

The solutions to moral hazard are generally to *monitor* what people are doing, punish them for bad behavior, and reward them for good behavior, placing incentives for good behavior wherever possible. For example, give people an insurance discount if they have no claims in five years. With current technology, some insurers are giving incentives for people to place

computerized monitors in their cars to monitor driving behavior. Send people to jail for stealing from you. Give your spouse gifts when they do things you like (and the cold shoulder when they don't)! If it is hard to monitor people, you can threaten them with the most horrible punishment imaginable. Sometimes we call this a "Boiling in Oil" contract for short, after the painful execution method used occasionally in Europe and Asia. Tell your employees that if they cheat you, you will take out a full page advertisement in the newspaper telling everyone, so that they can't find another job ("You'll never work in this town again!").

A second avenue for avoiding moral hazard takes the incentives strategy to the extreme. If your employees won't work hard and you can't monitor them, "sell the store" to them. If they are owners, then they will monitor themselves as the incentives are in their proper place. A middle ground is to sell franchises, where the make it or break it will depend on the effort of the franchisee. A very common method is to pay based on output, such as on a commission or piece rate.

Burkey (2008)² worried about moral hazard in health care provision. Doctors have the incentive to give you too much health care (they profit on every procedure, needed or not), but Health Maintenance Organizations (HMOs) tend to skimp on it (they lose money on every procedure done). Burkey suggested requiring HMOs to also provide a life insurance policy to patients: If they skimp too much and a patient dies, the HMO will suffer a large penalty!

7.2 Communication, Misinformation, and Signal Jamming

One way to overcome problems of information is simply to communicate the information to the other party. The problem is that you have to know when the information you are getting is believable. Consider the following simple statement:

I am a Pilot.

²Burkey, M. L. (2008). Selling the store to the HMO: A life insurance contract for optimal provision of care. *Journal of Economic Behavior & Organization* 65(1), 118–132.

Should you believe it? It all depends on the circumstances. If this is said by a passenger on an airplane right after the pilot has had a heart attack, you can probably believe it, because the other person's interests are aligned with your own: You both want someone who really can fly the plane to go to the cockpit. However, if this is said by a man to a young lady in a bar, then the information is probably not credible.

Rather than asking people for information, it is often better to give people a choice, and let them reveal information about themselves by their choices. "Would you rather have an essay test, or multiple choice?" Students who opt for multiple choice are more likely to be unprepared, wishing to rely on guessing. There is an apocryphal story of an economics professor, who on the first day of class said,

You know, 100 students is too many for this class. Let me make you a deal, this is a hard class to teach and a harder class to pass. If you are just here to get a 'C,' come up here, sign your name, and leave. You will get a C at the end of the course.

As the story goes, about one-third of the students signed and left. A few minutes later, he said,

You know, 67 students is still too many for this class. Let me make you a deal, if you are just here to get a 'B,' come up here, sign your name, and leave. You will get a B at the end of the course.

Whereupon 50 of the remaining students signed and left. The professor gave the students that remained As. More than likely, the students accurately revealed their "type": "A" students generally make As, while "C" students typically get Cs. The professor has used what is called a "Screening" device—he was able to discover who the A students were by their actions. The problem is, this could only work once! The next year, all students would wait to be in the "A" group.

When you don't want the other players to know what you are really up to, then lying and providing misinformation in other ways is used. For example, in World War II both sides built fake planes, boats, and tanks in order to deceive the enemy about their strength and positions. It was

also possible to send messages in a code that you knew the enemy could break that contained misinformation. Once a code is broken, it is also very important not to radically and suddenly change strategy in response to the new information—otherwise they will know that you know.

“Signal jamming” is the idea that if you don’t want someone to learn information about you from your actions, you should throw in some random noise to throw them off the scent. On D-day in WWII, bad weather and other issues caused Allied paratroopers to be accidentally dropped in the wrong areas, scattered over a wide region. This misled the German High Command into thinking that the Allies were launching a major air invasion rather than one largely by sea, and many German troops were pulled inland for defense. A brilliant accident!

7.3 A Few Examples from Ancient (and Not So Ancient) History

In the next chapters we will look at several categories of real world arenas where information play important roles. Here are three brief examples to contemplate that we can use to whet our appetite.

i. Pay Tribute Or We Will Invade

Often ancient cities would pay tribute to stronger, nearby neighbors hoping that this would keep them from invading them. But think about it, what signal are you sending to your neighbor when you deliver him 100,000 pounds of silver? You might as well put up a sign that says, “We are rich, but weak. Please invade us.” By sending any tribute at all, you are broadcasting that you are weak and unable to defend yourself. By sending such a large amount, you are signaling that you are very rich.

ii. Moral Hazard for Tax Collectors and Tax Farming

The main reasons for building an empire are to extend your borders for protection, the megalomania of the leader, and of course to collect taxes from the conquered areas. One of the problems faced by emperors was that when it takes weeks or months to travel from the capital to the outlying areas of the Empire, one has to trust what their subordinates are telling them about conditions on the ground. Suppose the

Emperor sends a tax collector to a far-off land, and he is instructed to collect 20% of the incomes of the people there and ship it back home. Having no idea how much income to expect, the Emperor is forced to accept whatever gets sent back. It was extremely easy for tax collectors to send back a moderate amount of money to the Emperor and keep the rest for themselves.

How can we keep the tax collector honest? One idea that was tried many times (without success) was to send someone to watch the tax collector. This rarely worked because it was too easy for the tax collector to bribe the watcher. Many emperors would send someone to watch the watcher, and also someone to watch that person. Sending all these “watchers of watchers” gets expensive and still has no guarantee that it will work.

An interesting solution was devised and used in the Roman and Ottoman empires, among others. After a new land was conquered, the Emperor or would call all of the upper military officers to a meeting. He would then hold an auction: to the highest bidder was granted the right to collect taxes for a certain number of years. Most of the time a down payment was required, plus a yearly payment on the balance thereafter. The failure to make these payments in the future was severely punished. How does this benefit the Emperor?

Instead of sending a tax collector who can then cheat him, the Emperor auctions off the tax collecting duties to people who have been there—to the ones who have the information needed to make a judgment about how much in taxes might be collected. The winner, known as a “tax farmer” would normally go back to the area himself (with some of his soldiers) to oversee the collecting of taxes, thus eliminating much of the moral hazard. This is an example of “selling the store,” discussed earlier.

iii. Screening: Rich Nigerian Prince Needs Your Help

Most of us have received “scam” emails at one point or another. Look at the following two letters, which are slightly modified versions of actual scam letters. Here are two questions:

1. Which is more believable?
2. If you were the scammer, which should you send?

<p>Dear Sir/Madam,</p> <p>I am Mrs. Agnes Maltwa, one of the founding directors of QualConsul QS, A consulting firm of professional quality surveyors, project managers, and building environment researchers. Visit the website: http://www.saccmp.org.za to find more information about the company.</p> <p>During my service in QualConsul QS—as the General Duty Assistant of the Construction Industry Development Board (2008–2010), I discovered a total sum of \$30.5m (thirty million five hundred thousand dollars) over invoiced contract fund. This fund must be transferred to a new foreign account or the government will claim back the fund. As you are aware, this government is corrupt and will use this money to oppress the Christians in the country.</p> <p>As you may want to know, I got your details from the chamber of commerce while searching for a reliable person who will help me move the fund immediately. For our mutual protection, we will create a jointly-owned account in a major bank. We must do so before the government gets to know that there was an over invoice sum of \$30.5M. I will pay a reasonable fee for your services.</p> <p>Meanwhile, I have been appointed as one of the consulate officers here in the South African Embassy, London—UK. You may call my secretary at</p>	<p>Dear sir, Its a pleasure for me to send you this email, i am Becky Ofori am from the republic of Nigeria,</p> <p>Sir, my main purpose of searching for a partner abroad is that i am looking for a foreign partner who will assist me in claiming my late father's wealth that he deposited in bank here in Ghana. INTERNATIONAL COMMERCIAL BANK, (I C B) My late father was very wealth farmer, he was assassinated during the war in my country, and before his death he has revealed to me his next of kin about this deposit in Ghana.</p> <p>My late father deposited \$15 million Dollars with the bank. Sir, I am in possession of the documents covering this deposit in the BANK. Sir, I am ready to offer 20% of the total money for anyone that would help me. I need a kind sole to help me pay a few expenses relating to the transfer, and send a bank account number in which to deposit the money. Sir, please help me find some one that will come to my rescue, because i really want to leave Africa. PLEASE REPLY WITH THIS NEW MAIL ADDRESSE (*****@yahoo.co.uk) I hope to hear from you soon.</p> <p>My Sincerely Regards, Becky Ofori</p>
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The surprising answers are: (1) The one on the left is more believable (at least, that was my intent...), but (2) The email you should send out as a scammer is the one on the right. Why?

The reason is that everyone with any sense whatsoever has heard of “Nigerian bank scams.” And anyone with any sense whatsoever knows that you do not give out your bank account information, and that serious professionals do not send e-mails with a lot of typos. Therefore, the *only*

people who would read the letter on the right all the way through, and consider replying, are those *without* any sense whatever... just the kind of customer a scammer is looking for!

Further Reading

On how scammers want to use horrible solicitation letters. Blatancy and Latency.

Retrieved from <http://www.economist.com/node/21557726>

Chapter 7 Preview