

## Targeting Teaching

# Asymmetric Information, Bargaining, and Comparative Advantage in Trade Relationships: An Interactive Game

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The concept of comparative advantage is a fundamental tool in economics. Yet, it is a concept that new students of economics frequently find challenging to grasp. In this interactive classroom game, I highlight the three essential lessons of comparative advantage: (i) individuals can have a comparative advantage (and thus benefit from specialization) in an activity despite not having an absolute advantage, (ii) the gains from specialization are greatest when individuals have the most heterogeneous skill sets, and (iii) the extent of each individual's share of the gains from specialization is often left to negotiation, with asymmetric information playing an influential role. This classroom game allows each player to possess a unique production function, thus better resembling the diverse pool of potential trade partners that characterizes real life.

**JEL Classification:** A20, C90, F10

## 1. Introduction

The concept of comparative advantage, that individuals or countries can gain from specializing in the activity in which their opportunity cost is lower, is a fundamental tool taught in economics. And although comparative advantage is used most extensively in classes relating to international trade, it is a concept introduced in virtually all principles of economics textbooks, and hence, presumably most principles classes. Yet, on first introduction of comparative advantage, the concept is often not fully grasped by the typical student. One reason for this is that the definition of comparative advantage itself does not lend to easy application in the real world. Telling students to specialize in activities with lower opportunity cost is often a foreign concept without proceeding further into the ideas of gains from specialization and terms of trade. In this paper, I present the layout of an interactive classroom game that highlights each of the essential elements of comparative advantage in a way that students can better grasp the underlying intuition and importance of this concept.

Classroom experiments emphasizing comparative advantage are not uncommon. Various authors have developed innovative classroom experiments to help students understand the

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notion of comparative advantage and the value of specialization and trade. For example, Stodder (1994) pairs students to represent either the United States or Mexico to show that gains from trade can exist despite one country having an absolute advantage in the production of all goods. In Hauptert's (1996) experiment, students possessing one of four production functions attempt to achieve their respective consumption goals by interacting with other students. More recent papers have incorporated utility functions into their games. For example, Bergstrom and Miller (2000) developed a game that uses a simple utility function defined by the minimum quantity of two goods produced, whereas Anderson et al. (2005) introduced a Cobb-Douglas utility function to more realistically incorporate the role of preferences in trade. Last, a web-based game entitled the Ricardian Explorer offers an alternative approach to the traditional classroom game that is useful in classes where computers are readily available (Isgut, Ravishanker, and Rosenblat 2005).

In the game presented in this paper, I emphasize the role of asymmetric information and negotiation in trade relationships. Unlike prior games, there are no predetermined trade partners; instead, each student represents a distinct firm that can benefit from trade with nearly all other firms. The contribution of the game is that the extent of the gains from specialization depends on estimating the privately known production functions of other firms and negotiating the terms of trade on the basis of available information.

The procedure of the game is simple: Students representing firms with an endowed production function openly negotiate to form partnerships to increase their own profit. This game has wide application: it can be effective in a class with as few as four students and in a class with over 100 students, it can be played by principles of economics students as well as graduate students, and it can be played and discussed within a 50-minute class period.

## **2. Essential Elements of Comparative Advantage**

The elements of comparative advantage can be described by the following: (i) individuals can have a comparative advantage in an activity (and benefit from specialization) despite not having an absolute advantage in that activity, (ii) the gains from specialization are greatest when individuals have the most heterogeneous skill sets, and (iii) the extent of each individual's share of the gains from specialization is often left to negotiation, with asymmetric information playing an influential role. Whereas most textbooks use a two-country, two-good Ricardian trade model to illustrate these elements, presenting comparative advantage in this manner in principles classes often does not lead to an easy understanding of how the gains from specialization are generated and shared. The following example presents an alternative approach to illustrate these features.

Assume that two brothers, Alex and Will, open a car wash service in their neighborhood, where a car will be washed and waxed by hand for a price of \$10. Assume that there are 24 cars interested in the service, resulting in total revenues of \$240. Further, assume the following productivity rates: Alex can wash a car in 15 minutes and wax a car in 30 minutes, while Will can wash a car in 20 minutes and wax a car in 1 hour. Table 1 presents these productivity rates in a simple matrix.

On the basis of Table 1, Alex has an absolute advantage in both activities and a comparative advantage in waxing, whereas Will has a comparative advantage in washing. Comparative advantage is determined by calculating the opportunity cost for an activity; for

**Table 1.** Productivity Rates: Number of Minutes to Wash and Wax One Car

	Wash	Wax
Alex	15	30
Will	20	60

example, Will's opportunity cost of washing one car is the capacity to wax  $1/3$  of a car, which is lower than Alex's opportunity cost of washing one car, the capacity to wax  $1/2$  of a car. Next, we determine each brother's hourly wage rate if they divide the job in half, so that each has 12 cars to wash and wax and each earns \$120. Using the productivity rates above, it would take Alex nine hours and Will 16 hours to complete the job, resulting in an hourly wage rate of \$13.33 and \$7.50, respectively. These wages represent the "autarky" equilibrium. When each brother specializes in the activity in which he has a comparative advantage, Will would wash all 24 cars in eight hours and Alex would wax all 24 cars in 12 hours. Using the hourly wage rates from autarky, Alex earns \$160 and Will earns \$60. Compared with the total wage of \$240 under autarky, the brothers are able to complete the task at a cost savings of \$20, which translates directly to the gains from specialization.

The final issue is how the \$20 is to be shared. One consideration is that, compared with autarky, Alex is able to work more hours than Will. In this case, Will may demand more of the gains from specialization (resulting in a higher hourly wage) before he agrees to the partnership. Another thought, based on John Stuart Mill's "Theory of Reciprocal Demand," which states that a country with greater preference for trade will acquire less of the gains (Mill 2004), would suggest that the brother who most desires the partnership would gain less. Another possibility addresses the fact that constant returns to scale in production is assumed; if we assume that diminishing marginal returns occur with specialization, then more gains would accrue to the brother who is more able to maintain productivity. Last, if the brothers' parents supervise the project, the parents could arbitrarily distribute the gains or simply keep the gains (i.e., as company profits).

In sum, specializing in the activity in which each brother has a comparative advantage led to reduced production costs (as evidenced by lower total wages paid on the basis of autarky wage rates) and increased efficiency (as evidenced by fewer total hours worked). Resources (the brothers' labor) are allocated to their highest productivity, which allowed cars to be processed more quickly and potentially benefiting both brothers by sharing the gains from specialization that result in higher wage rates.

### 3. The Classroom Game

The classroom game is based on the example presented in section 2. Ideally, the concept of comparative advantage is first taught using the example in section 2 and then the setup of the

classroom game is described, followed by each student receiving a preparation sheet to prepare for the game, which is most effective if played at the start of the following class period. Instructor preparation is minimal: completion of the student preparation sheets on the basis of the estimated number of participating students.

The game is based on a market of many small, perfectly competitive firms that help students format and proofread term papers for their classes. Each student in the class represents a firm (for larger classes, a group of students can represent one firm). Further, each firm provides services of equal quality with all other firms, and there is a standard pricing of \$100 per 24 pages of manuscript (includes both formatting and proofreading), with no quantity discounts. The university, which regulates the firms to ensure consistent quality, also controls the price (which is identical for all firms). The difference between firms lies in the rate at which firms can format and proofread papers to the quality standard.

Assume that a standardized shipment of papers (a.k.a. project) consists of 240 pages of manuscript (in some combination of term papers) and is worth \$1000 to the firm. Although there are an unlimited number of projects available, each firm is limited by time constraints. For the sake of simplicity, we assume constant returns to scale in each activity (which is consistent with the basic Ricardian model).

Before the game (preferably the class period prior), each student receives a preparation sheet (Appendix A) detailing the game as well as that student's confidential productivity rates. In real life, this confidential information is based on one's innate abilities. Both in this game and in real life, keeping information private can lead to greater gains when negotiating with other firms. The importance of private information must be emphasized to students.

The instructor's worksheet (Appendix B) provides a list of 18 productivity rates allowing 18 firms to be randomly assigned to the students. For classes greater than 18, teams can be formed, or one may simply duplicate the entire setup to a multiple of 18. If a remainder exists (e.g., 100 students = 5 sets of 18 and 1 set of 10) or if there are fewer than 18 students, the set can be reduced, preferably by eliminating productivity rates from the extremes (the very top and the very bottom). Particularly for smaller classes, this reduces the natural advantage that a student with very diverse abilities (as given in this game) may have. If each student represents his or her own firm, then this firm can simply be specified by the name of the student. If teams are formed, have each team specify a name for their firm to facilitate the negotiation process. Also shown on the instructor's worksheet is the calculation of the autarky (no specialization) number of hours to complete each project and the corresponding hourly wage rate (which is used to verify the student's calculation of his or her autarky wage rate).

The goal of this game is to interact with other firms in hopes of forming a mutually beneficial business partnership with one other firm, where each firm in the partnership completely specializes in one of the two tasks (i.e., formatting or proofreading). By forming a partnership and specializing in one's comparative advantage, gains from specialization are created. However, it is up to the firms to negotiate the share of the \$1000 project that each will attain from completing its agreed task. Note that the firms negotiate their share of the total value of the project, not the expected gains from specialization. This is designed to allow firms to keep their productivity rates private, and to use it to their advantage when forming a contract. It is up to each firm to accurately calculate the minimum share of the \$1000 that it requires to complete each task (i.e., minimum terms of trade) to improve over the autarky outcome. Students must calculate these values on their preparation sheets before the game.

At the start of the game, students begin open negotiations with all other firms in the class (market). There are various methods by which this can take place. For smaller classes, firms can simply negotiate openly with all other firms in the class. For larger classes, the same approach can be used, or instructors can choose to use an alternate method to ensure participation by all students. For example, instructors can designate an initial period where firms can only negotiate with other firms within a row (of a classroom), followed by a period where firms can openly negotiate with all other firms. Once two firms agree to a partnership, they must specify (on their preparation sheet) who their partner is, what the agreed task is, and the agreed share of the \$1000. This contract can be verified for accuracy after the game by auditing the forms of both firms in the partnership. Should any firm fail to enter into a partnership, its final wage rate is equal to its autarky wage (0% increase). Last, all contracts are final. Once a firm enters into a contract, it can no longer negotiate with other firms. In fact, it may facilitate the process if those already entered into contracts either sit down or exit the classroom temporarily.

An interesting aspect of this game is that no firm has a predetermined comparative advantage. Instead, comparative advantage is determined by the potential business partner, and this in fact can change. For example, one can be relatively better at formatting compared with one firm, but relatively better at proofreading compared with another firm. It is crucial that students understand this and not limit themselves to negotiating the same activity with all potential business partners.

The length of the negotiation aspect of the game is typically 15 to 20 minutes depending on the size of the class. Be sure to specify a strictly adhered to time limit, as this can influence the strategy taken by students (i.e., the greater the time, the more likely students are to engage in longer negotiations and with more students to improve their outcome). After the game has concluded, each student should calculate his or her own performance. There is no need for the instructor to verify all results, but rather just the transactions of the top performers (even if the business partner did not perform well), to verify accuracy.

For instructors who wish to award grades for this game, it is recommended that instructors place more weight on the participation in the game and the subsequent discussion, and less (or none at all) on the outcome of the game. Although the outcome of the game is largely determined by the student's understanding of the game and ability to implement strategies to maximize his or her performance, there is still some element of chance, whether by the randomly assigned productivity rates or by luck during the negotiations. Another suggestion is to grade the accuracy of the student's calculations, or assign follow-up questions or a problem set pertaining to comparative advantage.

#### **4. Classroom Discussion of Results**

The debriefing of the game can take place after the negotiation phase of the game once students complete the evaluation of their own results. However, in larger classes where the instructor may need to assist more students with these calculations, the debriefing can take place the next class period. Begin the debriefing by asking the top performers to discuss their strategies in the game. Then continue to open discussion to the rest of the class by asking students what their expectations were as they prepared for the game, and what challenges (both expected and unexpected) they faced in the game.

After the discussion, the instructor can conclude the analysis of comparative advantage by presenting the winner's case. What was his or her productivity rate? Did this productivity rate determine the set of potential trading partners with whom she/he would have comparative advantage in formatting (proofreading)? Did not knowing the range of other productivity rates in the market affect this perception? How about the winner's business partner? Were their productivity rates much different such that the total gains from specialization were substantial? Or were the productivity rates similar, but the winner was able to negotiate a substantial share of the gains from specialization?

This discussion highlights some important lessons from this exercise. First, negotiations are easier if there are more gains to negotiate. How does one generate more gains? By finding a business partner that is most different from oneself with respect to skill set. This maximizes the gains from specialization. Firms that did not attain the top performance level might be used in comparison here. Another important lesson is that the size of the gains will not allow a firm to benefit as greatly if the firm does not acquire a large share of those gains. Thus, strong negotiation skills and the ability to keep information (the firm's own productivity rate as well as information learned from other firms during the negotiation process) private can lead to a successful outcome despite not having many gains to negotiate. In some cases, a firm that failed to agree to a contract with another firm may end up returning to that same firm later in the negotiation process; however, the outcome may be worse for one firm compared with the initial price it had failed to agree on.

In sum, a firm can do well in this exercise in two ways: (i) finding a business partner that can generate the most total gains, which makes negotiation less critical, and (ii) finding a business partner that not necessarily generates the most gains, but is a weaker negotiator such that one can acquire most of the gains. Typically, the winner of the game is one that is able to master both of these tasks.

Last, there are some unique outcomes that sometimes occur, particularly if instructors use this game repeatedly. One unique outcome in particular is the use of collusion, where two students who are friends collude for one to win the game. This is accomplished by one friend negotiating a horrible outcome for himself (perhaps even worse than the autarky outcome) to give a friend a huge gain. Although instructors may allow this to happen (it does encourage creative thinking), it does reduce the ability to learn the basic lessons of the game, and therefore I would limit the possibility of such outcomes to small graduate classes (of course, one should never discuss this possibility before the game). For undergraduate classes, it is recommended that instructors discard any contract between students in which one business partner has an outcome worse than autarky whether by intent or by mistake, though instructors may use it as a discussion point after the main analysis.

## **5. Conclusion**

This interactive classroom game teaches the essential features of how firms and countries use comparative advantage, private information, and negotiation skills to gain from specialization and trade. It emphasizes that the benefits from specialization and trade are greatest when partners are most divergent in skill sets. It also illustrates the importance of negotiation in how the gains from specialization are shared, and how firms conceal

information they learn about themselves and others to increase their own share. In sum, all of the key concepts related to comparative advantage are featured in this game, including autarky equilibrium, total gains from specialization (trade), minimum terms of trade, final terms of trade, and individual gains from specialization (trade). Last, this game is easy to play, can be played in all class sizes and at both the undergraduate and graduate level, and can be played more than once by the same class. The lessons that can be learned from this game help to place this important yet often confusing concept into the real world.

**Appendix A: Student Handout (Provided One Class Period before the Game Is Played)**

*The Comparative Advantage Game*

*Setting:* You own a business that specializes in formatting and proofreading term papers for students. There are many firms similar to yours, and all firms are regulated by the university to ensure quality service. As such, the prices for formatting and proofreading are regulated, and set at the rate of \$100 per 24 pages of manuscript (with no quantity discounts). Assume a standard project is worth \$1000 for 240 pages of manuscript (consisting of several term papers).

*Goal:* Although you can perform each job on your own by doing both the formatting and the proofreading, you realize that there may be gains from specialization on the basis of comparative advantage. Therefore, you consider partnering with another firm in hopes of increasing your hourly earnings.

*Rules of the Game:* (i) Begin by calculating what your hourly earnings would be if you do not enter into a partnership. Determine the minimum amount of money you will need (for each task) to increase your hourly earnings by specializing in one of the two tasks. (ii) Negotiate with other firms to create a mutually beneficial partnership. You need not share your confidential information with any other firms, even a firm with which you eventually enter into a partnership. (iii) Once you decide to enter into a partnership, you must set a contract for: (a) who will specialize in formatting and who will specialize in proofreading, and (b) the agreed shares of the \$1000 per project (must sum to exactly \$1000). (iv) You may only enter into ONE partnership; all contracts are final once agreed. (v) If you fail to enter into a partnership, you operate the business on your own. (vi) If you do enter into a partnership, determine how many hours YOU must work to complete your part of each project; then, on the basis of your share of the \$1000 revenue, determine your new hourly earnings. (vii) The winner is the firm that achieves the highest percentage increase in hourly earnings on the basis of specialization due to comparative advantage.

**YOUR CONFIDENTIAL INFORMATION:**

You can format at the rate of: \_\_\_ pages/hour

You can proofread at the rate of: \_\_\_ pages/hour

**YOUR TIME TO COMPLETE THE PROJECT ALONE:** \_\_\_\_\_

**YOUR HOURLY EARNINGS:** \_\_\_\_\_

**MINIMUM SHARE FOR FORMATTING:** \_\_\_\_\_ **FOR PROOFREADING:** \_\_\_\_\_

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**PARTNER FIRM:** \_\_\_\_\_

**YOUR NEGOTIATED TASK (circle one):** Formatting or Proofreading

**YOUR NEGOTIATED SHARE OF \$1000:** \_\_\_\_\_

**NEW HOURLY EARNINGS:** \_\_\_\_\_ **% INCREASE:** \_\_\_\_\_

**Appendix B: Instructor’s Worksheet (on the Basis of 18 Students)**

To create a set of student preparation sheets, enter a unique formatting and proofreading rate (provided below) in the “Your Confidential Information” section, then print and duplicate as needed on the basis of the number of participants.

Because the “Autarky Wage” rates differ, students determine their overall performance on the basis of a percentage increase in hourly wages. Some students may have a slight endowed advantage, either by having a lower autarky wage rate or a more diverse productivity rate for the two activities. Nonetheless, these slight natural advantages will not significantly affect the ability of any student to be successful in this game.

Firm Number	Format Rate	Proofread Rate	Hours/ Project	Autarky Wage
1	8	20	42	\$23.81
2	10	20	36	\$27.78
3	8	16	45	\$22.22
4	10	16	39	\$25.64
5	8	15	46	\$21.74
6	10	15	40	\$25.00
7	12	15	36	\$27.78
8	10	12	44	\$22.73
9	12	12	40	\$25.00
10	10	10	48	\$20.83
11	12	10	44	\$22.73
12	15	12	36	\$27.78
13	15	10	40	\$25.00
14	15	8	46	\$21.74
15	16	10	39	\$25.64
16	16	8	45	\$22.22
17	20	10	36	\$27.78
18	20	8	42	\$23.81

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