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A two-round in-class trading game on the principle of comparative advantage and the theory of reciprocal demand

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ABSTRACT

This paper outlines a classroom trading game that explores equilibrium terms of trade using the principle of comparative advantage and theory of reciprocal demand. Students are divided into eight groups. Each group is assigned a country with hypothetical productivity and each country seeks its trading partner based on comparative advantage. Students simulate the trading of goods between countries with the objective of achieving the best possible terms of trade. The game encourages students to reflect on their learning of the principle of comparative advantage, consider improvements in trade terms through negotiation, and summarize the conditions for mutually beneficial terms of trade. The study contributes to the existing literature by extending the discussion beyond comparative advantage to incorporate mutually beneficial terms of trade as well as factors contributing to the distribution of trade gains.

1. Introduction

In 1800, David Ricardo developed the principle of comparative advantage to show how countries can leverage specialization and benefit from international trade. According to Ricardo, comparative advantage, determined by the difference in opportunity costs, is merely a basis for trade (Carbaugh, 2017).

Modern trade theory explains this using a production possibility schedule (PPS). For any particular trade between two countries, we can label the autarky points in the absence of trade, post-specialization production points, and post-trade consumption points on each country's PPS to visualize the production and consumption gains.

The post-trade consumption points that a nation can achieve are obviously determined by the international terms of trade. It appears reasonable that a trade deal would be agreed upon by both trading partners if for each of them, the international terms of trade are more favorable than their respective domestic terms of trade, that is, the domestic opportunity cost between the goods. Simply put, mutually beneficial terms of trade should be within the outer limits of the terms of trade, which are determined by the two countries' domestic trade terms.

However, a shortcoming of Ricardo's principle of comparative advantage is its inability to determine the actual terms of trade. The best description that Ricardo could provide was only in terms of the outer limits within which the terms of trade would fall. John Stuart Mill improved upon the Ricardian theory by developing the theory of reciprocal demand. In his view, the actual terms of trade are determined by the relative strength of each country's demand for the other country's product. The production costs determine the outer limits of the terms of trade, while the reciprocal demand determines the actual terms of trade within these limits.

It is always challenging for students to understand mutually beneficial terms of trade and the theory of reciprocal demand.¹ Durham et al. (2007) state that experiments may be useful tools for demonstrating complex concepts. A two-round trading game could improve students' understanding of this basis for trade by labeling autarky, post-specialization production, and post-trade consumption points, as well as calculating the gains from production and consumption. More importantly, it could help students overcome learning challenges by simulating the trading of goods between countries and enabling negotiations between hypothetical trading partners.

Several classroom experiments have included elements of trade theory. More recent ones include Winchester (2006), which is a pencil-and-paper experiment that discusses the effects of tariffs, and Isgut et al. (2005) and Johnson (2010), both of which are based on computerized experiments that leverage the computer's power to track trade information.

Some international trade experiments primarily focus on the application of comparative advantage. Stodder (1994) and Hauptert (1996) demonstrated the gains from trade using hand-run experiments. In particular, Stodder (1994) showed the gains from trade by having students pair up to trade and record their gains based on their different comparative advantages. Hauptert (1996) described trade gains by giving students a fixed allocation of inputs and a production function, as well as a consumption goal, and the opportunity to trade their output over a number of experimental trials. The experiment was designed so that students could achieve their consumption goals only by specializing in the production of the good in which they had a comparative advantage and then trading with other players. However, these two experiments could only demonstrate that both trading partners could realize trade gains by exploiting specialization and trade; they did not discuss the distribution of the gains from trade. The actual terms of trade, that is, the rate at which a country's export product is traded for the other country's export product, will directly determine the distribution of trade gains. Our study extends the discussion beyond comparative advantage to incorporate mutually beneficial terms of trade as well as factors contributing to the actual terms of trade or distribution of trade gains.

More closely related to this study is Chiang (2007), which illustrates the effects of asymmetric information and bargaining on the distribution of trade gains, and implies that negotiations play a critical role in this distribution. This study's contribution is to show that mutually beneficial terms of trade as well as the theory of reciprocal demand are other factors that contribute to the distribution of gains. There are relatively few classroom experiments that use these concepts.

In addition, the use of this two-round in-class game compared with the traditional approach can be justified on several grounds. Several studies advocate using games to complement the traditional lecture approach (Bergstrom and Miller, 2000; Hester, 1991). Given their tangible nature, classroom experiments improve students' understanding of abstract concepts (Oxoby, 2001). Games can also make learning interesting in that they mask the large amount of learning needed to play them successfully (Houser and DeLoach, 1998). As students have different learning styles, using a range of teaching methods improves the understanding of economics across various types of students (Becker and Watts, 1995, 1996). Students with high participation in classroom experiments experienced significantly greater gains in the Test of Understanding in College Economics (Emerson and Taylor, 2004). Moreover, the use of classroom experiments is shown to be a significant factor in the improvement of student attitudes toward the study of economics (Durham et al., 2007).

Another advantage of this game is the feedback that the instructor obtains on students' understanding of the principle of comparative advantage and theory of reciprocal demand. In a traditional lecture scenario, the instructor assesses students' learning based on an examination or quiz. The use of games provides instructors with immediate feedback on what students know and do not know, thereby allowing them to adjust their instructional strategies to meet learning objectives (Angelo and Cross, 1993). This can be achieved through performance assessments contained within the game that appraise whether trading pairs have established the correct trade directions and have achieved mutually beneficial terms of trade.

This game is suitable for introductory International Economics courses and for class sizes of 30–50 students. It is best played after students have learned the principle of comparative advantage; drawing a PPS; labeling autarky, post-specialization production, and post-trade consumption points; and calculating the production and consumption gains, but before discussions on mutually beneficial terms of trade and the theory of reciprocal demand. Approximately 45 min are required to introduce, play, and discuss the game.

Additionally, we conducted a survey regarding the effectiveness of this game among 179 players (in four different sections) of the learning game. The results show that engagement in the game has a clearly positive effect on learning. Both Hamari et al. (2016) and Ruggiero (2015) used survey instruments to measure the subjective experiences of students when playing educational games.

This paper is organized as follows: Section 2 shows the directions and key takeaways from the first and second rounds of the game; Section 3 reports the feedback from the student participants; and Section 4 concludes.

2. Materials and methods

2.1. First round of the game

2.1.1. Pre-game considerations

In a normal two-hour lecture, the instructor should spend the first hour describing the basic concept of the principle of comparative advantage. In this stage, the terms of trade should be directly provided, and the instructor should emphasize the question of why the given terms of trade are mutually beneficial, specifically, that both countries are better off. Students should be informed that

¹ Mutually beneficial terms of trade as well as the theory of reciprocal demand are common topics of student questions during consultation hours and errors in examinations.

they will be participating in a hypothetical trading game with prizes to explore these concepts independently. For countries where a two-hour lecture is not the norm and 50 min (3 days per week) or 75 min (2 days per week) is more common, the instructor could cover the theory in one section while organizing the game and leading the discussion in the following section.

2.1.2. Group assignment and game set-up

Divide the class into eight groups and assign each group one of the following countries: four countries assigned to category one (A, B, C, and D) and four assigned to category two (E, F, G, and H). Each country will use all its resources to produce only two goods, shirts and shoes, which are assumed to be divisible. Countries in category one share the same opportunity cost for one shirt, which is 1/3 shoe, while countries in category two have a common opportunity cost for a shirt, which is 3/2 shoes. Provide each group with a worksheet with its own PPS and location of autarky points (refer to the sample in Appendix A).

Instructors could always adopt a more flexible game setting, especially when the number of students exceeds 50. For example, there could be more countries per category with common opportunity costs or there could be more categories of countries. This study only illustrates the simplest setting with two categories and four countries within each category.

2.1.3. Introducing the rules of the game

Inform the students that the objective of the game is for each country to achieve the best terms of trade by trading its goods for products from another country. Each team will start by calculating the opportunity cost from the given PPS and then identify exactly one trading partner with whom to trade. Explain to the students that, based on the opportunity cost, they should first evaluate the direction of trade, that is, whether their country is an exporting country for shirts (or shoes). Inform the students that they can be creative when negotiating the terms of trade and should strive to achieve the most beneficial terms of trade possible. Effectively, the team leader should negotiate on behalf of the team to sell one unit of their exports for as many imports as possible. If no deal is made by close of trading, the default consumption gain would be zero.

There will be two or more winners in Round 1 based on the best terms of trade; external incentives, such as a bag of chocolate or cookies, could be provided to the students. This game is only associated with a free gift and no grade incentives. Dickie (2006) showed that using classroom experiments without grade incentives is associated with a significantly greater mean improvement in test scores. Meanwhile, adding a grade incentive to reward performance in experimental markets appears to exert a negative influence on student achievement, which partly offsets the beneficial effect of classroom experiments.

2.1.4. Conducting the first round of trading and listing trading outcomes

Allow for fifteen minutes of open trading. Each team may spend around two minutes to calculate their opportunity cost and five minutes to find a valid trading partner. When two countries with equal opportunity costs approach each other in error, they could simply observe that there is no difference in their opportunity costs or no basis for trade. Alternatively, even if they were to trade with one another, they would eventually reach the conclusion that regardless of the terms, there is no potential for a mutually beneficial trade. On the other hand, with a valid partner, every trading pair usually uses the remaining time for negotiation and final calculation of the gain from trade. After this, the instructor could list the eight countries on a whiteboard, with countries on the first and second rows belonging to categories one and two, respectively. Table 1 presents a sample table for visualization.

2.1.5. Encouraging students to reflect on their learning

First, ask each country on the first row the following questions:

- Which country is your trading partner?
- What is your opportunity cost and that of your partner?
- Based on what we have learned, do you export shoes or shirts?

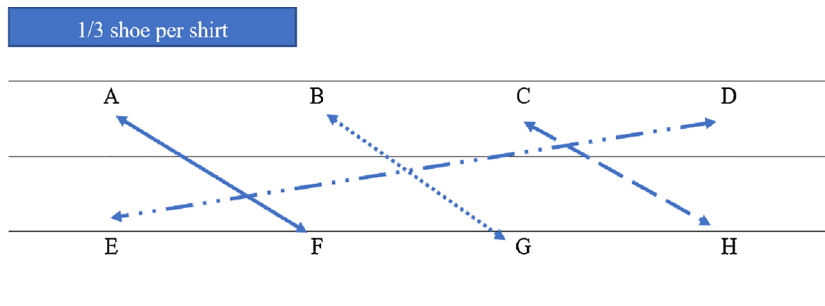
By listing the opportunity costs and connecting the trading pairs, the instructor could then reflect all the information collected from the game on the table. Below is the sample table for visualization (Table 2).

From the trading outcome, the instructor could then summarize the first key takeaway, which is that countries on row one with a

Table 1
Representation of Group Assignment.

A	B	C	D
E	F	G	H

Table 2
Opportunity Costs and Trading Pairs.



3/2 shoes per shirt

lower opportunity cost in shirts should specialize in and export shirts while countries on row two should sell shoes.

More importantly, the students should realize that there is no trade between countries on the same row. Mutually beneficial trade is only feasible between a country on the first row and a country on the second row. The instructor should then lead the discussion to probe the students on whether this is a coincidence and to assess if they can apply what they have learned to explain this situation.

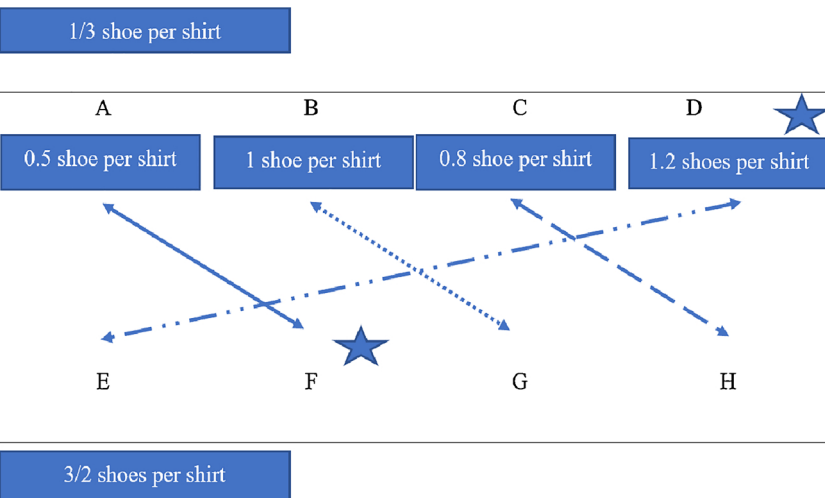
It is worth emphasizing the point that all four countries on row one share the same opportunity cost and this applies to the countries on row two as well. There is no basis for mutually beneficial terms of trade between countries with the same opportunity cost (i.e., on the same row). This takeaway reinforces, among students, the essence of the principle of comparative advantage.

For the second key takeaway, discuss the following question for each trade pair:

- How do you trade the two goods; in other words, what are the terms of trade?

The instructor should list the four terms of trade on the whiteboard and check whether they are mutually beneficial. (It would be clearer to standardize the terms of trade as number of shoes per shirt and the terms of trade should be between 1/3 and 3/2 shoes per shirt). First, students should be asked to take a closer look at the four terms of trade and figure out the winners in rows one and two, respectively. The instructor could guide the students to identify what constitutes better terms of trade from the perspective of countries on row one. Since countries on row one specialize in and sell shirts, the winner/winners would be the country/countries that successfully sell one shirt for the highest quantity of shoes. Similarly, for countries on row two, the winning countries should offer the lowest quantity of shoes to buy one shirt. Prizes, such as a bag of chocolates or cookies, could be given to the winners. [Table 3](#) presents the sample table to visualize the four terms of trade based on typical results from past experiments, with teams D and F as the winners.

Table 3
Terms of Trade and Winning Countries.



Thereafter, the instructor should randomly pick one country from row one and ask the representing team to draw the country's PPS and post specialization production point on the whiteboard. Then, the team members are required to label the post trade consumption point at the terms of trade of 1/5 shoe per shirt and to consider whether they would be willing to trade at this rate. The expected answer is no, since the country is worse off from this trade deal with the post trade consumption point inside its PPS. The instructor could increase the rate progressively to 1/4 and 1/3 and repeat the question. It should be evident to the entire class that, if the terms of trade are less than 1/3, the trade would result in a point inside the PPS and the country can never be better off, that is, the lower limit of the terms of trade should be 1/3. A similar question could be posed to a country from row two, as to whether the students would be willing to trade at the rate of two shoes per shirt (or equivalently offer two shoes to buy one shirt). After reflection, the students should realize that the upper limit of the terms of trade should be 3/2.

The instructor could emphasize this take away from the game by introducing domestic terms of trade, or the domestic opportunity costs between the goods. The countries on row one could always obtain 1/3 shoe by giving up one shirt. Thus, they could only benefit from international trade if its terms were more favorable than the domestic terms of trade. In other words, they would be willing to sell one shirt for more than 1/3 shoe and the higher the better. The same applies to the countries on row two. They would be willing to buy one shirt internationally with less than 3/2 shoes, and the lower the better. In summary, the terms of trade should fall within 1/3 to 3/2 shoes per shirt.

Before the second round of the game, the instructor should further probe the students: we already know the range of the valid terms of trade, but what are the actual terms of trade and what factors influence these terms?

There is always at least one student who responds citing negotiation skills or bargaining power. Then, the instructor should continue by asking about the factors that determine a country's bargaining power.

The answers generally vary. Some responses are from an economic perspective (e.g., GDP) while others are from a political perspective. The instructor should inform the students that there will be another round of bargaining for students to renegotiate the terms of trade based on the economic market conditions to identify one key factor that determines the actual terms of trade.

2.2. Second round of the game

2.2.1. Pre-game considerations

The game now includes four pairs of trading partners, each comprising one country from category 1 and another from category 2. Select two pairs of trading partners and assign them the names Buddy 1 and Buddy 2, distributing the *information for demand condition one* (refer to the sample in Appendix B) to the constituent countries that countries on row one are very eager for shoes from their trading partner, while countries on row two are not very eager for shirts. Assign the names Buddy 3 and Buddy 4 to the other two pairs and distribute the *information for demand condition two which applies exactly the opposite of condition one* (refer to the sample in Appendix B) to this set of countries.

2.2.2. Conducting the second round of trading

Conduct the second round of trading. Allow five additional minutes to trade. Then, announce that the trading time is over and record the updated terms of trade for each pair.

2.2.3. Encouraging students to reflect on their learning

List the four terms of trade for each team, Buddy 1 to 4, on the whiteboard and ask the students what they can observe from the four numbers. Emphasize that Buddy 1 and 2 have one set of common market conditions while Buddy 3 and 4 have another set.

The students should be able to spot the differences in the terms of trade. Specifically, the terms of trade for Buddy 1 and 2 should

Table 4

Terms of Trade under Different Demand Conditions.

1/3 shoe per shirt			
A	B	C	D
0.5 shoe per shirt	0.4 shoe per shirt	1.1 shoe per shirt	1.3 shoes per shirt
Buddy 1	Buddy 2	Buddy 3	Buddy 4
F	G	H	E
3/2 shoes per shirt			

be smaller than those for Buddy 3 and 4. In addition, the terms of trade for Buddy 1 and Buddy 2 should be closer to $1/3$, i.e., one shirt can only be exchanged for a small quantity of shoes.

On the other hand, the terms of trade for Buddy 3 and Buddy 4 should be closer to $3/2$, i.e., one shirt can be exchanged for a relatively large quantity of shoes. Table 4 illustrates the typical results for visualization purposes.

Now, leading the discussion, the instructor should ask the students from the Buddy 1 and 2 grouping, why their negotiated terms of trade are small. The students should be able to draw the right conclusion based on their demand information. In addition, the instructor can ask these students to guess the demand conditions for Buddy 3 and Buddy 4 to reinforce their theoretical understanding.

Last, the instructor can outline the conclusions and explain the theory of reciprocal demand. The actual terms of trade are determined by the relative strength of each country's demand for another country's product. If the countries in category 2 are more eager to buy shirts than the countries in category 1 are to buy shoes, the terms of trade will end up closer to the category 2 countries' cost ratio of $3/2:1$. Meanwhile, if the countries in category 1 are keener to buy shoes than the countries in category 2 are to buy shirts, the terms of trade will end up closer to the category 1 countries' cost ratio of $1/3:1$. Hence, production costs determine the outer limits of the terms of trade, while reciprocal demand determines the actual terms of trade within those limits.

For courses such as Introductory Economics, the game could be extended with a discussion on the factors that may affect reciprocal demand. Various factors could be mentioned such as alternative suppliers of the relative imports, size of the economy, and political factors. The instructor could also emphasize the importance of elasticity of demand.

On the other hand, for courses such as International Economics, the instructor could lead the students to compare two situations. In the first situation, the two countries are of equal economic size while in the second situation, their economic sizes are unequal. The instructor should ask the students to identify the conditions under which the theory of reciprocal demand best applies. From discussion, the students should realize that this theory best applies when the two nations are of equal economic size so that their demand has a significant effect on the market price. If the two nations are of unequal economic size, the relative demand strength of the smaller nation will be dwarfed by that of the larger nation; thus, the small nation can export as much of the commodity as it desires.

3. Results & discussion

3.1. General feedback from the students

Data for the effectiveness of this game were gathered by a survey (sample in Appendix C) of 179 players in four different sections of the learning game.

Before participating in the game, 78% of the students rated their knowledge of comparative advantage and terms of trade to be somewhat or fairly low. On the other hand, 81% of the students considered their knowledge of these topics to be somewhat or fairly high after participating in the game. More than 90% of the students agreed or strongly agreed that the design of the game was appealing and highly motivating, the learning objective and the activity were engaging, and the instructions were clear and easy to follow. In addition, a majority of the students were satisfied with the game and considered it effective. To summarize, the results show that participating students perceived the in-class game to be an effective, useful, enjoyable, and engaging learning experience.

3.2. Select Student Evaluations

Apart from the general quantitative feedback, this section highlights excerpts of the qualitative feedback obtained through the surveys.

"The game has definitely helped me to gain a better understanding of the concepts. Such creative and interactive form of learning through the use of an example has helped me to not only feel more energized, but also more engaged throughout the lessons. It lightened the mood and sparked our interest in learning more about the concepts taught."

"It was an interesting way of learning about comparative advantage and I felt that it was very useful because the concept can be quite confusing. If the Professor who had taught me comparative advantage previously had used [this] game, I would definitely have had an easier time trying to understand the concept."

3.3. Problems encountered by students in past rounds of the game

This game has been conducted more than 10 times in the International Economics course at Singapore Management University, which does not have massive lecture theatres. Instead, all students take seminar-style classes set in MBA-styled seminar rooms. There are no more than 45 students in each class.

Based on students' feedback, some problems were encountered when participating in this game. Some students mentioned the space constraints of the seminar room as an issue because it was difficult to move around to talk to different groups. Thus, a larger classroom would be more suitable for replicating this game.

Other students raised the difficulty in reaching an agreement as both parties sought better terms. As such, instructors should always remind the students when there are only two minutes remaining before trading period closure that if no deal is made, the consumption gain will be zero while a concession to the other party's request may be better than zero.

Another potential problem is related to identification. Specifically, it is sometimes difficult to identify the various team members during the game. To resolve this issue, at the outset of the game, each team can be asked to let their class members know its leader and where they are seated.

4. Conclusion

After several years of huge trade deficits with China, U.S. President Trump has promised to boost the U.S. economy and create jobs by closing trade gaps. Most economists disagree with his anti-free trade policies. Referring to the basic theory of David Ricardo, both countries benefit through trade, even if one has a deficit.

Therefore, it is extremely important to find effective ways of illustrating and explaining the concept of comparative advantage. This paper describes a classroom trading game that is suitable for helping students understand the principle of comparative advantage. By simulating the trading of goods between countries and negotiating the best possible terms of trade, students can effectively reflect on what they have learned about the principle of comparative advantage and overcome the challenges: the conditions for mutually beneficial terms of trade and the effects of reciprocal demand on these terms.

The game is interesting. Compared to online games, it is easier to play and requires very basic equipment such as pencils, rulers, and paper. Instructors can prepare the materials within 20 min while students do not need to bring laptops into class. All the necessary instructions can be given to the participants within five minutes.

The game is closely tied to the learning objectives, whereby successful completion of the game moves the student closer to mastery of the principle of comparative advantage and the theory of reciprocal demand. By simply observing the trading results, the game can effectively provide the instructor with focused feedback concerning the students' progress towards the defined course objectives.

Last, this game emphasizes qualitative analysis and would be more suitable for use in International Economics courses for non-economics major students without prior knowledge of Economics, such as demand and supply. For advanced International Economic courses or courses for Economics major students, the second round of this game could be extended with an actual demand and supply schedule to determine the exact equilibrium terms of trade.

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Declarations of interest

None.

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