A Classroom Experiment on Import Tariffs and Quotas Under Perfect and Imperfect Competition

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Abstract

This manuscript develops a classroom experiment on international trade that is suitable for undergraduate intermediate macroeconomics, international trade, and international finance courses. Students representing buyers, in a small home country and foreign country, and sellers, both home and foreign, participate in a double-oral-auction to determine the price and level of international trade. By imposing tariffs and quotas and altering the structure of the home market from one of perfect competition to one of imperfect competition, the students experience the importance of market structure when seeking to determine efficiency effects of import tariffs and quotas.

JEL Codes: A22, C91, D43, F11, F12

Keywords: experiments, trade, quota, tariff, imperfect competition

***PRELIMINARY DRAFT, DO NOT CITE WITHOUT PERMISSION.

I. Introduction

Undergraduate students who have recently completed a principles of economics sequence often have a cursory knowledge of the "law of one price." They can usually recall how the movement from closed to open trade lowers the price in one country while raising the price in the other. What students often struggle with is the mechanism by which tariffs and quotas alter both the behavior of consumers and producers. Furthermore, many students fail to grasp the role of market structure in defining the incentives faced by consumers and producers. Experiencing the mechanism firsthand through a class experiment enhances the likelihood that students gain and, most importantly, retain a more thorough understanding of tariffs and quotas under different market structures.

This manuscript describes a class room experiment that can be used in intermediate macroeconomics, international trade, and international finance courses to help student think more clearly about the effects of tariffs and quotas under various types of market structures. This experiment focuses on how under imperfect competition in the home market, an import quota results in higher prices and lower quantity than an import tariff.

In a small country with perfect competition, tariffs and quotas alter the incentives faced by consumers and producers similarly. Under the assumption that quotas are uniformly assigned across foreign producers, import tariffs and quotas both affect price, quantity, home producer surplus, and home consumer surplus similarly.[1] However, if the home market is imperfectly competitive, say for instance it is home to a single, non-discriminating monopolist, an import quota leads to higher prices and lower quantity for the home country consumers than an import tariff. This is because once an import quota is exhausted; the remaining demand is met by the

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[1] Foreign producer surplus, however, is different depending upon both whether a tariff or quota is used and how each are implemented.

home monopolist which sets the quantity that maximizes profits. Under a tariff the monopolist continues to face a constant, though higher, marginal revenue curve and must compete with the foreign producers for each and every consumer.

Students play the roles of consumer and producer in both the home and foreign markets. The students' goals are to maximize their producer surplus if they are producers or consumer surplus if they are consumers. Ideally, students participate in two to three double oral auction periods in each round, making sure to record their agreed to prices and quantities. Each new round begins with the introduction of a new tariff, quota, or alternative market structure.

In the first round, students can only trade with producers or consumers within their own country. In the second round, students are allowed to trade with both home and foreign consumers and producers. In the third round, the home country places a quota on the imports; in the fourth round the home country then institutes a tariff. With the import tariff still in place, the fifth round alters the market structure by combining all producers in the home country so that they become a single, non-price discriminating monopolist. The sixth and final round replaces the tariff with the quota. At the end of the experiment, students can be rewarded for the highest level of producer and consumer surplus respectively from rounds one through four.

The experiment reinforces several important theoretical findings to students. First, like experiments by Hazlett (1999) and many others, students experience the law of one price as individual country specific prices adjust to the "world price" once exchange between consumers and producers in both countries is allowed. The experiment demonstrates how open trade increases total gains from trade, and yet, results in the reduction of surplus for some traders. Second, students experience how a tariff and quota alter the possible level of exchange from the point of view of domestic and foreign consumers and producers. They learn that, under perfect

competition, tariffs and quotas have similar effects, reducing home consumer surplus and raising home producer surplus by raising the price paid for foreign imports.

Altering the structure of the home production market from many sellers to a single non-price discriminating monopolist enhances students' understanding of how and why a quota results in higher prices and lower quantity than a tariff. By experiencing the changes in the incentives, students gain firsthand knowledge of how a home single non-price discriminating monopolist is able to restrict quantity and thus raise prices once the foreign producers' quota has been exhausted. After the experiment, many of these concepts and ideas are brought to the surface through a series of discussion questions.

II. Preparation

Before conducting the experiment, print the participant instructions shown in Appendix A and the buyer and seller information sheets found in Appendix B. The experiment is designed for 16 or more students. For classes of 16 to 48 students, see Appendix C for the number of students who should be assigned as home buyers, home sellers, foreign buyers, and foreign sellers. Although the example below uses 24 students, the results can be scaled up or down depending on the class size.

For a class of 24 students familiar with double oral auctions markets, this experiment and discussion should take about 40 minutes if each of the six rounds consists of only one five minute trading period. If each round consists of two five minute trading periods, the experiment and discussion should take about 75 minutes. If class time is a constraint, this experiment can easily be split into two class periods: one on the effects of tariffs and quotas under perfect

competition and the second focused on the effects of tariffs and quotas under imperfect
competition.

III. Experiment Details

Students are given the instructions on how to conduct a double oral auction market.[2]
They are initially divided into two separate double oral auction markets for the same hypothetical
good. Each market represents a separate country, the home country or the foreign country. Each
sheet lists whether the student is a citizen in the home country or the foreign country. Examples
of the buyer and seller sheets can be found in Appendix B. Students that are sellers are given
marginal cost schedule sheets. Each sheet lists the marginal cost of producing each unit of the
fictitious good. Students that are consumers receive marginal value schedule sheets. Each sheet
lists the marginal value received from consuming each unit of the hypothetical good. In the
initial round, a trade barrier prevents any exchange between countries. Each market will arrive at
a unique equilibrium.

In home country, the consumer sheets consist of the integer values along the demand
curve of $p_h = 10 - q_h$. Each home producer is given a marginal cost sheet for integer values
associated with a marginal cost curve of $p_h = q_h$. In the foreign country, consumers are given the
same integer values as the home consumers: $p_f = 10 - q_f$. The foreign producers, however, are
given a constant marginal cost; each foreign firm is given a marginal cost curve of $p_f = 2$. In
autarky, the home economy ends up with an equilibrium of price of 5 ($p_h = 5$) and a quantity of 5
units ($q_{i,h} = 5$) per home firm or per home consumer. The total quantity consumed will be equal

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to $Q_h = (n/4)*q_{i,h}$ where n_h is the number of students in the class. So, as shown in Figure 1, for a class of 24 students $Q_h = (24/4)*5 = 30$. [3]

Producers report the Buyer ID, the total number of units sold to each buyer, and the total revenue receive from each buyer. The instructor records the transactions for all home and foreign country participants separately so that participants can see any differences between the two counties. During each round, while conditions are held constant, the instructor will grant students two or three trading periods in order to give participants the opportunity to find a stable equilibrium.

Figure 1

Home Supply and Demand
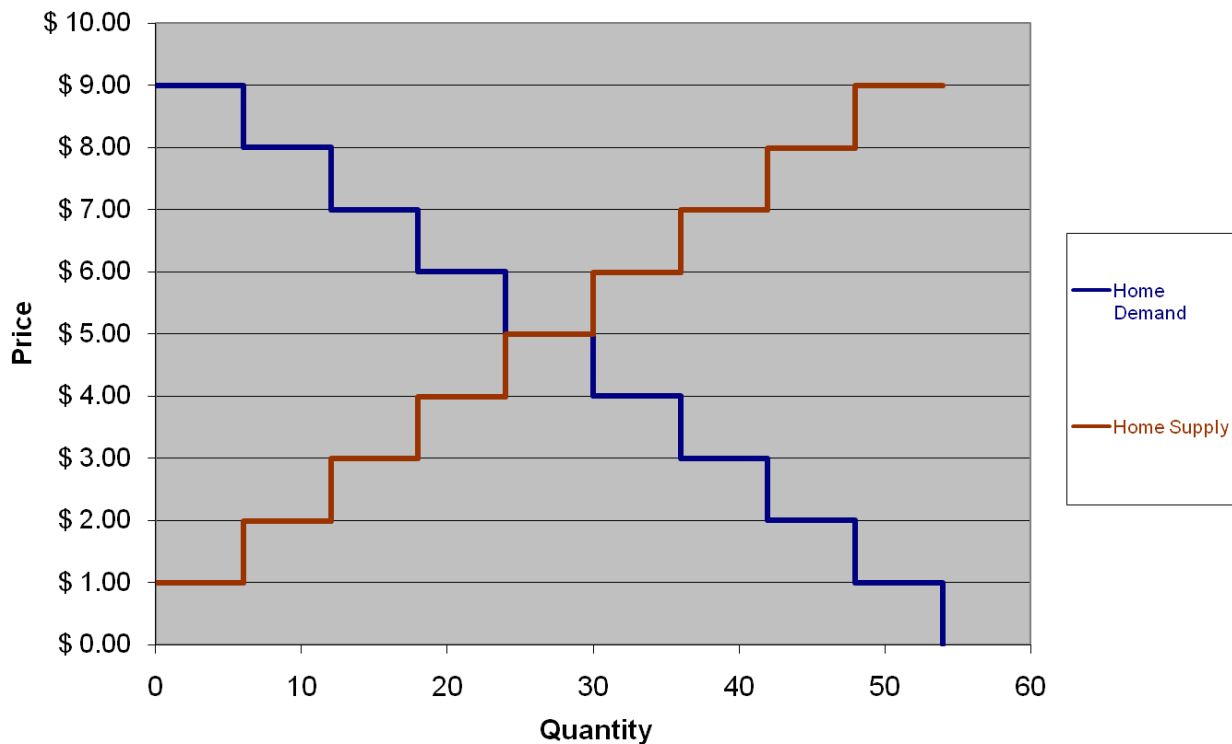
[3] These graphs are step functions because traders cannot buy or sell fractions of a widget. The graphs are created using a program created by Jim Murphy (2004) and downloaded from his website.

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In the foreign country, each firm will supply $q_{i,f} = 8$ at a price of $p_f = 2$. As shown in Figure 2, for a class of 24 students, the total quantity sold in the foreign country will be $Q_f = (24/4)*8 = 48$ units. The higher production costs in the home country result in a higher price ($p_h = 5$ versus $p_f = 2$) for the hypothetical good than that in the foreign country.

Figure 2

Foreign Supply and Demand
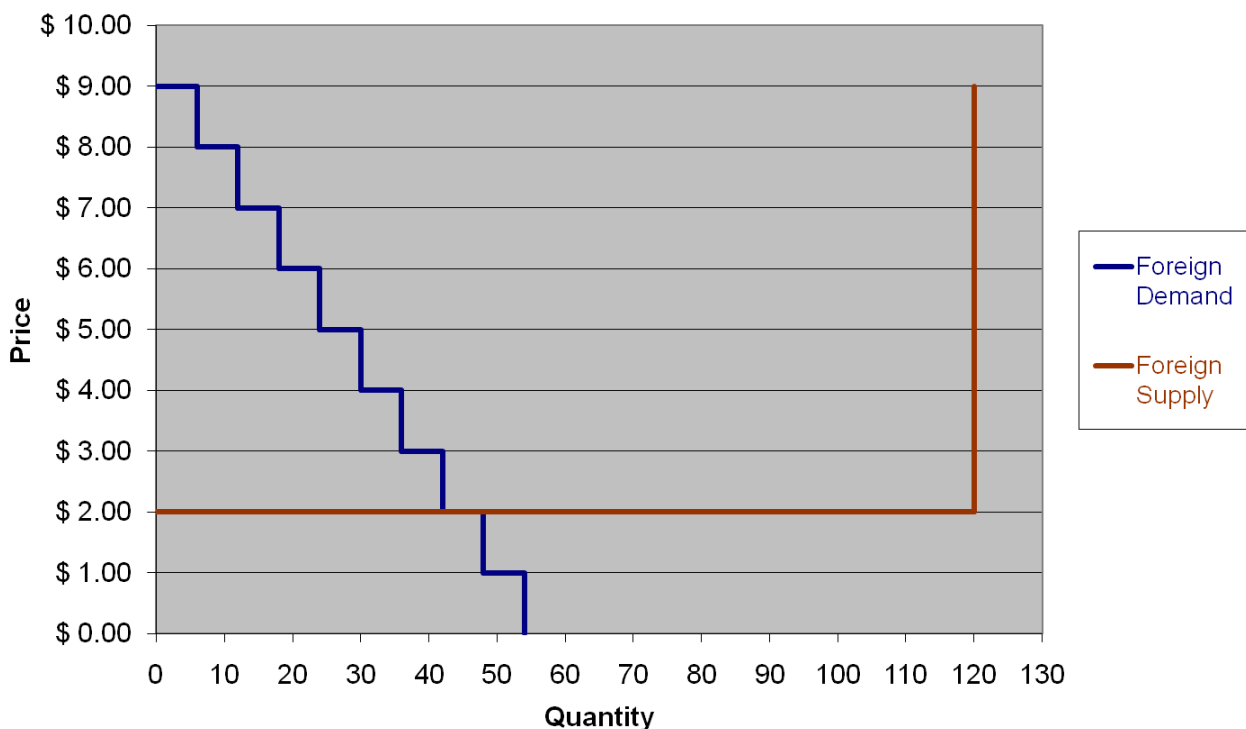
To begin the second round, the instructor announces that buyers and sellers can trade with those in either country. As shown in Figure 3, once trade is opened, the world price predicted by theory is $p_w = 2$. With a world price of 2, the quantity sold by home producers will be $q_h = 2$ each, for a total of $Q_h = 12$. Foreign producers will sell $q_f = 8$ each, for a total of $Q_h = 84$. The total quantity sold, Q_w, will be 96 units. Again give the participants a few trading periods before announcing a new round so that a stable equilibrium price and quantity is established.

Figure 3

World Supply and Demand
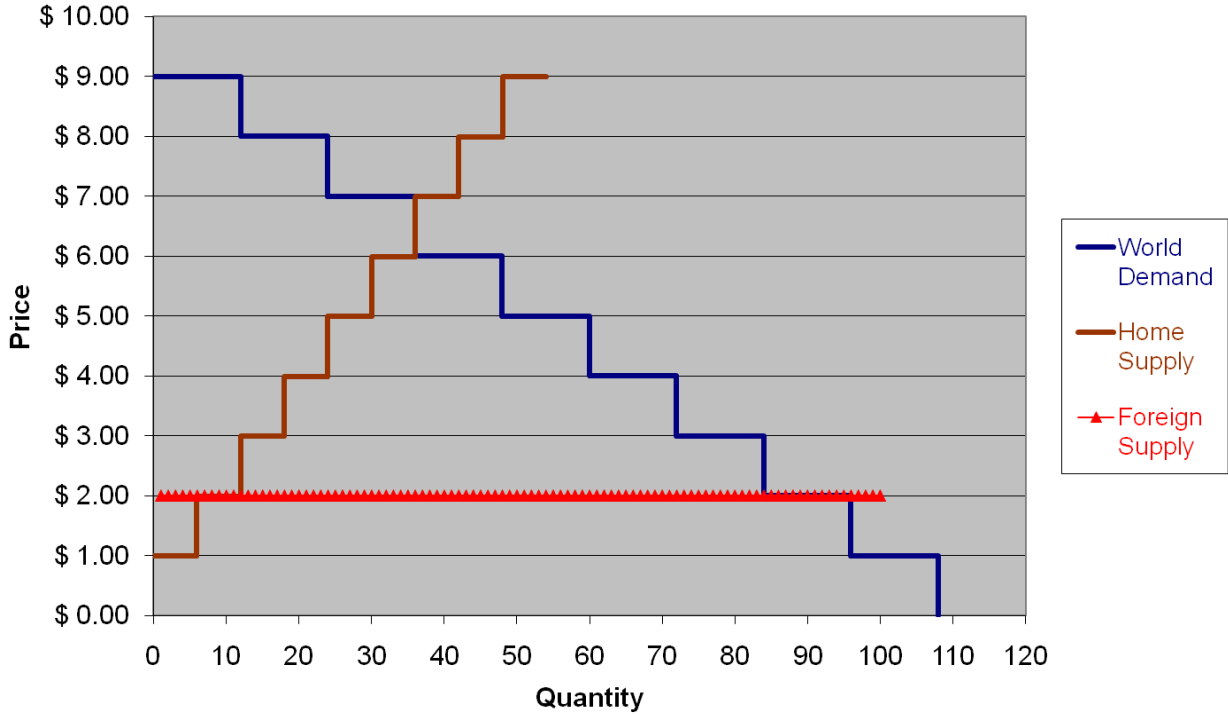
Begin the third round by announcing that due to the loss of customers by home producers, the home country imposes a quota of 2 units per foreign producer (or a total quota equal to 2*number of foreign firms). Thus continuing with our class of 24 students, the foreign firms can now sell 2 units each for a total of $Q_f = 12$ to the home buyers, while the six home suppliers can now sell 4 units each for a total of $Q_h = 24$ units. Thus, as shown in Figure 4, theory predicts that a total of 36 units will be consumed by home consumers.

Figure 4

Home Supply and Demand w/Quota
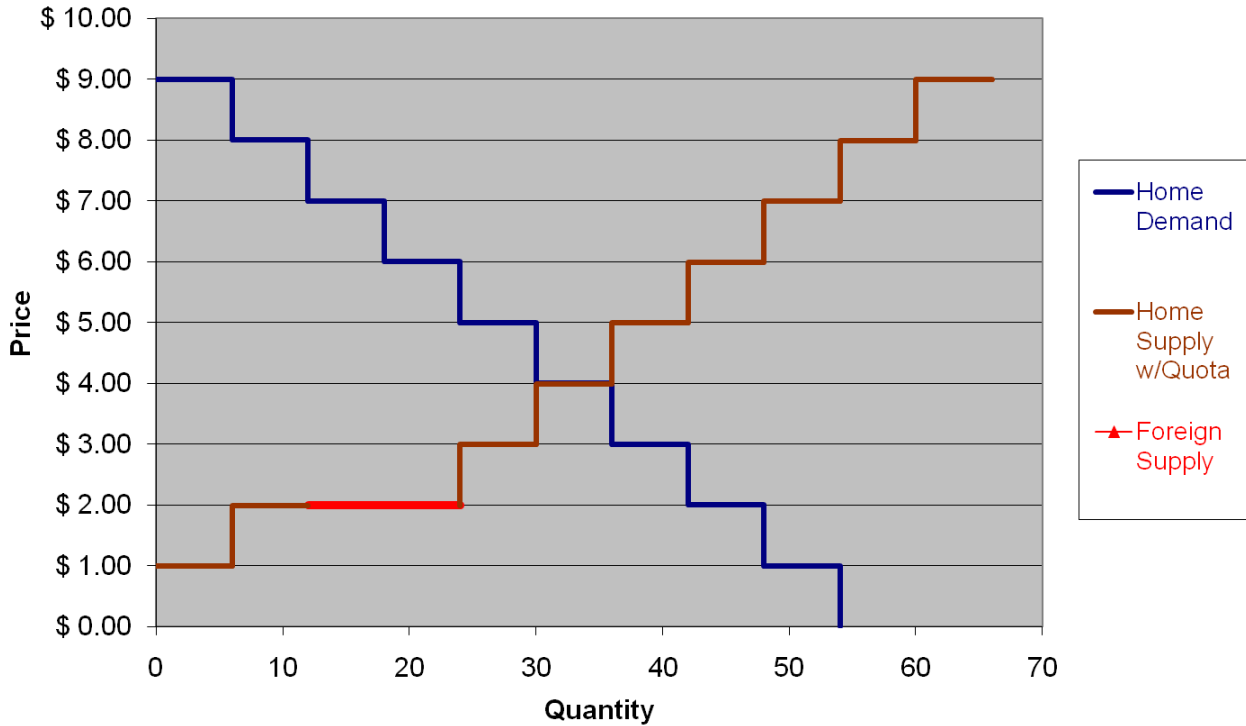
In the fourth round, the country switches from a quota to a tariff to determine if the effects of a tariff are any better or worse at protecting the domestic producers. Unlike before, any foreign producer can now choose to sell in the home market as long as they are able to pay the tariff amount and cover their costs of production. Instead of eliminating parts of the supply curve, relative to the free trade condition, the tariff simply shifts the entire foreign supply curve up by two dollars. Shown in Figure 5, the tariff of $2 per unit results in a higher marginal cost for foreign producers of $p_f = \$4$. The equilibrium price and quantity under a tariff is the same outcome as the quota: $Q_h = 24$ units, $Q_f = 12$, with a total of 36 units consumed by home consumers.

Figure 5

Home Supply and Demand w/Tariff
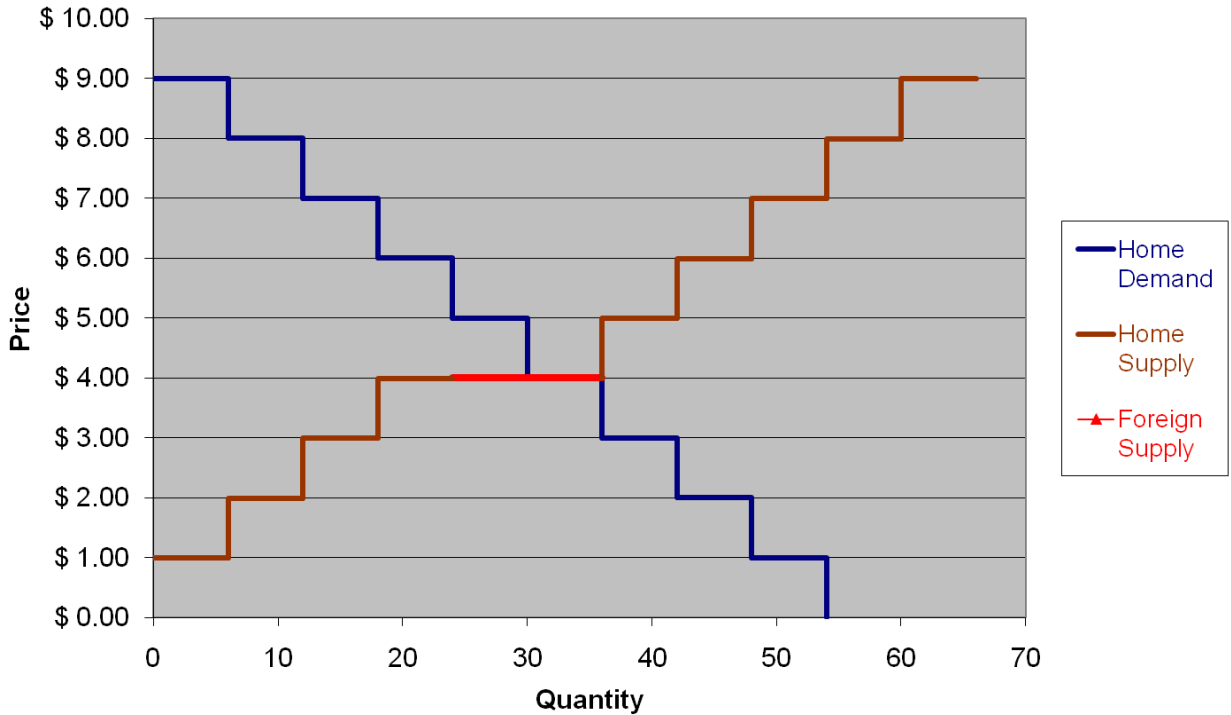
In the fifth round, keeping the tariff in place, the instructor announces that all the home firms now merge their collective production abilities into a single non-price discriminating firm, so that the home market is now defined by a monopolist. Now all home producers collectively decide how much to produce, and, with this decision, the price at which they sell all units on the market. Home producers can collude to set a higher price than before. Although the home producer no longer faces domestic competition, it still faces competition from the foreign producers who pay a tariff to import their goods. Figure 5 again represents the theoretical outcome. If the home monopolist attempts to raise prices by restricting the number of units offered for sale, the foreign producers will simply increase the number of units sold in the home market by the corresponding amount.

Because the home monopolist faces a constant marginal revenue curve of $4 regardless of the quantity they sell, they continue to operate as a competitive firm.

In the sixth round, the home government reverts to the import quota from round 3: each foreign producer may sell a maximum of two units in the home market. The total amount foreign producers can sell in the home country is $Q_f = 12$. Unlike with the tariff, once the foreigner suppliers exhaust their quota of 12 units, the home monopolist is sheltered by the quota. The remaining demand (D – 12 units), shown in Figure 6, is subject to profit maximization of the monopolist. The monopolist sets its new marginal revenue curve equal to its marginal costs and will sell fewer units at a higher price than under a tariff. Given the monopolist's marginal revenue curve, the home monopolist restricts the quantity it sells on the market to somewhere between 12 and 18 units for a price of five dollars.

Figure 6

Home Supply and Demand w/Quota and Imperfect Competition
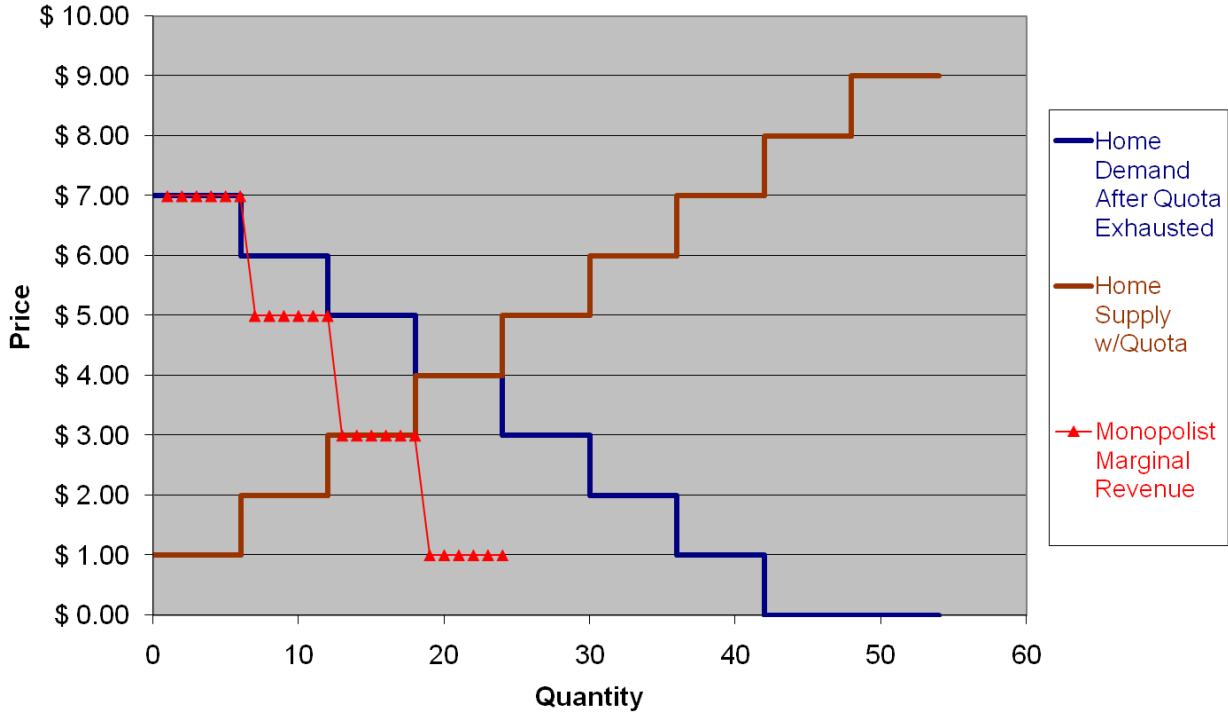
After the experiment, students can calculate the actual consumer surplus, producer surplus, and total gains from trade experienced in each period as well as the *expected* consumer surplus, producer surplus, and total gains from trade for each round. This exercise shows students how lowering trade barriers increases total gains from trade, how imposing a quota or tariff in a perfectly competitive market similarly lowers the total gains from trade, and how imposing a quota results in a greater reduction in the gains of trade than a tariff when the home market is defined by imperfect competition.

IV. Results from Initial Trial

Table 1 below shows the results from the first trial of the classroom experiment. Following theory, in the move from autarky to free trade the price of widgets fell from 5.1 to 3.8 and the quantity of widgets exchanged increased from 24 to 34. In the move from open trade to a quota on foreign imports, again the results followed what theory would suggest: an increase in the home price from 3.8 to 4.5 and a decline in the quantity bought and sold in the home market from 34 to 24. The move from a quota to a tariff results in a small increase in the quantity, 24 to 27, and little to no change in the price.

Table 1: Price and Quantity Results from Experiment

Round	Round 1	Round 2	Round 3	Round 4	Round 5	Round 6
Market Structure		Perfectly Competitive			Home Monopolist	
Trade Rules	Autarky	Open	Quota	Tariff	Tariff	Quota
Home Market						
Avg Price	5.146	3.838	4.521	4.574	4.700	3.615
Quantity	24	34	24	27	25	26
Foreign Market						
Avg Price	4.083	4.706	4.242	4.375	4.262	3.940
Quantity	30	34	31	24	21	25

Keeping the tariff in place in round 5, the market structure in the home country is changed from competitive to imperfectly competitive. This results in a small decline in the number of units exchanged, 27 to 25 and a small increase in the price 4.5 to 4.7. In round 6 the tariff is replaced

by the same quota as imposed in round 3. In a result that disagrees with theory, the price fell

substantially, from 4.7 to 3.6, while the quantity only increased by one from 25 to 26.[4]

V. Questions for Discussion

1. When the trade barrier between the two countries was in place, what price and quantity does economic theory predict for the Home and Foreign Country, respectively? How closely did the experiment results reflect our theoretical hypothesis?

2. Assume that the trade barrier between the two countries is lifted, what price and quantity does economic theory predict for the Home and Foreign Country, respectively? How closely did the experiment results reflect our theoretical hypothesis?

3. How did buyers and sellers from each country view the opening of trade?

4. When the home country had many sellers how did the tariff alter incentives? How did the quota alter incentives? How closely did the experiment results reflect our theoretical hypothesis?

5. When the home country had one seller, how did the tariff alter incentives? How did the quota alter incentives? How closely did the experiment results reflect our theoretical hypothesis?

VI. Follow-Up Assignment

1. The World Trade Organization encourages countries, especially smaller countries, to replace many import quotas with tariffs. Why?

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[4] This result may be driven by the fact that in this initial trial I failed to instruct the home monopolist to behave as a non-price discriminating monopolist. Therefore, the single home monopolist varied their prices based on the buyers' willingness to pay and thus charged different prices to different consumers. In future trials, I will require the monopolist to offer a set price to all home buyers during each trading period.

Works Cited

Hazlett, Denise, (1999).<u>Economics Experiments in the Classroom: an instructor's manual to accompany their undergraduate economics textbooks</u>. Addison-Wesley.

Murphy, James (2004). "A simple program to conduct a hand-run double auction in the classroom." *Journal of Economic Education*, Online Section.Vol. 35, Number 2, page 212.

Appendix: A

INSTRUCTIONS FOR THE INTERNATIONAL TRADE EXPERIMENT

You live in either the Home country or the Foreign country. Each country has a market for the hypothetical good called a widget. You are either a buyer or seller of widgets. Your private information sheet tells you which country you live in and whether you are a buyer or seller. A trade barrier exists between the Home country and the Foreign, so that you may trade only with people from your own country.

The experiment will consist of a series of market periods. In each period buyers and sellers will offer to buy and sell widgets based on the information sheet. No one may trade a fraction of a widget.

Those of you who are **buyers** have a set of values on your private information slip that tells you how much consuming a particular widget is worth to you. If you buy a widget, you earn the difference between the value of this widget and the price that you pay for that widget. For instance if the value of consuming the 4th widget is 25 and the value of consuming the 5th widget is 21, you would be willing to purchase the fourth widget for 22, but not the 5th. You should negotiate for the lowest possible price, as long as that price is lower than your value for that widget. Never pay a higher price than what a widget is worth to you, or you would make a loss. If you do not buy a widget, you earn zero that period.

Those of you who are **sellers** have the production cost of each widget you produce on your private information slip. For instance if the cost of producing your 4th unit is 1.0 and the cost of producing the 5th is 1.5, then you would be willing to sell your 4th unit for 1.2 but not your 5th. If you sell a widget, you earn the difference between the price you receive for that widget and the cost of producing that widget. You should negotiate for the highest possible price, as long as that price is higher than your cost of producing that widget. Never sell a widget for a price lower than your cost of production, or you would make a loss. If you do not sell a widget, you earn zero for that period.

Buyers and sellers make trades using a double oral auction market. Buyers and sellers will mingle on the trading floor designated for their country. Buyers call out offers by saying, for example, "Buy at 15," which indicates willingness to buy a number of widgets at a price of 15. Similarly, sellers call out offers by saying, for example, "Sell at 45.5," which indicates willingness to sell a number of widgets at a price of 45.5. Any buyer may accept any seller's offer, and any seller may accept any buyer's offer, as long as both buyer and seller are from the same country.

When a buyer and seller have agreed on a price for one or more widgets, write down the price paid for each widget, the surplus gained from buying or selling each unit, the buyer's ID number or the seller's ID letter, and the country they are from on your sheet. For instance, if Buyer B1 agrees to purchase two units from Seller HF for four dollars each, Buyer B1 will fill out their sheet by listing the price paid for each unit, calculating the Consumer Surplus (CS) for each unit, listing the Seller ID, and listing the entire expenditures paid to this seller as well as the total number of units purchased from this seller. Buyer B1's sheet will then look like Figure A1.

Buyer Sheet

•Buyer B1 agrees to buy 2 units for $4.00 each from Seller HF

				Round 1		
Unit	MV	Price	CS	Seller ID	Total Expend. to Seller	Total Quantity from Seller
1st	9	$4	$5	HF	___	___
2nd	8	$4	$4	HF	$8	2
3rd	7	___	___	___	___	___
4th	6	___	___	___	___	___
5th	5	___	___	___	___	___
6th	4	___	___	___	___	___
7th	3	___	___	___	___	___
8th	2	___	___	___	___	___
9th	1	___	___	___	___	___
10th	0	___	___	___	___	___
Total			$9		___	___

Given this exchange, Seller HF fills out their sheet by listing the price of each unit, the producer surplus generated from the exchange (Price – Marginal Cost (MC)), the Buyer ID, the total Revenue from Buyer B1, and the total quantity purchased by B1. Figure A2 shows the completed form.

Figure A2

Seller Sheet

•Seller HF agrees to sell 2 units for $4.00 each to Buyer B1

				Round 1		
Unit	MC	Price	PS	Buyer ID	Total Rev. from Buyer	Total Quantity from Buyer
1st	1	$4	$3	B1	___	___
2nd	2	$4	$2	B1	$8	2
3rd	3	___	___	___	___	___
4th	4	___	___	___	___	___
5th	5	___	___	___	___	___
6th	6	___	___	___	___	___
7th	7	___	___	___	___	___
8th	8	___	___	___	___	___
9th	9	___	___	___	___	___
10th	10	___	___	___	___	___
Total			$5		___	___

Once you have entered your trade information, the buyer and seller may then continue to buy or sell from other sellers or buyers if they wish as long as they believe they are able to still sell or buy given their marginal cost or marginal value of a widget. Once you have finished, return to your seats and wait for the next trading period. Once everyone who wishes to has traded, I will then ask sellers to report their information so that I am able to record this information on the board for everyone to see. Then, I will start a new period, in which everyone again starts with zero units bought or sold.

Appendix B

Seller Sheet
Seller ID   HOME A

Round 1

Unit	MC	Price	PS	Buyer ID	Total Rev. from Buyer	Total Quantity from Buyer
1st	1	____	____	____	____	____
2nd	2	____	____	____	____	____
3rd	3	____	____	____	____	____
4th	4	____	____	____	____	____
5th	5	____	____	____	____	____
6th	6	____	____	____	____	____
7th	7	____	____	____	____	____
8th	8	____	____	____	____	____
9th	9	____	____	____	____	____
10th	10	____	____	____	____	____
Total			____		____	____

Round 2

Unit	MC	Price	PS	Buyer ID	Total Rev. from Buyer	Total Quantity from Buyer
1st	1	____	____	____	____	____
2nd	2	____	____	____	____	____
3rd	3	____	____	____	____	____
4th	4	____	____	____	____	____
5th	5	____	____	____	____	____
6th	6	____	____	____	____	____
7th	7	____	____	____	____	____
8th	8	____	____	____	____	____
9th	9	____	____	____	____	____
10th	10	____	____	____	____	____
Total			____		____	____

Round 3

Unit	MC	Price	PS	Buyer ID	Total Rev. from Buyer	Total Quantity from Buyer
1st	1	____	____	____	____	____
2nd	2	____	____	____	____	____
3rd	3	____	____	____	____	____
4th	4	____	____	____	____	____
5th	5	____	____	____	____	____
6th	6	____	____	____	____	____
7th	7	____	____	____	____	____
8th	8	____	____	____	____	____
9th	9	____	____	____	____	____
10th	10	____	____	____	____	____
Total			____		____	____

Round 4

Unit	MC	Price	PS	Buyer ID	Total Rev. from Buyer	Total Quantity from Buyer
1st	1	____	____	____	____	____
2nd	2	____	____	____	____	____
3rd	3	____	____	____	____	____
4th	4	____	____	____	____	____
5th	5	____	____	____	____	____
6th	6	____	____	____	____	____
7th	7	____	____	____	____	____
8th	8	____	____	____	____	____
9th	9	____	____	____	____	____
10th	10	____	____	____	____	____
Total			____		____	____

Round 5

Unit	MC	Price	PS	Buyer ID	Total Rev. from Buyer	Total Quantity from Buyer
1st	1	____	____	____	____	____
2nd	2	____	____	____	____	____
3rd	3	____	____	____	____	____
4th	4	____	____	____	____	____
5th	5	____	____	____	____	____
6th	6	____	____	____	____	____
7th	7	____	____	____	____	____
8th	8	____	____	____	____	____
9th	9	____	____	____	____	____
10th	10	____	____	____	____	____
Total			____		____	____

Round 6

Unit	MC	Price	PS	Buyer ID	Total Rev. from Buyer	Total Quantity from Buyer
1st	1	____	____	____	____	____
2nd	2	____	____	____	____	____
3rd	3	____	____	____	____	____
4th	4	____	____	____	____	____
5th	5	____	____	____	____	____
6th	6	____	____	____	____	____
7th	7	____	____	____	____	____
8th	8	____	____	____	____	____
9th	9	____	____	____	____	____
10th	10	____	____	____	____	____
Total			____		____	____

Round 7

Unit	MC	Price	PS	Buyer ID	Total Rev. from Buyer	Total Quantity from Buyer
1st	1	____	____	____	____	____
2nd	2	____	____	____	____	____
3rd	3	____	____	____	____	____
4th	4	____	____	____	____	____
5th	5	____	____	____	____	____
6th	6	____	____	____	____	____
7th	7	____	____	____	____	____
8th	8	____	____	____	____	____
9th	9	____	____	____	____	____
10th	10	____	____	____	____	____
Total			____		____	____

Round 8

Unit	MC	Price	PS	Buyer ID	Total Rev. from Buyer	Total Quantity from Buyer
1st	1	____	____	____	____	____
2nd	2	____	____	____	____	____
3rd	3	____	____	____	____	____
4th	4	____	____	____	____	____
5th	5	____	____	____	____	____
6th	6	____	____	____	____	____
7th	7	____	____	____	____	____
8th	8	____	____	____	____	____
9th	9	____	____	____	____	____
10th	10	____	____	____	____	____
Total			____		____	____

Buyer Sheet
Buyer ID Home 1

Round 1

Unit	MV	Price	CS	Seller ID	Total Expend. to Seller	Total Quantity from Seller
1st	9	____	____	____	____	____
2nd	8	____	____	____	____	____
3rd	7	____	____	____	____	____
4th	6	____	____	____	____	____
5th	5	____	____	____	____	____
6th	4	____	____	____	____	____
7th	3	____	____	____	____	____
8th	2	____	____	____	____	____
9th	1	____	____	____	____	____
10th	0	____	____	____	____	____
Total		____			____	____

Round 2

Unit	MV	Price	CS	Seller ID	Total Expend. to Seller	Total Quantity from Seller
1st	9	____	____	____	____	____
2nd	8	____	____	____	____	____
3rd	7	____	____	____	____	____
4th	6	____	____	____	____	____
5th	5	____	____	____	____	____
6th	4	____	____	____	____	____
7th	3	____	____	____	____	____
8th	2	____	____	____	____	____
9th	1	____	____	____	____	____
10th	0	____	____	____	____	____
Total		____			____	____

Round 3

Unit	MV	Price	CS	Seller ID	Total Expend. to Seller	Total Quantity from Seller
1st	9	____	____	____	____	____
2nd	8	____	____	____	____	____
3rd	7	____	____	____	____	____
4th	6	____	____	____	____	____
5th	5	____	____	____	____	____
6th	4	____	____	____	____	____
7th	3	____	____	____	____	____
8th	2	____	____	____	____	____
9th	1	____	____	____	____	____
10th	0	____	____	____	____	____
Total		____			____	____

Round 4

Unit	MV	Price	CS	Seller ID	Total Expend. to Seller	Total Quantity from Seller
1st	9	____	____	____	____	____
2nd	8	____	____	____	____	____
3rd	7	____	____	____	____	____
4th	6	____	____	____	____	____
5th	5	____	____	____	____	____
6th	4	____	____	____	____	____
7th	3	____	____	____	____	____
8th	2	____	____	____	____	____
9th	1	____	____	____	____	____
10th	0	____	____	____	____	____
Total		____			____	____

Round 5

Unit	MV	Price	CS	Seller ID	Total Expend. to Seller	Total Quantity from Seller
1st	9	____	____	____	____	____
2nd	8	____	____	____	____	____
3rd	7	____	____	____	____	____
4th	6	____	____	____	____	____
5th	5	____	____	____	____	____
6th	4	____	____	____	____	____
7th	3	____	____	____	____	____
8th	2	____	____	____	____	____
9th	1	____	____	____	____	____
10th	0	____	____	____	____	____
Total		____			____	____

Round 6

Unit	MV	Price	CS	Seller ID	Total Expend. to Seller	Total Quantity from Seller
1st	9	____	____	____	____	____
2nd	8	____	____	____	____	____
3rd	7	____	____	____	____	____
4th	6	____	____	____	____	____
5th	5	____	____	____	____	____
6th	4	____	____	____	____	____
7th	3	____	____	____	____	____
8th	2	____	____	____	____	____
9th	1	____	____	____	____	____
10th	0	____	____	____	____	____
Total		____			____	____

Round 7

Unit	MV	Price	CS	Seller ID	Total Expend. to Seller	Total Quantity from Seller
1st	9	____	____	____	____	____
2nd	8	____	____	____	____	____
3rd	7	____	____	____	____	____
4th	6	____	____	____	____	____
5th	5	____	____	____	____	____
6th	4	____	____	____	____	____
7th	3	____	____	____	____	____
8th	2	____	____	____	____	____
9th	1	____	____	____	____	____
10th	0	____	____	____	____	____
Total		____			____	____

Round 8

Unit	MV	Price	CS	Seller ID	Total Expend. to Seller	Total Quantity from Seller
1st	9	____	____	____	____	____
2nd	8	____	____	____	____	____
3rd	7	____	____	____	____	____
4th	6	____	____	____	____	____
5th	5	____	____	____	____	____
6th	4	____	____	____	____	____
7th	3	____	____	____	____	____
8th	2	____	____	____	____	____
9th	1	____	____	____	____	____
10th	0	____	____	____	____	____
Total		____			____	____

Seller Sheet
Seller ID Foreign S

Round 1

Unit	MC	Price	PS	Buyer ID	Total Rev. from Buyer	Total Quantity from Buyer
1st	2	____	____	____	____	____
2nd	2	____	____	____	____	____
3rd	2	____	____	____	____	____
4th	2	____	____	____	____	____
5th	2	____	____	____	____	____
6th	2	____	____	____	____	____
7th	2	____	____	____	____	____
8th	2	____	____	____	____	____
9th	2	____	____	____	____	____
10th	2	____	____	____	____	____
11th	2	____	____	____	____	____
12th	2	____	____	____	____	____
13th	2	____	____	____	____	____
14th	2	____	____	____	____	____
15th	2	____	____	____	____	____
16th	2	____	____	____	____	____
17th	2	____	____	____	____	____
18th	2	____	____	____	____	____
19th	2	____	____	____	____	____
20th	2	____	____	____	____	____
Total					____	____

Round 2

Unit	MC	Price	PS	Buyer ID	Total Rev. from Buyer	Total Quantity from Buyer
1st	2	____	____	____	____	____
2nd	2	____	____	____	____	____
3rd	2	____	____	____	____	____
4th	2	____	____	____	____	____
5th	2	____	____	____	____	____
6th	2	____	____	____	____	____
7th	2	____	____	____	____	____
8th	2	____	____	____	____	____
9th	2	____	____	____	____	____
10th	2	____	____	____	____	____
11th	2	____	____	____	____	____
12th	2	____	____	____	____	____
13th	2	____	____	____	____	____
14th	2	____	____	____	____	____
15th	2	____	____	____	____	____
16th	2	____	____	____	____	____
17th	2	____	____	____	____	____
18th	2	____	____	____	____	____
19th	2	____	____	____	____	____
20th	2	____	____	____	____	____
Total					____	____

Round 3

Unit	MC	Price	PS	Buyer ID	Total Rev. from Buyer	Total Quantity from Buyer
1st	2	____	____	____	____	____
2nd	2	____	____	____	____	____
3rd	2	____	____	____	____	____
4th	2	____	____	____	____	____
5th	2	____	____	____	____	____
6th	2	____	____	____	____	____
7th	2	____	____	____	____	____
8th	2	____	____	____	____	____
9th	2	____	____	____	____	____
10th	2	____	____	____	____	____
11th	2	____	____	____	____	____
12th	2	____	____	____	____	____
13th	2	____	____	____	____	____
14th	2	____	____	____	____	____
15th	2	____	____	____	____	____
16th	2	____	____	____	____	____
17th	2	____	____	____	____	____
18th	2	____	____	____	____	____
19th	2	____	____	____	____	____
20th	2	____	____	____	____	____
Total					____	____

Round 4

Unit	MC	Price	PS	Buyer ID	Total Rev. from Buyer	Total Quantity from Buyer
1st	2	____	____	____	____	____
2nd	2	____	____	____	____	____
3rd	2	____	____	____	____	____
4th	2	____	____	____	____	____
5th	2	____	____	____	____	____
6th	2	____	____	____	____	____
7th	2	____	____	____	____	____
8th	2	____	____	____	____	____
9th	2	____	____	____	____	____
10th	2	____	____	____	____	____
11th	2	____	____	____	____	____
12th	2	____	____	____	____	____
13th	2	____	____	____	____	____
14th	2	____	____	____	____	____
15th	2	____	____	____	____	____
16th	2	____	____	____	____	____
17th	2	____	____	____	____	____
18th	2	____	____	____	____	____
19th	2	____	____	____	____	____
20th	2	____	____	____	____	____
Total					____	____

Round 5

Unit	MC	Price	PS	Buyer ID	Total Rev. from Buyer	Total Quantity from Buyer
1st	2	____	____	____	____	____
2nd	2	____	____	____	____	____
3rd	2	____	____	____	____	____
4th	2	____	____	____	____	____
5th	2	____	____	____	____	____
6th	2	____	____	____	____	____
7th	2	____	____	____	____	____
8th	2	____	____	____	____	____
9th	2	____	____	____	____	____
10th	2	____	____	____	____	____
11th	2	____	____	____	____	____
12th	2	____	____	____	____	____
13th	2	____	____	____	____	____
14th	2	____	____	____	____	____
15th	2	____	____	____	____	____
16th	2	____	____	____	____	____
17th	2	____	____	____	____	____
18th	2	____	____	____	____	____
19th	2	____	____	____	____	____
20th	2	____	____	____	____	____
Total					____	____

Round 6

Unit	MC	Price	PS	Buyer ID	Total Rev. from Buyer	Total Quantity from Buyer
1st	2	____	____	____	____	____
2nd	2	____	____	____	____	____
3rd	2	____	____	____	____	____
4th	2	____	____	____	____	____
5th	2	____	____	____	____	____
6th	2	____	____	____	____	____
7th	2	____	____	____	____	____
8th	2	____	____	____	____	____
9th	2	____	____	____	____	____
10th	2	____	____	____	____	____
11th	2	____	____	____	____	____
12th	2	____	____	____	____	____
13th	2	____	____	____	____	____
14th	2	____	____	____	____	____
15th	2	____	____	____	____	____
16th	2	____	____	____	____	____
17th	2	____	____	____	____	____
18th	2	____	____	____	____	____
19th	2	____	____	____	____	____
20th	2	____	____	____	____	____
Total					____	____

Round 7

Unit	MC	Price	PS	Buyer ID	Total Rev. from Buyer	Total Quantity from Buyer
1st	2	____	____	____	____	____
2nd	2	____	____	____	____	____
3rd	2	____	____	____	____	____
4th	2	____	____	____	____	____
5th	2	____	____	____	____	____
6th	2	____	____	____	____	____
7th	2	____	____	____	____	____
8th	2	____	____	____	____	____
9th	2	____	____	____	____	____
10th	2	____	____	____	____	____
11th	2	____	____	____	____	____
12th	2	____	____	____	____	____
13th	2	____	____	____	____	____
14th	2	____	____	____	____	____
15th	2	____	____	____	____	____
16th	2	____	____	____	____	____
17th	2	____	____	____	____	____
18th	2	____	____	____	____	____
19th	2	____	____	____	____	____
20th	2	____	____	____	____	____
Total					____	____

Round 8

Unit	MC	Price	PS	Buyer ID	Total Rev. from Buyer	Total Quantity from Buyer
1st	2	____	____	____	____	____
2nd	2	____	____	____	____	____
3rd	2	____	____	____	____	____
4th	2	____	____	____	____	____
5th	2	____	____	____	____	____
6th	2	____	____	____	____	____
7th	2	____	____	____	____	____
8th	2	____	____	____	____	____
9th	2	____	____	____	____	____
10th	2	____	____	____	____	____
11th	2	____	____	____	____	____
12th	2	____	____	____	____	____
13th	2	____	____	____	____	____
14th	2	____	____	____	____	____
15th	2	____	____	____	____	____
16th	2	____	____	____	____	____
17th	2	____	____	____	____	____
18th	2	____	____	____	____	____
19th	2	____	____	____	____	____
20th	2	____	____	____	____	____
Total					____	____

Buyer Sheet
Buyer ID Foreign 1

Round 1

Unit	MV	Price	CS	Seller ID	Total Expend. to Seller	Total Quantity from Seller
1st	9	____	____	____	____	____
2nd	8	____	____	____	____	____
3rd	7	____	____	____	____	____
4th	6	____	____	____	____	____
5th	5	____	____	____	____	____
6th	4	____	____	____	____	____
7th	3	____	____	____	____	____
8th	2	____	____	____	____	____
9th	1	____	____	____	____	____
10th	0	____	____	____	____	____
Total		____			____	____

Round 2

Unit	MV	Price	CS	Seller ID	Total Expend. to Seller	Total Quantity from Seller
1st	9	____	____	____	____	____
2nd	8	____	____	____	____	____
3rd	7	____	____	____	____	____
4th	6	____	____	____	____	____
5th	5	____	____	____	____	____
6th	4	____	____	____	____	____
7th	3	____	____	____	____	____
8th	2	____	____	____	____	____
9th	1	____	____	____	____	____
10th	0	____	____	____	____	____
Total		____			____	____

Round 3

Unit	MV	Price	CS	Seller ID	Total Expend. to Seller	Total Quantity from Seller
1st	9	____	____	____	____	____
2nd	8	____	____	____	____	____
3rd	7	____	____	____	____	____
4th	6	____	____	____	____	____
5th	5	____	____	____	____	____
6th	4	____	____	____	____	____
7th	3	____	____	____	____	____
8th	2	____	____	____	____	____
9th	1	____	____	____	____	____
10th	0	____	____	____	____	____
Total		____			____	____

Round 4

Unit	MV	Price	CS	Seller ID	Total Expend. to Seller	Total Quantity from Seller
1st	9	____	____	____	____	____
2nd	8	____	____	____	____	____
3rd	7	____	____	____	____	____
4th	6	____	____	____	____	____
5th	5	____	____	____	____	____
6th	4	____	____	____	____	____
7th	3	____	____	____	____	____
8th	2	____	____	____	____	____
9th	1	____	____	____	____	____
10th	0	____	____	____	____	____
Total		____			____	____

Round 5

Unit	MV	Price	CS	Seller ID	Total Expend. to Seller	Total Quantity from Seller
1st	9	____	____	____	____	____
2nd	8	____	____	____	____	____
3rd	7	____	____	____	____	____
4th	6	____	____	____	____	____
5th	5	____	____	____	____	____
6th	4	____	____	____	____	____
7th	3	____	____	____	____	____
8th	2	____	____	____	____	____
9th	1	____	____	____	____	____
10th	0	____	____	____	____	____
Total		____			____	____

Round 6

Unit	MV	Price	CS	Seller ID	Total Expend. to Seller	Total Quantity from Seller
1st	9	____	____	____	____	____
2nd	8	____	____	____	____	____
3rd	7	____	____	____	____	____
4th	6	____	____	____	____	____
5th	5	____	____	____	____	____
6th	4	____	____	____	____	____
7th	3	____	____	____	____	____
8th	2	____	____	____	____	____
9th	1	____	____	____	____	____
10th	0	____	____	____	____	____
Total		____			____	____

Round 7

Unit	MV	Price	CS	Seller ID	Total Expend. to Seller	Total Quantity from Seller
1st	9	____	____	____	____	____
2nd	8	____	____	____	____	____
3rd	7	____	____	____	____	____
4th	6	____	____	____	____	____
5th	5	____	____	____	____	____
6th	4	____	____	____	____	____
7th	3	____	____	____	____	____
8th	2	____	____	____	____	____
9th	1	____	____	____	____	____
10th	0	____	____	____	____	____
Total		____			____	____

Round 8

Unit	MV	Price	CS	Seller ID	Total Expend. to Seller	Total Quantity from Seller
1st	9	____	____	____	____	____
2nd	8	____	____	____	____	____
3rd	7	____	____	____	____	____
4th	6	____	____	____	____	____
5th	5	____	____	____	____	____
6th	4	____	____	____	____	____
7th	3	____	____	____	____	____
8th	2	____	____	____	____	____
9th	1	____	____	____	____	____
10th	0	____	____	____	____	____
Total		____			____	____

Appendix C

Because there are four roles for students, home producers, home consumers, foreign producers and foreign consumers, thus the optimal class size is any divisible by four. If there is one student remaining, the experiment works best if the lone additional student is a foreign producer. If there are two additional students, the best way to organize the experiment is with an additional home producer and consumer. If there are three additional students, one should place them in the home producer, home consumer, and foreign producer respectively.

Student Assignment By Class Size

Class Size	Number of Home Producers	Number of Home Consumers	Number of Foreign Producers	Number of Foreign Consumers
16	4	4	4	4
17	4	4	5	4
18	5	5	4	4
19	5	5	5	4
20	5	5	5	5
21	5	5	6	5
22	6	6	5	5
23	6	6	6	5
24	6	6	6	6
25	6	6	7	6
26	7	7	6	6
27	7	7	7	6
28	7	7	7	7
29	7	7	8	7
30	8	8	7	7
31	8	8	8	7
32	8	8	8	8
33	8	8	9	8
34	9	9	8	8
35	9	9	9	8
36	9	9	9	9
37	9	9	10	9
38	10	10	9	9
39	10	10	10	9
40	10	10	10	10
41	10	10	11	10
42	11	11	10	10
43	11	11	11	10
44	11	11	11	11
45	11	11	12	11
46	12	12	11	11
47	12	12	12	11
48	12	12	12	12