Discovering Economics in the Classroom with Experimental Economics and the Scottish Enlightenment*

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Abstract

This paper describes a curriculum for teaching economics using laboratory experiments. The key features of the curriculum are the low technology barriers, complete instructions for running the experiment and debriefing the results, and a guide for teacher-led roundtable discussions motivated by the Scottish philosophers. Our main goal is to present economic principles to young students in a way that is both exciting and accessible, while emphasizing the discovery process underlying wealth creation in modern economies using laboratory experiments.

Introduction

Research in experimental economics is about discovering facts, new observations that may or may not be consistent with the theory we have constructed to organise our understanding of economics. From the perspective of students, the teaching of economics is also about the discovery of facts and the construction of theoretical models that organise those facts. Thus, it is not surprising that experimental economics has become a valuable tool for teaching economics. Whether one is a high school student or a tenured college professor, our philosophy is that we all learn from economic experiments by inferring meaning from a replicable pattern of observable behaviours.

But by what process do these reproducible patterns emerge? Whether they are the impersonal orders of markets or our personal social relationships with friends, family and neighbours, the standard textbook analysis is rather silent about how it is that socio-economic orders form. It was the genius of the Scottish Enlightenment – Adam Smith, David Hume, Adam Ferguson, and others – who described the existence of social, legal and economic orders that 'are indeed the result of human action but not the execution of human design…' (Ferguson 1767, p. 102). Everyone is familiar with Adam Smith as the founder of modern economics, though rare is the student of economics who actually reads *The Wealth of Nations*. No doubt, his 18th century English diction may be difficult for the 21st century teenager to relate to and to comprehend. But why is it that teachers of economics do not attempt to relate Adam Smith to their students and make him comprehendible? One answer is that the way that current economics is taught is not how Adam Smith and his contemporaries viewed economics. Whereas the Scottish philosophers saw the world as dynamic, constantly in 'transition from one state to another, and through states intermediate' (Ferguson 1915, p. 199), modern economics is primarily taught with models of static equilibrium. So while there have been many advances in our understanding of economics since the 18th century, the impression given, if not the working assumption, in modern introductions to economics is that our socio-economic systems are founded on the conscious and deliberate use of deductive reason: there exists more goods and services in a world in which two countries specialise and trade than in one in which both are self-sufficient; there is a price such that the quantity demanded equals the quantity supplied; it is a given that people backwards induct to take actions regardless of personal experiences that yield the highest payoffs for themselves.

In contrast, the Scottish philosophers and their modern descendant, F.A. Hayek, would ask: what is the principle that gives rise to specialisation and what drives people to discover it? What is the process by which people use the price system to coordinate their private, individual circumstances? Why is it that in some situations people are cooperative and in others they are appear not to be?

In this paper, we describe a curriculum for teaching economics using laboratory experiments and drawing connections to the Scottish Enlightenment. The key features of the curriculum are the low technology requirements, complete instructions for running the experiment and debriefing the results, and a guide for teacher-led roundtable discussions motivated by the Scottish philosophers. Our main goals are to present economic principles in a way that is both exciting and accessible, while emphasising the discovery process underlying the wealth of nations since the Industrial Revolution. To accomplish these goals, this paper describes modules based on three topics in economics. The first module illustrates the gains from specialisation and exchange in a production and consumption experiment (Crockett, Smith and Wilson 2009). Second, as Smith (1982) discusses, the classic oral double auction demonstrates how a price mechanism orders the buying and selling decisions of individuals with dispersed and private knowledge

of their personal circumstances (for the first published double auction experiment, see Smith 1962).[1] Finally, the extensive form game experiment illustrates the prevalence and success of trust and reciprocity in modern contexts that are otherwise apparently dominated by impersonal self-interested exchange in markets (Rigdon, McCabe and Smith 2003).[2,3]

The remainder of this paper is organised as follows. First we review ideas from the Scottish Enlightenment. In addition, this section outlines the Scottish Enlightenment themes teachers can use to motivate discussion and draw the link between the students' experience in the experiment and the relevant textbook principles.[4] Then we describe each experiment, the economics principles they illustrate, and how the findings can help students assess the advantages and pitfalls of economic theory. We then describe the practical elements of curriculum implementation, in particular, how an easy-to-use computer interface assists teachers with running the experiments and presenting results. Finally, we conclude.

The Scottish Enlightenment and the experiments

The period in the 18th century known as the Scottish Enlightenment was marked by the massive outpouring of ideas that expanded understanding of natural phenomena, human nature and all manner of social, political and economic institutions. As James Buchan writes:

> 'For a period of nearly half a century, from about the time of the Highland rebellion of 1745 until the French Revolution of 1789, the small city of Edinburgh ruled the Western intellect. For near fifty years, a city that had for centuries been a byword for poverty, religious bigotry, violence and squalor laid the mental foundations of the modern world' (Buchan 2003, p. 1).

According to the Scottish philosophers of the 18th century, the central reason for the rise above 'violence and squalor' of old Edinburgh, was the expansion of trade made possible by increases in specialisation and impersonal exchange in markets. These forces derived from evolved informal norms of cooperation supporting personal exchange (Smith 1759 [1982], Smith 1998) and interacted with time and place to ignite an economic revival. The three experiments discussed in this paper place students in environments where these key ideas of the Scottish philosophers are at work and use the results to motivate greater understanding of the economic principles underlying wealth creation in modern economies.

Adam Smith began *The Wealth of Nations* by emphasising the central importance of the division of labour, 'The greatest improvement in the productive powers of labour, and the greater part of the skill, dexterity, and judgment with which it is any where directed, or applied, seem to have been the effects of the division of labour' (Smith 1776 [1981], p. 23). The discussion of this central principle is usually introduced to students through the example of a simple two-good exchange economy where two agents have endowments and technology to transform endowments into output. It is straightforward to solve for the competitive equilibrium in this exchange economy, and traditionally, the teacher demonstrates this through the logic of paper-and-pencil manipulations. Yet as Adam Smith says:

> 'This division of labour, from which so many advantages are derived, is not originally the effect of any human wisdom, which foresees and intends that general opulence to which it gives occasion. It is the necessary, though very slow and gradual, consequence of a certain propensity in human nature which has in view no such extensive utility; the propensity to truck, barter, and exchange one thing for another' (Smith 1776 [1981], p. 25).

So if it is not a rational deductive process that generates the wealth from specialisation and exchange, what does drive it? The first module presents a hand-run production and consumption experiment adapted from the computerised version used by Crockett, Smith and Wilson (2009; hereafter CSW). We expose students to the principles of specialisation and exchange Adam Smith emphasised as essential for understanding the nature and causes of the wealth of nations. In this experiment, students must *discover* exchange, that is, they are not explicitly directed to do so in the instructions, but striking upon the idea they can take advantage of specialisation. The students see that in serving their own interests they find it natural to use their social learning-teaching skills to help each other solve the problem of exchange and specialisation. Hence, being a good neighbour will leverage their ability to do well for themselves.

But how does exchange between small numbers of people grow to include thousands or millions buying and selling many more than two goods? Adam Smith's answer was 'the obvious and simple system of natural liberty,' which organised individuals in impersonal markets to facilitate exchange:

> 'The inhabitants of the town draw from the country the rude product which constitutes both the materials of their work and the fund of their subsistence; and they pay for this rude produce by sending back to the country a certain portion of it manufactured and prepared for immediate use' (Smith 1776 [1981], p. 686).

Modern institutions, such as the Chicago Mercantile Exchange and New York Stock Exchange, exist and serve the same purpose: to match buyers and sellers in a system that economises on the need for fellow-feeling between the participants.

The second module presents the double oral auction experiment and the interpretation of Smith (1982). In the experiment, buyers and sellers interact through a central auctioneer who records bids and asks and recognises contracts, i.e. a buyer-seller agreement on price. At the beginning of the experiment, buyers and sellers are assigned values and costs, respectively. To make profit, buyers contract at a price below their value, while sellers contract above their cost. The set of buyer values and seller costs can be used to derive demand and supply curves and a price prediction.

However, as noted by Smith (1982), the conditions under which these experimental markets realise the competitive price and extract all the gains from exchange do not accord with the assumptions of economic theory: 'Strict privacy together with the trading rules of a market institution are sufficient to produce competitive market outcomes at or near 100% efficiency' (p. 167). Starting only with knowledge of their individual circumstances, the double auction institution coordinates the participants actions into bids, asks and prices that communicate all the information needed to extract all the gains from exchange. Thus, students participating in this experiment experience firsthand that 'the most significant fact about this [price] system is the economy of knowledge with which it operates, or how little the individual participants need to know in order to be able to take the right action' (Hayek 1945, p. 526).

The final insight we incorporate into our curriculum is the distinction between personal (social) exchange among family, friends and neighbours, and impersonal exchange in markets. To do this, the final module presents the widely studied two-person extensive-form game in which defection is predicted by game theory but cooperation is routinely observed in the laboratory (Smith 1998, p. 11). In his first book, *The Theory of Moral Sentiments*, Adam Smith provides the refreshing insight that although selfishness is frequently observed in our daily activities, it is not the chief motive in our interpersonal relationships: 'How selfish soever man may be supposed, there are evidently some principles in his nature, which interest him in the fortune of others, and render their happiness necessary to him, though he derives nothing from it except the pleasure of seeing it' (p. 9).

Later Adam Smith further articulated a reason why people in these two-person extensive form games might deviate from the predictions of game theory: 'Of all the persons…whom nature points out for our peculiar beneficence, there are none to whom it seems more properly directed than to those whose beneficence we have ourselves already experienced' (p. 225). The importance of this social interpretation of human nature in exchange was omitted in favour of Smith's later statements in *The Wealth of Nations*. However, where the extensive-form game identifies

cooperation among two people, the basic structure of the exchange relationship is maintained from the previously described specialisation and exchange experiment: one player must initiate exchange by giving (red or blue) poker chips and another must reciprocate. Thus, our goal in this module is to emphasise how students' decisions in the extensive-form games underlie their experience in the experiments from the other modules: either because the (specialisation and exchange) institution allowed them wide range to build-up effective personal exchange relationships or because the (oral double auction) institution embodied rules, fine-tuned over time through experience that was not their own, to help them extract the gains from exchange. In this way we emphasise the essential conceptual unity between interpersonal social exchange and market exchange. In both cases people must give in order to receive, and all benefit from the process.

Experiments

In this section, we describe the three experiments used in each module. In particular, each sub-section outlines the experiment design and implementation and the relevant economic principles. In all cases, the experiments have minimum technological requirements: one computer is needed to collect data and present the results and otherwise the experiment is hand-run.

1 Specialisation and exchange

The production and consumption experiment is derived from the computerised version used by CSW. It is straightforward to solve for the competitive equilibrium of this simple exchange economy but this does not capture the learning process that leads from specialisation to exchange. Thus, CSW's primary aim was to observe under what conditions specialisation and exchange would emerge in a laboratory environment under weak specification of the institutional rules. Their findings suggest that the extensive impersonal exchange observed in real world and traditional laboratory markets is not an intuitive first-step. Instead, 'exchange [in the CSW experiments] is characterised by a growing number of bilateral trades over time that are highly personal and social, i.e. not by the multilateral sort of exchange usually associated with markets organised by institutional rules specified by the experimenter' (p. 30).

It was the essential insight of North (1990) that the opportunity for gains from exchange could be stifled or promoted by a particular set of institutional rules. Thus, the 'highly personal and social' aspect of exchange identified by CSW and absent from the textbook treatment of comparative advantage is central to understanding the process of wealth creation. In particular, when subjects were able to base their experience in an eight-person economy on previous successes in

more personal exchange in two- and four-person economies, this allowed them to thoroughly explore their production possibilities as well as find an appropriate trading partner.

To give salience to the specialisation and exchange concepts discussed in introductory economics textbooks, students participate in the experiment and then discuss their results. Having participated in the experiment and seen the solution to the specialisation and exchange problem, students are then prepared to participate in a classroom discussion led by the teacher. Specifically, Ridley (1998) provides concrete examples to help students connect their experience in the experiment with theory and historical instances in which specialisation and exchange have been the engine of prosperity. Thus, when students return to textbook learning they have a better understanding of the social process underlying the economic analysis.

Experiment design

Figure 1 shows the production and consumption worksheets used by students to record the relevant data. The experiment consists of 10 periods with two phases: Phase A is for production and Phase B is for exchange and consumption. Students are assigned the role as either *odd* or *even*. In the production phase, students set the level of effort to devote to the production of *red* and *blue* and record this choice on the portion of the worksheet displayed in panel (a) of Figure 1. This choice implies production of *red* and *blue* given in the tables shown in Appendix 1 (section A.9).[5] After the production decision is made, the teacher distributes poker chips to each student representing his/her production of *red* and *blue* in that period.

In the exchange and consumption phase, with red and blue poker chips in hand, students can seek out another with whom they can engage in mutually beneficial trade. The instructions, however, say nothing about exchange. They simply state

Figure 1: Worksheets for Specialisation and Exchange Experiment

(a) Production Worksheet

	Red <<< Choose Effort >>> Blue							Amount Produced	
Period	All	High	Low	Equal	Low	High	All	Red	Blue
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									

Teacher

(b) Consumption Worksheet (for Odd)

For every 3 Red you need 1 Blue to earn 3 points.

	Consumption		
Period	Red	Blue	Points
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Teacher

that after receiving their production, they can proceed to the other side of the room to turn in chips for consumption. While mulling or standing in line to turn in their consumption decision, students can on their own strike upon the idea of exchange. After all exchange has taken place, students record the amount of *red* and *blue* for consumption on the portion of the worksheet in panel (b) of Figure 1 and the teacher awards points based on the tables Appendix 1 (section A.10).

Practically, production and consumption should take place at two tables across the room from each other to allow students to interact with one another on their way from the production to the consumption tables. In addition, in a pilot of this experiment we found that the distribution (production) and collection (consumption) of poker chips was easiest with three people: one to distribute, one to collect, and a 'runner' to move chips between the tables at the end of each period. The experiment lasts 45 minutes (i.e. approximately four minutes per period) and teachers are free to decrease the number of periods to accommodate available class time.

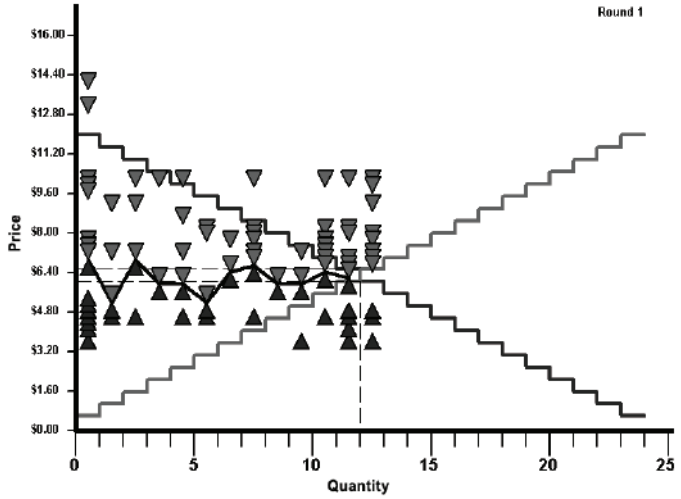
Economic theory

In this experiment, *odd* and *even* types have comparative (and absolute) advantages in the production of *red* and *blue*, respectively. In addition, in order to earn points, the students must consume *red* and *blue* in strict proportions: *odd* students earn 3 points for each combination of 3 *red* and 1 *blue*, while *even* students earn 2 points for each combination of 2 *blue* and 1 *red*. Thus, without exchange, when equal effort is devoted to the production of *red* and *blue*, *odds* produce and consume 3 *red* and 1 *blue* while *evens* produce and consume 2 *blue* and 1 *red*, and earn 3 and 2 points, respectively. However, when students completely specialise in the good in which they have a comparative (absolute) advantage, *odds* will produce 13 *red* and *evens* will produce 11 *blue*. Then, at the competitive price in which 4 *red* are exchanged for 3 *blue*, *odds* consume 9 *red* and 3 *blue*, *evens* consume 8 *blue* and 4 *red,* and each earn 9 and 8 points, respectively.

2 Oral double auction

The oral double auction has been shown to consistently converge to the market clearing price and quantity across many replications and under a variety of market conditions. For example, as few as three buyers and three sellers is enough for the market to approach 100% efficiency. Thus, this experiment can complement the textbook presentation of consumer demand with brief introductions to supply, equilibrium and efficiency (i.e. welfare). However, Smith (1982) emphasises a different take on the results produced by the double auction institution: 'the attainment of [competitive equilibrium] outcomes is possible under much less

Figure 2: Double Auction Market



Source: Wilson (2011).

stringent conditions than has been thought necessary by the majority of professional economists' (p. 177). The experimental findings can be used to extend the theory presented in introductory microeconomics (i.e. demand and supply, equilibrium and welfare) by showing that a market can be highly efficient even when participants know only their own circumstances (values and costs).

The teachers present the results of the experiment through computer software, showing step-by-step how buyer values and seller costs translate into demand and supply curves displayed in Figure 2. Each step in the demand and supply schedule represents a buyer value or seller cost, respectively. The software then replays each bid, ask and contract, and fills in the buyer and seller profits from each transaction.[6] In this experiment, students can also participate in markets with different demand and supply conditions (i.e. a commodity with equilibrium price of zero) and more restrictive institutional rules (i.e. a price ceiling). After the experiment and presentation, the teacher leads students in classroom discussion drawing on the alternative views of the market process presented by Jevons (1888) and Hayek (1945).

Experiment design

Figure 3 displays the buyer and seller worksheets for one trading period. Students are assigned the role as either a buyer or a seller and use these worksheets to make and record their decisions. Panel (a) shows a decreasing schedule of buyer values for four units for a single period; think about the buyer values as the resale value of

Figure 3: Worksheets for Double Aution Experiment

(a) Buyer Worksheet

Unit	Value	Price Paid	Profit on Unit Value - Price Paid
1st	$10.20		
2nd	$9.50		
3rd	$6.00		
4th	$5.30		
		Total Profit:	

(b) Seller Worksheet

Unit	Price Received	Cost	Profit on Unit Price Received - Cost
1st		$3.90	
2nd		$6.00	
3rd		$8.10	
4th		$10.20	
		Total Profit:	

a unit. Panel (b) shows an increasing schedule of seller costs for four units for a single period; think about the seller costs as the made-to-order cost of a unit. Buyers earn profit (assigned to the students as points) by contracting at a price below the value for a given unit and sellers earn profit by contracting at a price above the cost of a given unit. Importantly, buyers only receive the resale value and sellers only incur costs once a contract has been recognised. Finally, buyer values and seller costs are strictly private, i.e. the students are told not to reveal the information on their worksheets to others.

In the interest of brevity, we refer the interested reader to Davis and Holt (1993, chapter 3) for the detailed rules on how to solicit bids and asks and consummate trades. Our software records all bids, asks and contracts with the assistance of a student helper. As the auctioneer recognises these actions, they are displayed for all participants to see. Figure 2 shows how bids, asks and contracts are displayed. (During the experiment the supply and demand arrays are not visible.) On the *x*-axis is the quantity of units under contract and on the *y*-axis is price. Bids and asks are displayed as down- and up-pointing carets, respectively, and contracts occur where down- and up-pointing carets meet. The software produces buyer values and sellers costs for up to three trading periods and each period lasts approximately 10 minutes.

Economic theory

Recall that individual buyer values and seller costs are private and known only to the particular individual. However, when implemented in the laboratory, an

experimental economist knows the values and costs of each participant. From buyer values and seller costs, the experimentalist can then derive the demand and supply curves for the market. Figure 2 shows the demand and supply curves overlaid on the market activity. We construct the demand schedule by collecting and ordering all buyer values from highest to lowest, starting on the left. Similarly, we construct the supply schedule by arraying all seller costs from lowest to highest. Where these curves intersect gives the total number of units traded and the equilibrium price, in this case, a range between $6.25 and $6.50. The area underneath the demand and above the supply schedules represents the maximum possible gains from exchange.

3 Extensive-form games

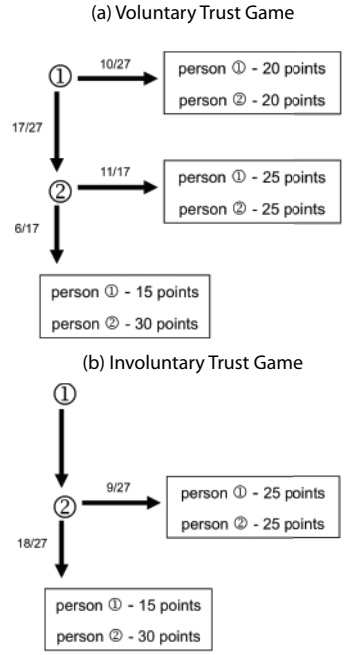
The two-person extensive-form trust game has been widely studied in experimental economics[7] and is noteworthy for the observed systematic deviations from the non-cooperative equilibrium. In this module, students participate in the voluntary and involuntary one-shot extensive-form trust game, are exposed to simple non-cooperative game theory, and then discuss the results of the experiment and the predictions of theory in the context of Adam Smith's *Theory of Moral Sentiments*. The basic setup is shown in panel (a) of Figure 4. Player 1 (the top node) chooses to move either *right* or *down*: a move right yields payouts of $20 each for Player 1 and Player 2; a move down passes on the decision over payouts to Player 2. Player 2 (the bottom node) chooses to move *right* or *down*: a move right yields payouts of $25 and $25 for Player 1 and Player 2, respectively; a move down yields $15 for Player 1 and $30 for Player 2. Typical results have roughly half of players 1 moving down and roughly two-thirds of players 2 moving right. As observed by Smith (1998), these results 'strongly reject the game theoretic hypothesis that in a single interactive play of the game subjects will overwhelmingly play non-cooperatively, and that conditional on moving down, players 2 will overwhelmingly defect' (p. 11).

These findings have been given various interpretations by economics researchers: Is the outcome in this game the result of irrationality, reciprocity for repeated personal (social) exchange, or a preference for fairness?

Experiment design

For the voluntary trust game, the worksheet is identical to that depicted in panel (a) of Figure 4. Students are assigned a role as either Player 1 or Player 2. The worksheet is initially distributed to all players 1. First, players 1 write their names on a sticky note on the front of the worksheet that also includes a number that corresponds to a number written on the worksheet. Second, they circle the arrow corresponding with their decision: that is, a move right gives 20 points each to Player 1 and Player

Figure 4: Extensive-Form Game Tree



Source: Rigdon, McCabe and Smith (2003).

2 or a move down allows Player 2 to decide the payoffs. After all players 1 have made their decisions, the teacher collects the worksheets, removes the sticky notes and redistributes the sheets to players 2, who are instructed to write their name at the top right of the worksheet. Players 2 make their decision by circling the appropriate arrow: again, a move right gives Player 1 and Player 2 25 points, and a move down gives Player 1 15 points and Player 2 30 points. The teacher recollects the worksheets and enters the result into the computer. The teacher can also place the stikkie note over the top of players 2 name and return the sheets to the players 1 with the instruction *not* to look at the identity of their counterpart.

The worksheet for the involuntary trust game is shown in panel (b) of Figure 4. The procedures are identical to those for the voluntary trust game with one exception. After players 1 write their names on the sticky note, they *must* circle the arrow pointing down. Otherwise, players 2 are given identical choices as in the voluntary trust game. Together the voluntary and involuntary implementations of the extensive form game generally take 20 minutes.

Economic theory

From the perspective of economic theory, the outcome of the voluntary trust game is straightforward. Starting with the decision of Player 2 (the bottom node), he/she faces payouts of either $25 for moving right or $30 for moving down. Therefore, from Player 1's perspective, he/she expects Player 2 to move down and take $30. Moving to the decision of Player 1 (the top node), he/she faces expects to earn $15 for moving down or $20 for moving right. Thus, economic theory predicts that Player 1 will move right and both players will be awarded $20: the non-cooperative outcome. However, notice that if Player 1 moves down the total surplus is larger. Thus, both players are better off and the surplus is maximised if Player 1 moves down and Player 2 moves right: the cooperative outcome.

The predicted outcome in involuntary trust game spawns from the set of theories developed to explain the observed deviations from the non-cooperative outcome. According to the trust and reciprocity (TR) hypothesis, when there are gains from exchange, Player 1 moves down to signal cooperative intentions by foregoing an assured payout by moving right and Player 2 foregoes a large payout to reciprocate (Rigdon, McCabe and Smith 2003). Alternatively, according to outcome-based hypotheses, one player has a preference for the payout of another (Fehr and Schmidt 1999). In the involuntary trust game, the TR hypothesis predicts that in the absence of the signal of Player 1's intentions (moving down when he/she could have moved right), Player 2 will cooperate less. However, the outcome-based hypotheses predict no difference between the voluntary and involuntary trust game in terms of Player 2's move (conditional on Player 1 moving down).

Curriculum

In this section, we outline the implementation of the curriculum. We provide teachers access to computer software that facilitates setting up each experiment (e.g. generating buyer and seller values for the oral double auction), reviewing instructions, and displaying results. As outlined above, through the software, we provide teachers with the previous results of each experiment from research as well as primary source materials to motivate discussion and draw the connection between the students' participation in the experiment and the relevant economic principles.

Computer interface

To begin, teachers select an experiment and the number of participants.[8] The software then generates a document containing experiment instructions for the teacher to read aloud as well as the relevant worksheets for the students to use. The instructions are a version of those used in the research experiment, modified for use in the classroom. The worksheets are experiment-specific and indicate the endowments and decision-information the students should record throughout the experiment. For example, Figure 1 displays the worksheets for an *odd*-type in the production and consumption experiment. In the left section, students select an effort-level for production and record the combination of red and blue this yields.[9] In the right section, students record (after exchange) the amount of red and blue for consumption and the number of points awarded.[10] In addition, this portion also reminds students of their preferences; in this case, 3 red and 1 blue are needed to earn 3 points.

At the end of the experiment, the teacher collects the decision sheets and enters the information for each student (or student-group) into the computer. The software then aggregates the data and generates results for debriefing. For example, for the specialisation and exchange experiment, teachers input the production and consumption choices made by students in each period and the software displays time-series of specialisation and total production. In addition, the software also displays illustrative results from previous replications of the experiment to facilitate classroom discussion.

Finally, the computer software provides teachers with access to the relevant primary source materials and discussion questions to distribute to students. The former includes links to the works of Adam Smith, David Hume and others, through Liberty Fund's online *Library of Economics and Liberty* as well as citations to book chapters and the relevant research papers. A list of these reading materials is available upon request from the authors.

Instructions

Each experiment is accompanied by an exact transcript of instructions to read aloud to students before the experiment. These instructions provide students with the critical information on the environment and operant institution, including the rules of exchange and how points are awarded. For example, in the production and consumption experiment, the instructions inform students of their production technology, preferences, and that all exchange is voluntary (i.e. red and blue poker chips change hands only if both parties agree on the exchange). In the oral double auction, the instructions inform students acting as buyers that they earn points by buying units at prices below the relevant values on their sheet, while those acting as sellers earn points by selling at prices above the relevant values on their sheet. In this case, the institution requires that all bids, asks and contracts are placed through the auctioneer (teacher): bids and asks not recognised by the auctioneer cannot become contracts and no side deals are allowed.

In addition, step-by-step instructions for implementing each part of each module are provided to assist teachers. These include directions for installing the computer software, printing experiment materials and distributing them to students, tasks to be performed during the experiments, inputting the results of the experiment, and debriefing and leading classroom discussion. These instructions along with the computer software described in the previous sub-section should work to keep the barriers to using this curriculum relatively low: both in terms of classroom implementation and out-of-class preparation.

Discussion and conclusion

For whatever reasons, the modern teaching of economics no longer conveys the brilliant insights of the Scottish Enlightenment. At the forefront of the industrial revolution, these scholars observed firsthand the wealth-creating power of exchange and specialisation, the importance of decentralised and dispersed knowledge, and the unifying connection of personal social exchange and impersonal market exchange. In this paper we present three modules that we have used in our classes to enhance the current equilibrium-focused perspective of introductory economics with a dynamic social viewpoint that more accurately describes the world. These modules blend the firsthand experiences of economic experiments with the primary sources of the Scottish Enlightenment to generate a richer context for viewing and understanding economics.

One future project of ours involves developing a complementary module on the connection between morality and the origins of property that makes the intimidating insights of David Hume in *A Treatise of Human Nature* accessible to the introductory student of economics. Scholars of modern economics recognise that well-defined property rights are essential to the workings of markets. However, this is rarely conveyed in the modern textbooks except for the obvious counterexamples of public goods and externalities. Hume provides a foundation for tying the traditions of morality to the conventions of property that make market exchange possible.

Appendix 1: Software instructions

Open the software by double-clicking on the hand-run icon. Select the experiment you wish to run. If you select the 'Production and Consumption' experiment see Section A; if you select the 'Double Auction' experiment see Section B; if you select the 'Extensive Form Game' experiment see Section C.

A Production and consumption experiment

Requirements

- 3 monitors: 1 teacher and 2 student helpers.
- Poker chips (at least two different colours). Each odd-type student requires at most 13 poker chips of one colour, say red, and each even-type requires at most 11 poker chips of a different colour, say blue, per period. Poker chips can be reused each period.

Classroom setup

1. Clear the middle of the classroom to allow room for students to move around during the experiment. Push the desks to the side and the students sit while you read the instructions (see below).
2. Set up two tables at opposite ends of the classroom. One will be the production station: students will collect their poker chips here. The other will be the consumption station: students will pass in their poker chips and earn points here.
3. For an example of the classroom setup, see the diagram below. The production station is marked with a 'P' and the consumption station is marked with a 'C.'

Experiment setup

4. In the computer software, select the number of groups in the drop-down box. This will be half the number of students in your class or smaller and must be an even number.
5. Enter the two colours of poker chips in the bottom right corner of the screen in boxes titled 'Good 1 Name' and 'Good 2 Name.'
6. Click the 'Print Hand Outs' button at the top screen. This will generate experiment instructions, student worksheets, and production and consumption tables (for teacher use). Print the worksheets and distribute to students.
7. Odd and even types are identified with an odd or even number following the word 'Sheet' at the top. Ask students with odd- and even-numbered worksheets

Diagram: classroom setup

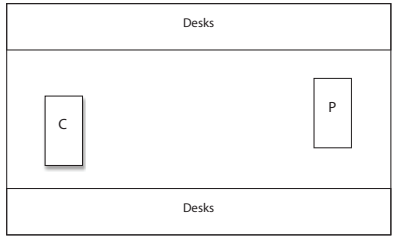


Diagram: production tables

(a) Odd-type

Production	Red All	High	Low	Equal	Low	High	Blue All
Red, Blue	13, 0	10, 0	7, 1	3, 1	1, 1	1, 2	0, 2

(b) Even-type

Production	Red All	High	Low	Equal	Low	High	Blue All
Red, Blue	3, 0	2, 1	2, 2	1, 2	1, 5	0, 8	0, 11

to stand at separate ends of the classroom. In the above diagram, the two groups should be at desks and standing across from each other.

8. Read the instructions aloud.

During experiment

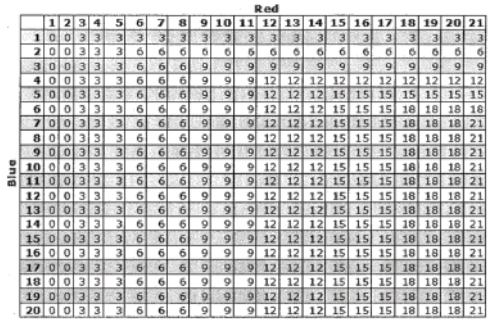
9. At the beginning of each period, students should go to the production monitor having selected the level of effort to devote to production. The table shown below (and included in the printed out materials; see Step 5 above) instructs the production monitor the level of production associated with the level of effort chosen by the student, based on the student type: either *odd* or *even*. The production monitor should distribute the poker chips and write corresponding production numbers on the student's worksheet.
10. After the students have received their production (and made any trades), they should go to the consumption monitor. The table shown below (and included in the printed out materials: again, see Step 5 above) instructs the consumption monitor on the number of points associated with the consumption bundle. The consumption monitor should collect the poker chips and write the corresponding number of points on the student's worksheet.
11. Step 9 and Step 10 should be repeated for the desired number of periods (up to 10).
12. If a student asks whether they can trade, reply with the sentence from the instructions: 'anything (within reason) not explicitly prohibited by the instructions is allowed'.

After experiment

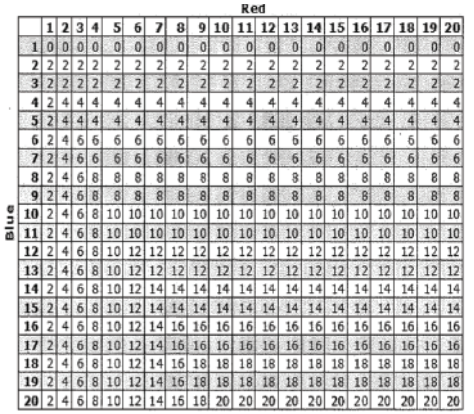
13. At the end of the experiment, collect all student worksheets. Use these to record the earnings of each student.
14. Outside of class, enter the information on production and consumption on the student worksheets into the computer software under the headings 'Production Results' and 'Consumption Results,' respectively.
15. The total number of points earned by each student (or student group) is displayed in the right portion of the screen under the heading, 'Total Points.'

Diagram: consumption tables

(a) Odd-type



(b) Even-type



16. Click the 'Display Results' button. This shows the percentage of possible profit earned and the total production per period.
17. The 'Display Results' button also shows the results from research experiments.
18. Click the 'Save' button to save the results.
19. Click the 'Load' button to retrieve results from a previous experiment. To display the results again see Step 15.

B Oral double auction experiment

Requirements

- 2 monitors: 1 teacher and 1 student helper.
- A computer for recording decisions during the experiment.

- Although not necessary for running the experiment, a computer connected to a projector is helpful for displaying bids, asks and contracts in real time during the experiment and displaying the results after the experiment.

Classroom setup

1. All desks should be facing one direction, as if the teacher was lecturing.

Experiment setup

2. In the computer software, select the number of participants: 5 buyers and 5 sellers, 6 buyers and 6 sellers, or 7 buyers and 7 sellers. We would recommend that all students work in pairs. Thus, for a class of 20 students we recommend the 5 buyers and 5 sellers design.
3. Click the 'Initialize Experiment' button. This will generate experiment instructions and student worksheets.
4. Click the 'Generate Printouts' button. Print the worksheets and distribute to students.
5. Read the instructions aloud. The instructions will provide examples that will use the 'Demo' tab in the computer software.
6. After you have read the instructions and are ready to begin the experiment, click the 'Experiment' tab.
7. Check the 'Bid/Ask' box at the bottom of the screen. This will display each bid and ask in real time.

During experiment

8. After the first trade is complete, stop and remind students to fill in their worksheets. Remind that the only the buyer and seller who have traded are moving onto their second units (rows) and that everyone else is still working on their first unit (row). Also remind them that the queue is now empty and that they are free to submit bids and asks at any price (in 25¢ increments).
9. If you do not wish to complete all three periods, click the '+' button in the bottom right corner of the screen until you are prompted that the experiment is over. *NB: You must click the '+' button after the last period of trading to save all of the data.*
10. The data file for the experiment will be saved automatically.

After experiment

11. To review the results, click the 'Experiment' tab.
12. Click the 'Reset' button (if you just ran the experiment) and then click the 'Load Data File' button. Select the data file of the experiment you wish to display. A time and date stamp identifies the data file.
13. The following software features are available along the bottom portion of the screen:
    - *Bid/Ask:* displays all the bids and asks of a given period.
    - *Contract Line:* draws a line through each trade.
    - *Arrays:* displays all the buyer values (blue) ordered highest to lowest and all seller costs (red) ordered from lowest to highest. Each step represents a single buyer value or seller cost. Respectively, the arrays form the demand and supply curves of the market.
    - *Gains From Trade:* highlights (in green) the total surplus extracted.
    - *Add:* replays, in order, which buyer and seller were involved with each trade.
    - *Sub:* replays, in order, which buyer and seller were involved with each trade and either the gains from trade (in green) or the losses (in red) for the trading pair.
    - *Clear:* in order to click 'Add' or 'Sub' after previously clicking one of them, you must click clear.
    - *Round:* to move between rounds click the '–' or '+' buttons.
14. In addition, the number of units traded is always displayed in the top middle portion of the screen, and when the 'Arrays' box is checked, the total efficiency (percent of gains from trade realised) is also shown.
15. A data file of a previous session that achieved 100 per cent efficiency in the first round is also provided when the software is downloaded.
16. At the end of the experiment, collect all student worksheets. Use these to record the earnings of each student.

C Extensive form game experiment

Requirements

- 1 monitor: teacher.

Classroom setup

1. All desks should be facing one direction, as if the teacher was lecturing.

Experiment setup

2. In the computer software, select the number of pairs in the drop-down box. This will be half the number of students in your class or smaller and must be an even number.
3. Check the box for the games that you would like to produce materials for: the voluntary and/or involuntary extensive form game (you can check one or both).

4. Click the 'Print Hand Outs' button at the top screen. This will generate experiment instructions and student worksheets. Print the worksheets.
5. Read the instructions aloud.

During experiment

6. If you printed out sheets to run both the voluntary and involuntary extensive form trust game, select which of these you would like to do first and set the other sheets aside. Please note that from our experience in the classroom, the results of the involuntary trust relative to the voluntary trust game are *not* robust if conducted in conjunction with the voluntary trust game with the same class. (The hint of a future means that the subjects are not playing a one-shot game.) We suggest running one or the other design with one class and collecting data for the other design with another class which only sees one design.
7. Identify half of the students (or student groups) to act as Players 1 and distribute the worksheets. Instruct the students acting as Players 1 to write their names on the *back* of their worksheets. If there is a group of students acting as a Player make sure they all write their names.
8. Next, instructs all Players 1 to circle the arrow corresponding to their decision. That is, they can circle the arrow pointing to the right or the arrow pointing down.
9. Collect all of the worksheets and redistribute them to those acting as Players 2, i.e. the other half of the students (or student groups).
10. Then instruct all Players 2 to write their names on the *front* of the worksheet and to circle the arrow corresponding to their decision: Again, they can circle the arrow pointing to the right or the arrow pointing down.
11. Notice that Players 2 should never see the names of Players 1.
12. Repeat Step 7 through Step 11 to run the other experiment.

After experiment

13. At the end of the experiment, collect all student worksheets. Use these to record the earnings of each student.
14. Outside of class, enter the number of Players 1 that chose each decision: either a move right or a move down. Similarly, enter the number of Players 2 that chose each decision.
15. The software also allows you to 'Save' and 'Load' results. A loaded data file reports the results saved from the experiment. This shows a game tree with the number of students that made each decision. The file *Trust_Game_JEBO_EI_PNAS.txt* reports the data from research experiments:
    a. M. Rigdon , K. McCabe, and V. Smith, 'Positive Reciprocity and Intentions in Trust Games', *Journal of Economic Behavior and Organization*', 52, 2003.
    b. K. McCabe and V. Smith, 'A Comparison of Naïve and Sophisticated Subject Behavior with Game Theoretic Predictions', *Proceedings of the National Academy of Arts and Sciences*, 97(7), 2000.
    c. J. Cox and C. Deck, 'On the Nature of Reciprocal Motives', *Economic Inquiry* 43, 2005.

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Notes

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1 The implementation of the oral double auction does not differ significantly from the presentation by Davis and Holt (1993; pp. 47–62). With this experiment, our main innovation is in the presentation to a new audience in the context of Smith (1982) and in conjunction with other experiments.

2 Henrich (2000) and Henrich et al. (2005) present evidence that these types of exchange coexist in cross-cultural studies in which cooperation in personal exchange is measured in two-person (ultimatum and dictator) games and positively correlated with closeness to impersonal markets. See Smith (2008, pp. 200-202) for further discussion of these results.

3 The observation that personal and impersonal exchange coexist was Hayek's (1988) insight, borrowed from the Scottish philosophers, that, 'If we were to apply the unmodified, uncurbed, rules of the micro-cosmos (i.e., of the small band or troop, or of say, our families) to the macro-cosmos (our wider civilization), as our instincts and sentimental yearnings often make us wish to do, *we would destroy it*. Yet if we were always to apply the rules of the extended order to our intimate groupings, *we would crush them*. So we must learn to live in the two sorts of world at once. To apply the name "society" to both, or even to either, is hardly any use, and can be most misleading' (p. 18).

4 The list of primary source materials and sample discussion questions are given in the Appendix.

5 Only the teachers have *a priori* knowledge of the production function in the form of the possible combinations of red and blue associated with each effort level (see Appendix I, section A.9); students must discover the production possibilities through their choices.

6 Notice that any buyer or seller with values or costs to the left of the intersection of the demand and supply curves can profitably contract with each other at any price (with the previously stated restriction). Moreover, the rules of the double auction institution do not impose any particular pairing of these buyer and sellers. Thus, Buyer 1 (the first step from the left) can contract with Seller 3 (the third step from the left).

7 For summaries, see Camerer (2003) and Smith (2008).

8 The number of participants can but must not be equal to the number of students in the class. Teachers can assign students to work in pairs and our experience teaching with these experiments supports the notion that students learn more when they discuss their decisions in the experiment in small groups. This is particularly true for the production and consumption and oral double auction experiments, however the extensive form games are more potent when each student makes his/her own decision.

9 The teacher provides information on the number of red and blue produced based on the production table (see Figure 1).

10 The teacher provides information the number of points awarded based on the consumption table (see Appendix I, section A.10).

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