

## **EcoSim: An Innovative Tool for Teaching Economics**

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EcoSim is a teaching tool that brings together students from principles micro and macroeconomics, intermediate micro and macroeconomics, public sector economics, mathematical economics, managerial economics, and econometrics in a unified comprehensive economic simulation. The simulation was designed with the intent of providing students with a laboratory in which they could experience real economic forces, and application for most of the theory covered in undergraduate economics courses. Although the flexibility of EcoSim allows it to be used simultaneously in all of the courses listed above, the simulation works quite well when used with students from only one or two of these courses.

EcoSim provides students with a computer *based* not computer *generated* economy. All prices, interest rates, employment and inflation rates, investment, production and consumption levels, are established by the players themselves as they interact with each other. Because the computer does not interfere in the economy, expectations, information, and risk behavior play as important a role in EcoSim as they do in the external world.<sup>1</sup>

EcoSim players are divided into two groups: company/population players and government/central bank players. Each company/population player is issued a company and a group of people at the start of the simulation. While playing the role of a company, the player hires labor from other populations and purchases materials from other companies to produce a product which is then sold to other companies or to other populations. In the short run, players must determine the optimal combination of labor and materials to use in production and their profit maximizing output levels. In the long run, players must determine the optimal combinations of capital (plant and equipment) and technology to acquire. Players can purchase materials and hire labor to produce products, buy and sell stock and bonds in other players' companies, speculate in commodities markets, invest in plant and equipment or research and development, move between industries, enter contractual agreements with other players, lobby the government, form cartels, and undertake entrepreneurial ventures. Each company player receives a grade for his company which is based on the percentage growth of the value of the company's stock portfolio from the beginning of the simulation to the end.

While playing the role of a population, the player hires out workers to earn money which he uses to purchase goods for his population to consume. In the short run, players decide what combinations of various goods to consume and how much of their population's time should be devoted to work and how much to leisure. In the long run, players try to achieve the optimal population size by adjusting their population growth rates. Each player receives a grade for his population which is based on the cumulative utility the population achieves over the course of the simulation.

Government/central bank players act as the government and monetary authority for the company/population players. The government/central bank can impose price controls, sales quotas, income taxes, profits taxes, and sales taxes, issue subsidies, impose fines, issue transfer payments, produce public goods, alter the money supply, borrow and lend money, and enact laws and regulations. The political climate (i.e. democratic, totalitarian, or anything in between) and the economic climate (i.e. capitalistic, socialistic, or

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<sup>1</sup>It is problematic to use the phrase "real world" because the economic forces generated within EcoSim are "real" insofar as they result solely from the constrained maximizing behavior of real agents.

anything in between) are determined by the government as it attempts to appease its constituents. The government/central bank players elect one from their group to serve as the Head of State. The Head of State has the sole power to enact fiscal and monetary policy and to enforce laws. The remainder of the government/central bank players are legislators and are assigned a number of company/population players as constituents. Each round of play, each company/population player casts a vote *for* or *against* the Head of State and *for* or *against* the player's legislator. These votes have no bearing on who holds government office, rather the votes reflect the company/population players' satisfaction (or lack thereof) with the government. Each government/central bank player receives a grade based on the number of "for" votes obtained over the course of the simulation.

Because the EcoSim economy is not fabricated by the computer, but is the result of true economic forces resulting from the interactions of real consumers and producers, the economic data generated by the simulation provides a wealth of information and examples for econometrics students. Econometrics students can download the macro and micro data generated in the simulation, perform statistical analyses, and construct forecasts of commodity prices, output levels, inflation, gross domestic product, and any of another fifty economic time series and cross sectional data sets.

EcoSim is programmed for a VAX/VMS minicomputer. A windows version for use on a PC network is under development. The simulation typically runs twenty-four hours a day, seven days a week, over the course of several months. Students access the simulation as frequently or as infrequently as they deem necessary. On average, students spend thirty minutes per day on the computer and another fifteen minutes per day making deals, discussing strategy, and writing contracts with other players "off-computer". The EcoSim software is almost fully self-sufficient. The only requirement it makes of the course instructor is that the instructor notify the computer when it is to advance the simulation to the next round of play (i.e. the next accounting cycle).

In its most simple form, an EcoSim game can include at least 15 company/population players from a single course and will run without a government/central bank. Because of the small number of companies, players will be most concerned with striking deals with other players, forming cartels and trusts, and establishing monopolies.

In its most complex form, an EcoSim game can include up to 500 company/population "teams" (each team can be comprised of several students from any of the following courses: principles micro/macroeconomics, intermediate micro/macroeconomics, mathematical economics, managerial economics, finance, management, and marketing), up to 100 government/central bank players (while the government/central bank should be played by public sector economics or macroeconomics students, these students benefit from having other students from political theory, government, and public relations courses also play as legislators), and any number of econometrics students who will supply the players with statistical analyses and economic forecasts. Because of the large number of players, there will be well developed stock and bond markets, significant trading in options and futures contracts, a respectable amount of contract litigation (usually mediated by the government), many laws passed regulating company and population behavior, significant campaigning by the government/central bank players and lobbying by the company/population players, and much entrepreneurial activity.

Several universities have designed laboratory sessions based on EcoSim which run concurrently with the economics classes. While students play EcoSim on their own time outside of class, the laboratory sessions are times in which the students can come together in a more formal setting to make deals, discuss strategies, and perform analyses under the direction of the instructor.

The EcoSim software is available free of charge. Students who use the software must purchase a manual and spreadsheet disk. The manual explains the rules of EcoSim and discusses player strategy in terms of economic theory. The spreadsheet can be used by the students to perform "what-if" analyses on their companies and populations. The spreadsheet takes information from the a student's company and population and computes measures of the student's total revenue, total cost, average variable cost, average fixed cost, average total cost, marginal cost, total product, average product, marginal product, marginal product per dollar, utility, marginal utility, and marginal utility per dollar. The spreadsheet also creates graphs of the players' product curves, indifference curves, and budget constraints.