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A NEW LABORATORY FOR ECONOMISTS

Computer models now mimic consumers and businesses

Has macroeconomics gone Hollywood? Some economists think so. Macroeconomics, they lament, seems to offer increasingly simple-minded plots jazzed up with ever more mind-boggling special effects. That's why Axel Leijonhufvud, an emeritus economics professor at the University of California at Los Angeles, founded UCLA's Center for Computable Economics in 1991. It's one of several new efforts seeking to instill a sense of reality in the dismal science--by coming at economics from a different direction, with new tools.

New computer models are essential to understanding today's dynamic economy. The assumptions behind current models, which make forecasts by analyzing huge amounts of macroeconomic data, are "sham and delusion," says Barbara R. Bergman, an economics professor at American University in Washington, D.C.

The new models combine lessons from biology with a bottom-up analysis. The aim is to create a society-in-miniature inside a computer. Instead of grinding through historical economic data, the new models create virtual worlds with hundreds of miniprograms. Each miniprogram represents a real-world economic entity--such as a factory, store, bank, or household. These get tossed together in a silicon realm where they evolve as they interact with other entities, creating a dynamic economic model.

EVOLUTION. Each of these miniprograms can vary in certain details, so many

outcomes are possible. One household might be made to shop for the lowest price, for example. Another might prefer quality over cost. Once these agents are set loose, what happens next is anyone's guess. The humans running the show set up the initial environment and constraints, and then "evolution" takes over. It's a Darwinian world, where only some solutions endure.

The most ambitious of the new models so far is a system called Aspen. It's the brainchild of Richard J. Pryor, a computational sciences manager at Sandia National Laboratories. Aspen is still being developed, but some economists consider Aspen and its lesser brethren a major step forward. "This is probably the best thing that's come along in a long time," says Lawrence R. Klein, a Nobel prize-winning economist and a pioneering economics modeler at the University of Pennsylvania. Stephen Gibson, executive director of the Bionomics Institute in San Rafael, Calif., says "a whole new laboratory workbench has been created, and a new research community is starting to coalesce around it."

Because the new models evolve, the miniprograms that represent the economic actors, or agents, are called genetic algorithms. Each program mutates by swapping bits of computer code ("genes") with others--creating new agents with different behaviors.

Unveiled a year ago and still in the prototype stage, Aspen has already turned up some surprises. While Aspen was simulating the effects of different monetary and fiscal policies (one of which triggered an economic slump), the synthetic companies did something totally original. "The firms learned to cooperate," says Sandia economist Nipa Basu. "We didn't put that into the software," she notes. "But when things stayed sour, the firms got together and helped each other out"--just as real companies might help their suppliers over rough times.

Aspen's make-believe world can have 10,000 households plus 1,500 factories, stores, banks, and government agencies--the economic ingredients of a city or country. The size is vital, says Pryor, who dreams of models with 100,000 agents and more. "With thousands of players, you see behavior you wouldn't get in macro models," he explains.

Aspen can be used to analyze things for which there is little data--such as underground economies in Eastern Europe and trade breakthroughs such as the North American Free Trade Agreement. But Pryor expects the main applications to be in analyzing the causes of business cycles, both nationally and in specific industries. In addition, government officials could also try Aspen on tasks performed by conventional models, such as previewing the economic fallout from tax and regulatory changes.

Among the larger projects to date was a look at alternative ways for Washington to

stimulate the economy. The simulation showed exactly what economists would expect: Increased federal investments had little effect if the Federal Reserve allowed bond interest rates to float, because higher rates offset the stimulus. But when the Fed bought bonds to hold their rates as flat as possible, gross national product zoomed.

Already, similar economics models are creeping into the real world. Bernardo A. Huberman, a physicist at Xerox Corp.'s Palo Alto Research Center (PARC), has created a cold-air market in one of the center's buildings. Multiple thermostats sense the temperature and compete to "buy" units of flowing air. The system yields better temperature stability than one using conventional controls, Huberman has found. He and researcher Tadd Hogg are refining a similar bartering system that bids for time slices on computers linked to a network. Another PARC researcher, Natalie S. Glance, joined them to run a simulation that probed the pros and cons of investing in employee training.

Daniel D. Bachman, an economist with WEFA Group in Eddystone, Pa., agrees the new approach might be valuable but says Aspen is probably too expensive for widespread business use. Sandia has a couple of proposals pending in Washington. One would assess the direct and indirect paybacks from the Energy Dept.'s investments in supercomputers, which might help Energy defend its budget from congressional pruning. Meanwhile, Pryor is hatching a proposal for creating a new breed of robots that would learn to cooperate and find ways to improve productivity, the way human workers do.

As is often the case with upstart contenders, the developers of the bottom-up models "tend to think they're going to overturn the standard way of doing economics," says PARC's Huberman. "I don't agree." He doubts computer models can ever replace analytical thinking. What simulations will do, Huberman predicts, is help economists find new insights that put the real world in a new light.

By Otis Port in New York

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