assumptions are false, and where they can end up blindly following strategies that border on the lunatic.

"A systems analyst who computerizes an organization may only be there long enough to see the normal operation of that organization," says John L. King, at the University of California, Irvine, who has focused much of his research on the impact of computers on social processes. "But it's like a nuclear power plant—the emergency system may be very important, even if you only use it once a year."

The idea of an emergency system takes on additional significance in light of some recent theoretical work done by Bernardo Huberman and Tad Hogg at the Xerox Palo Alto Research Center. They are quick to point out that they have not explicitly modeled the stock market. Nonetheless, their approach to what they call "computational ecologies" does seem to be relevant.

The underlying theory is nonlinear game dynamics, explains Huberman. To begin with, he says, "imagine that you have a bunch of interacting agents, each choosing a strategy. The important thing is that the payoff of each strategy depends on what the other agents are doing." As an example, each agent might have to balance the benefits of collaboration with the fact that too many agents using the same strategy might use up finite resources. Next, he says, assume that each agent has imperfect knowledge about what the others are doing, and assume also that each agent's knowledge is slightly out of date—that there are delays in obtaining information. Then finally, model the whole thing on a computer, extracting the aggregate behavior of the agents as a group.

"What you find is that you can get very weird behaviors," says Huberman. The system may settle down for a while and seem stable—and then suddenly go into a period of nonlinear oscillation with sharp undershooting and overshooting. In the language of dynamic systems theory, such behavior is described as a so-called strange attractor. In practice that means that its sudden excursions are inherently unpredictable.

So is this what is happening in the stock market? Maybe, says Huberman, although for now, the theory is only a metaphor.

On the other hand, the possibility does lead to an intriguing thought: for all the pundits' efforts to explain the gyrations of the stock market, most of those gyrations may not have an explanation. Following the course of its strange attractor, the market may rise and fall simply because that is the way such systems behave. As Irvine's King points out, "what Monday illustrates to me is just how little we know." ■

M. MITCHELL WALDROP

Gramm-Rudman-Hollings Strikes Back

Despite the positive actions by House and Senate appropriations committees, growth in many basic and applied research programs funded by the federal government will be limited, if not reversed, this year. The gloomy budget outlook for fiscal year 1988 is driven by two factors—the remodeled Gramm-Rudman-Hollings deficit reduction law and the chaos in the nation's stock markets.

The revitalized Gramm-Rudman law, known officially as the Balanced Budget and Emergency Deficit Control Reaffirmation Act of 1987, has been looming in the background of budget deliberations since Congress adopted it in September. Like the budget act passed in 1985 (*Science*, 25 October 1985, p. 421), the new Gramm-Rudman-Hollings law sets a schedule for reducing annual federal spending deficits to zero. The goal is to eliminate budget deficits by 1993.

To enforce the schedule for reducing deficits, the law contains a provision to automatically withhold sufficient funds from federal programs when necessary. This "sequestration" mechanism kicks in if the Office of Management and Budget (OMB) concludes by 20 November of each year that deficit limits are being exceeded.

For fiscal year (FY) 1988, which began 1 October, Congress stipulated that only $23 billion had to be cut from the deficit. The goal is to shave it down to $144 billion, but the target is not legally binding this year. For 1989, however, Congress has set a firm target of $136 billion. Thereafter, the deficit must be lowered $36 billion annually.

If Congress and the White House cannot figure out how to cut the 1988 deficit by $23 billion in the next few weeks, most Department of Defense (DOD) programs will be subject to a 10.5% across-the-board reduction in FY 1988. Civilian programs will face reductions of 8.5%, according to OMB estimates. These percentage reductions could change, pending final OMB estimates in mid-November.

Under the sequestration process, budget reductions are achieved by taking half the funds from DOD activities and the remaining 50% from nondefense programs. Social security, federal retirement, worker disability, and a number of other social programs, which account for half of the federal budget, are exempt from sequestration.

If FY 1988 appropriations bills are enacted and subject to an 8.5% reduction, here is how some research programs might be affected:

■ **National Institutes of Health** (NIH) programs would emerge with an estimated budget of $6.3 billion, about $600 million less than what the House and Senate appropriations committees have called for NIH funding in 1987 was $5.94 billion.

■ **Office of Energy Research** spending at the Department of Energy would be about $173 million less than the $2-billion appropriation that the House and Senate have approved. This would bring spending to $1.87 billion, close to 1987's budget of $1.86 billion.

■ **National Aeronautics and Space Administration** (NASA) activities would be substantially curtailed. The agency's budget would fall from about $9.3 billion to an estimated $8.5 billion. NASA's budget was $10.5 billion in 1987.

■ **National Science Foundation** (NSF) support for research and other scientific undertakings would be lower than expected too. The budget could be reduced to about $1.67 billion compared to a potential figure of $1.83 billion that House and Senate appropriations committees might agree on in conference. NSF's budget for 1987 was $1.62 billion.

Automatic spending reductions can be avoided if Congress and the President enact appropriations bills that achieve the required $23 billion in deficit reduction. House and Senate Democrats have sought to address part of this challenge by imposing new taxes that would generate about $12 billion in new revenue.

Before the stock market went into a nose dive last week, President Reagan steadfastly refused to consider new taxes. But, under pressure from House and Senate Republicans and Wall Street, Reagan has indicated that he will accept some new taxes.

Even if Reagan goes along with some new taxes, it is clear that about $11 billion in spending reductions will be necessary. That could translate to reductions in FY 1988 appropriations bills on the order of 4%. These reductions might be deeper—even with a tax increase. Congress could change its mind and decide to cut more than $23 billion from the deficit, as many in the financial community have urged.

At *Science*'s press time, it appeared likely that House and Senate leaders and the White House would attempt to reach an agreement before the 20 November sequester deadline. In fact, OMB contends that this year's deficit target of $144 billion can be met. But, the Congressional Budget Office is pessimistic. It projects the deficit at $156 billion after accounting for $23 billion in reductions. ■ MARK CRAWFORD