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high-tech markets. All through the 1970s and well into the 1980s, Arthur points out, the federal government followed a "hands-off" policy based on a conventional economic wisdom, which did not recognize the importance of nurturing an early advantage before the other side locks in the market. As a result, high-tech industries were treated exactly the same as low-tech, bulk-commodity industries. Any "industrial policy" that might have given a boost to infant industries was ridiculed as an assault on the free market. Free and open trade on everything remained a national goal. And firms were discouraged from cooperating by antitrust regulations drawn up in an era when the world was dominated by bulk commodities. That approach has begun to change a bit in the 1990s, says Arthur. But only a bit. So he, for one, argues that it is high time to rethink the conventional wisdom in light of increasing returns. "If we want to continue manufacturing our wealth from knowledge," he says, "we need to accommodate the new rules."

Arthur was certainly not alone in thinking this way. "By the early eighties, several people were working on increasing returns," he says. Paul Romer at the University of Chicago was doing beautiful work on endogenous growth theory—"basically, how positive feedback affects growth. The more growth there is, the more it stimulates further growth." Meanwhile, he says, MIT's Paul Krugman and others were studying positive feedbacks in international trade theory: "The more you produce, the cheaper per unit it is. But then, why do Germany and the United States export cars to each other? Because with positive feedback, firms in Germany can produce certain cars very cheaply, while U.S. firms produce slightly different forms of cars just as cheaply. So the trade becomes profitable to both."

But Arthur was looking for something more general: a rigorous, mathematical way to analyze how increasing returns worked over time to select one out of the several possible outcomes a market could end up with. "I'm certainly not against mathematics per se," he says. "I'm a heavy-duty user. I'm just against mathematics when it's misapplied, when it becomes formalism for its own sake." Used correctly, he says, mathematics can give your ideas a tremendous clarity. It's like an engineer who gets an idea for a device and then builds a working model. The equations can tell you which parts of your theory work and which don't. They can tell you which concepts are necessary and which aren't. "When you mathematize something you distill its essence," he says.

Besides, says Arthur, he knew that if he didn't come up with a rigorous