

Artificial Intelligence and Globalization

Kenneth Rogoff

Today's conventional wisdom is that the rise of India and China will be the single biggest factor driving global jobs and wages over the twenty-first century. High-wage workers in rich countries can expect to see their competitive advantage steadily eroded by competition from capable and fiercely hard-working competitors in Asia, Latin America, and maybe even some day Africa.

This is a good story, full of human drama and power politics. But I wonder whether, even within the next few decades, another factor will influence our work lives even more: the exponential rise of applications of artificial intelligence.

My portal to the world of artificial intelligence is a narrow one: the more than 500-year-old game of chess. You may not care a whit about chess, long regarded as the ultimate intellectual sport. But the stunning developments coming out of the chess world during the past decade should still command your attention.

Chess has long been the centerpiece of research in artificial intelligence. While in principle, chess is solvable, the game's computational complexity is almost incomprehensible. It is only a slight exaggeration to say there are more possible moves in a chess game than atoms in a universe.

For most of the twentieth century, programmers were patently unsuccessful in designing chess computers that could compete with the best humans. A human chess master's ability to intuit, visualize, and prioritize easily prevailed over the brute force approach of computers. The computers gradually improved, but they still seemed far inferior to the top humans. Or so we thought.

Then, in 1997, in what will surely long be remembered as a historical milestone for modern man, IBM's "Deep Blue" computer stunned the world by defeating the world champion Garry Kasparov. Proud Kasparov, who was perhaps more stunned than anyone, was sure that the IBM team must have cheated. He sarcastically told reporters that he sensed the "the hand of God" guiding his silicon opponent.

But the IBM team had not cheated. Rather, through a combination of ingenious software and massive parallel computing power, they had produced a silicon-based entity capable of such finesse and subtlety, that international chess grandmasters worldwide (including me) were simply amazed. Since 1997, the computers have only gotten better, to the point where computer programmers no longer find beating humans a great challenge.

Only a game, you say? Perhaps, but let me tell you this: when I played professional chess 30 years ago (I once represented the United States in the World Chess Championship cycle), I felt I could tell a lot about someone's personality by seeing a sampling of their games, even those of

an amateur. Until a short while ago, I could certainly distinguish a computer from a human opponent.

Now everything changed like lightning. The machines can now even be set to imitate famous human players – including their flaws – so well that only an expert eye (and sometimes only another computer!) can tell the difference.

More than half a century ago, the godfather of artificial intelligence, Alan Turing, argued that the brain's function could all be reduced to mathematics and that, someday, a computer would rival human intelligence. He claimed that the ultimate proof of artificial intelligence would be met if a human interrogator were unable to figure out that he was conversing with a computer.

The “Turing test” is the holy grail of artificial intelligence research. Well, for me, a chess game *is* a conversation of sorts. From my perspective, today's off-the-shelf computer programs come awfully close to meeting Turing's test.

Over the course of a small number of games on the Internet, I could not easily tell the difference. True, today's computers have not evolved to the level of the deranged chess-playing HAL in the filmmaker Stanley Kubrick's masterpiece “2001: A Space Odyssey,” much less Arnold Schwarzenegger-like droids from the Terminator movies. But the level that computers have reached already is scary enough.

What's next? I certainly don't feel safe as an economics professor! I have no doubt that sometime later this century, one will be able to buy pocket professors – perhaps with holographic images – as easily as one can buy a pocket Kasparov chess computer today.

So let's go back to India and China. Globalization proceeded at a rapid pace through much of the last century, and at a particularly accelerated rate during its last two decades. Yet the vast body of evidence suggests that technological changes were a much bigger driver in global wage patterns than trade. That is, technology, not trade, was the big story of the twentieth-century economy (of course, the two interact, with trade helping to diffuse and stimulate technology, but this is a matter of semantics).

Are we so sure that it will be different in this century? Or will artificial intelligence replace the mantra of outsourcing and manufacturing migration? Chess players already know the answer.

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