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**Special Edition**

# Coexistence with artificial intelligence

- Interview with Michael A. Osborne by Masaki Fukui -

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## Executive Summary

*The threat of artificial intelligence, robotics and other such technologies replacing human labor across a broad range of jobs is a growing concern. What types of jobs are least likely to be replaced by computers? How should humans and computers coexist? Masaki Fukui spoke with University of Oxford Professor Michael A. Osborne about such questions. Dr. Osborne is a Machine Learning researcher and co-author of *The Future of Employment*, which analyzed various jobs' susceptibility to being automated out of existence by computers.*

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### Michael A. Osborne

Associate Professor, University of Oxford

Associate Professor in Machine Learning, an Official Fellow of Exeter College, and a Faculty Member of the Oxford-Man Institute for Quantitative Finance, all at the University of Oxford. Co-Director of Oxford Martin Programme on Technology and Employment since January 2015. Co-author of *The Future of Employment: How Susceptible are jobs to computerization?* (2013).

### Masaki Fukui

Executive Director,  
Nomura School of Advanced Management

Joined Nomura Research Institute (NRI) in 1982. Temporarily assigned to NRI Europe in 1993 to help build risk management frameworks. Appointed Research Counselor in 2004 and Corporate Officer in 2005. Appointed president of Nomura Holdings subsidiary Joinvest Securities in 2006 after serving as head of NRI's Financial IT Research Center and Financial IT Innovation Center. Director at NRI Netcom since 2009. Appointed to current post in 2015.



## Global employment will be hard hit by artificial intelligence and robotics

**Fukui:** Your 2013 paper *The Future of Employment* attracted a lot of attention with its alarming conclusion that nearly half of the US labor force is at risk of eventually being displaced from their jobs by some form of automation. How was the reaction for you personally?



**Osborne:** Really positive. Actually, I was expecting a little more skepticism about how real these job-displacing technology trends were, but a lot of these trends have become even more prominent since we wrote the paper three years ago. I think it's now hard to find people who'd disagree that Machine Learning will have some sort of impact upon employment.

**Fukui:** We've just collaborated with you to analyze Japanese employment. The study concluded that some 49% of Japan's labor force is at high risk of being replaced by computer technology. You estimated the corresponding percentages of the UK and US labor forces at 35% and 47%, respectively. Why is a larger percentage of the Japanese labor force at risk?

**Osborne:** Actually, these three percentages are not directly comparable. The data we used for the three nations are very different. I can't conclude there is any meaningful difference between those nations. The broad trends are very similar in all three. Each has a very large chunk of employment at high risk of being automated, another large chunk at low risk and only a small amount in the middle.

**Fukui:** I see. One of the conclusions of the Japan study is that jobs that require creativity or high-level interpersonal skills are invariably at low risk of being automated out of existence in any country. Why?

**Osborne:** Because we don't have a good idea of how to teach machines to be creative or social. This is a fundamental bottleneck to automation within Machine Learning, within Robotics. Human creativity draws upon a deep reservoir of tacit, implicit knowledge that's very difficult to explicitly represent in computer code.

## Computerization's impact on the financial sector

**Fukui:** I imagine that artificial intelligence and robotics' impact would be of keen interest within the financial sector, given how widely computers have long been used in the sector.

**Osborne:** We've seen a lot of interest in Machine Learning in the field of quantitative finance. I think people are starting to realize that data can be processed much more feasibly using Machine Learning algorithms and that these algorithms can be used to identify correlations, patterns or trends from which successful trading strategies can be derived. In that respect, I think a lot of financial firms in London are thinking very seriously about how Machine Learning might impact upon their businesses.

**Fukui:** Financial sector jobs that our Japan study identified as highly susceptible to computerization include bank tellers, insurance claim/policy processing clerks and accountants and auditors. Why are these jobs susceptible to automation?

**Osborne:** The underlying trend here is that algorithms are perhaps better able to process, store and access large amounts of data than humans can in these roles. Take auditing as an example. Whereas human auditors typically use sampling to review a small subset of the available data, an algorithm can look at 100% of the data and use sophisticated means of detecting anomalies or anything else that warrants closer examination.

**Fukui:** But bank tellers interact with customers and recommend products based on those interactions. In that respect, doesn't being a bank teller require considerable interpersonal skills and creativity that would rule out computerization?

**Osborne:** I question how much of that kind of social intelligence is actually required for such jobs. Similar arguments about the need for understanding customers have been used with respect to, for example, secretaries or the typing pools of the 1950s.



People thought that the ability to take dictation or make coffee was essential for those occupations, but it ultimately wasn't sufficiently important to stop those jobs from being replaced by word processing software. Bank tellers have likewise been largely replaced by ATMs unable to make small talk. It's important to note that a job might be able to be replaced even without automating all the tasks involved in that job.

**Fukui:** Having worked in the securities industry for my entire career, I'm interested in the impact on the securities industry in particular. Jobs in the securities industry can be broadly classified into three categories: (1) customer-facing jobs, (2) trading and (3) back-office jobs, which include functions such as trade settlement, finance and compliance. How would each of these types of jobs be affected if computerization continues to advance?

**Osborne:** You're absolutely right that automation will probably not have a big impact on front-office jobs involving customer relations. Those jobs very much rely upon social intelligence. In the back office, I think a lot of routine decision-making jobs



could be replaced by algorithms. In addition to auditing, which I mentioned already, accounting and even some legal functions could very well be delegated to an algorithm, just as back-office functions have previously been offshored. If a job can be handed off to someone in a distant country, we could structure that task so it could be performed by an algorithm.

**Fukui:** What about trading jobs? Algorithmic trading that automatically generates buy and sell orders in response to market events is already quite advanced.

**Osborne:** Trading is an interesting domain because you can argue that trading algorithms, given their increasingly widespread use, will replace human traders. But I would argue that humans will still be needed to execute the creative function of developing new trading strategies. My rationale is that trading is fundamentally adversarial. You're trying to outsmart someone else and, to that extent, I think human traders will still be needed to develop new algorithms regardless of how widespread algorithmic trading becomes.

**Fukui:** Very interesting. Your comment about trading being adversarial reminds me of chess. When world chess champion Garry Kasparov squared off against the Deep Blue supercomputer, he knew was outmatched. But instead of playing the match as man vs. computer, he approached it as man + computer vs. man + computer. He had to thoroughly understand Deep Blue's decision-making process. In that sense, both sides were leveraging massive computing power to play chess, but human judgment remained at play. Is that a good analogy for trading?

**Osborne:** Absolutely! I think that's a really enlightening example of how humans' non-automatable, creative skills can complement computers' brute processing power. In trading, algorithms are likewise used by humans who are creatively interpreting what the algorithm is saying and also creating new algorithmic strategies to replace existing ones.

**Fukui:** That human traders will still be needed in the future is good news in one sense, but it's concerning that a small number of traders would likely reap even more benefit from computerization-driven productivity improvement than they already do. Meanwhile, economic inequality within society will probably worsen as a result of computers displacing jobs.

**Osborne:** Yes, we've seen worsening inequality over the last 30-40 years. In our analysis, we look at automation's implications in terms of inequality. We've found that highly skilled individuals are less susceptible to automation. Meanwhile, those least-skilled individuals being replaced by technology might not be able to easily move into whatever new jobs are created. So you're absolutely right that we might see a worsening of inequality as a result of these trends. Society faces a challenge to come up with new institutions, new policies to ensure that what wealth is created is shared more equitably.





## Education in the computerized era

**Fukui:** One of your conclusions in *The Future of Employment* is that "educational attainment exhibit[s] a strong negative relationship with the probability of computerization." If computerization continues to progress, I imagine it would have a big impact on education. What should we teach students who will have to earn a living in a highly computerized economy?

**Osborne:** Technological advancement is now accelerating so rapidly that we can't predict with any precision what today's students will need to prepare them for the workforce of 20-30 years from now. So we're forced to talk in very general terms. The bottlenecks to computerization that we talked about earlier—creativity and social intelligence—are the kinds of things we probably want to focus on inculcating in our children. Those are the attributes least likely to be replicated by algorithms.

I think it's really important for students to acquire the ability to learn rather than a static set of knowledge. The ability to learn is tied in with creativity and social understanding and, in my biased opinion, is best inculcated by the kind of tutorial experience we use at Oxford and Cambridge. I think what we want to do in the classroom is have really deep conversations with students on a particular topic rather than simply imparting information.

**Fukui:** Being involved in executive education myself, I want to ask you about educating individuals already in the workforce. As Machine Learning and Big Data become more widely used, I suspect that the process of formulating management strategy will change. How will the skills required of executives change in response?

**Osborne:** The role of management will obviously have to respond to those new technologies. I think strategy formulation needs to be informed by data in ways that it hasn't been previously. It's important for executives to have some understanding of how to use Machine Learning techniques to glean insights from data.

**Fukui:** Japanese executives, unlike their Western counterparts, typically spend their entire careers at a single company and approach strategy from the standpoint of the knowledge and experiences they've gained while rising through the ranks of their company. Will computers supplant even the management wisdom developed over the long course of one's career?

**Osborne:** Executives need to be able to make use of the increasing availability of data within their organization. The traditional means by which executives have gathered information about their firms through successive promotions is to some extent being superseded by monitoring by means of algorithms that process huge datasets to glean insights that executives can use. The ability to work with those algorithms will probably become more important than knowledge learned through long-term career progression within a firm.

**Fukui:** So executives will no longer be able to rely on experience or gut instincts alone.

**Osborne:** That's right. It's probably okay for executives to leave algorithm development to internal experts, data scientists and Machine Learning researchers. What executives need to understand are the limitations of what can be achieved with data and what data can't tell them. The realm in which data can't help you is where the traditional social intelligence that managers bring to their jobs really comes to the fore.

**Fukui:** I see. Thank you for taking the time to speak with me today.



## about NRI

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