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Lab workers at a new Sinovac factory in Beijing built to produce a Covid-19 vaccine. Sinovac is one of 11 Chinese companies approved to carry out clinical trials of potential vaccines for the coronavirus.
PHOTO: AGENCE FRANCE-PRESSE

Ask NUS economists

When open science meets closed borders

The nature of basic science makes it harder for sanctions to work

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For The Straits Times

Q *Will United States' sanctions stunt the ascent of Chinese science?*

A China has been fast ascending the world league table of science. According to the latest Nature Index, which is based on total publications in 82 top science journals, including Cell, Nature, and Science, China ranks second globally, after the US.

The index also shows that China has been narrowing the gap with the US: With total research output measured by a fractional count of total publications, which gives each co-author an equal share of the article she contributes to, Chinese scientists produced 37 per cent as much as their American counterparts did in 2015; that ratio went up to 67 per cent last year.

China's rapid progress in basic research clearly benefits from its engagement with US science. In the 2018-2019 school year, 171,000 Chinese students were enrolled in science and engineering programmes at US universities.

My research shows that of the elite Chinese scientists, those who have published as senior authors in the three top science journals of Cell, Nature, and Science in the past decade, 60 per cent either received their doctoral or post-doctoral training in the US.

And 70 per cent of these papers involved at least one US-based research collaborator last year.

This is not surprising since science is a cumulative process: To see further, you have to climb on the shoulders of giants. And the US, being the dominant science superpower, has plenty of giants.

Perhaps for the same reason, science has been in the crosshairs of the US sanctions against China. The US government has taken legal action against prominent US scientists who have been recruited by the Chinese government's Thousand Talents Programme to help boost China's scientific research capability.

There has also been discussion about imposing curbs on students and scholars wanting to train in science and technology in the US.

How does this bode for the future of Chinese science? To answer this, we need to understand that science is also an open process, making it different from technology innovation in commercial enterprises.

DIFFERENT SORTS OF EXCLUSIVITY

Both scientists and commercial inventors are rewarded by exclusivity. For scientists, the exclusivity comes from their being the first to discover a new law or matter of nature; commercial inventors derive their exclusivity from being the sole owner of a new technology.

Scientists establish exclusivity by fully disclosing their discovery, including the process it takes to arrive at the findings. This enables their claim on exclusivity to be verified and recognised by other scientists. Such peer affirmation is crucial for establishing exclusivity, which is also a reputation booster and the primary source of professional payoffs for scientists.

However, the most effective way for commercial innovators to profit from their inventions is to keep them secret. But secrecy is not always feasible. The molecular structure of a new chemical drug can be rediscovered by others through reverse engineering, so that it is imperative for the inventor of the drug to apply for patents to guard against imitation. Even then, the commercial innovator will not disclose more about the drug than what is legally required of him to do.

The quick and wide diffusion of new knowledge is intrinsic to science. The rivalry among scientists often promotes, rather than impedes, knowledge diffusion. Dr Francis Crick and Dr James Watson are credited with the discovery of the double helix structure of DNA. But it was Dr Rosalind Franklin's work on X-ray crystallography that played an instrumental role in the discovery despite the fierce rivalry among them.

Nowadays, much of this diffusion takes place on the Internet. Numerous online platforms allow scientists to publish their research before it appears in academic journals.

And when it is published in those journals, which usually charge hefty subscription fees, it has become common practice for researchers to pay these journals to grant readers free access to their articles, presumably to spread the influence of their work.

THE COVID-19 EXAMPLE

Open science was on full display when the Covid-19 pandemic galvanised the global scientific community in a joint and collaborative effort to decipher the virus: the sequencing of its genome, clinical studies of patients with the virus, et cetera. Information was shared in a timely and transparent way, creating a global public good.

However, when it comes to vaccine development, much remains in the dark because enormous commercial and even geopolitical interests are at stake.

These suggest that the US sanctions against China in basic scientific research may not be as effective as their initiators had imagined, if the objective is to deny Chinese scientists access to cutting-edge research.

And the sanctions have produced an unintended consequence.

FIXING THE WEAKER LINK

Basic scientific research has long been recognised as a weaker link in China's increasingly sophisticated technology innovation machinery compared with applied, engineering-based research and innovation.

The geopolitical rivalry with the US has accentuated this vulnerability, to which China is responding with significantly more investment in science.

China's minister of science and technology recently announced that its expenditure on basic research has doubled in the last five years.

Also, the president of the Chinese Academy of Sciences promised to turn the US sanction list, including lithography technology and equipment, a major Western stranglehold on China's high-end semiconductor manufacturing, into a to-do-list for his institution.

It is unclear whether this is the best way to guide science. But to the extent that China's investment in science contributes to the global public good, it should be welcomed.

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