Relations of power in worldwide university science

Simon Marginson

University of Oxford

University of Regina/ 4 May 2023

**[title slide: Relations of power in worldwide university science]**

Thank you [NAME ] Greetings all! I’m very sorry not to be with you. It’s great taking part in face to face conferences again. Today I want to start our shared reflections on higher education with *global science*. ‘Global science’ is here defined as knowledge in the two main bibliometric collections, Web of Science and Scopus, as I will discuss. This includes part of the social sciences and some humanities. Why talk about research and science at a conference on higher education? Science and higher education are closely joined. Not all higher education institutions conduct research but those that do are important in science. More than four fifths of published science papers have at least one university author. And of course, science matters. So relations of power in science matter too.

I’ll start with the global science system, and the relation between on one hand global science, and on the other hand national government and national science. Then I will move to who and what are dominant in global science, and who and what are excluded. Followed by signs of change, for even as we speak, global science is continually evolving.

[**1. Growth of global science]**

First, the growth of global science. This is an outcome of the spread of Internet-mediated communications, a process led initially by faculty in North America. This meant that on one hand the global science system became patterned by the expansionary dynamics of an open network, and on the other hand shaped by American faculty norms, including free collegial interaction independent of government. And the Anglophone sense of superiority!

**[The global science system]**

Since 1996 the number of papers in the global literature has grown by 5 per cent per year. Published science doubles every 12 years or so. There has also been rapid growth in the number and proportion of papers with international co-authors; and partly through this, active science has spread to many more countries. Most of the important new science starts in the global literature, not single nation literatures. In the STEM disciplines, though less so in other disciplines, global science has become epistemically primary, across the world.

**[Dynamics of open networks]**

There’s a lot to be said for the open network in science. In networks, knowledge, messages and information travel with lightning speed without respect for national borders. Innovations spread very rapidly. Networks become cheaper per connection as they grow. By joining the pre-existing network, new researchers and new national science systems gain access to immense resources. Established institutions and large countries cannot gatekeep because researchers can form ties with any other researcher in the network. The fastest growth is in relations between researchers in different emerging science countries.

**[Growth of science papers in Scopus by country]**

The graph on the left shows there has been rapid growth since 1996 in total science papers in China, India and the rest of the world. The established science systems in US, UK, Germany and Japan have expanded more slowly. Three decades ago the Anglophone countries, Western Europe, Russia and Japan dominated science. This is no longer the case. The number of countries generating 90 per cent of world science rose from 20 in 1987 to 32 in 2017. Over 60 countries now have viable science systems, with doctoral graduates in at least some disciplines. All these national systems connect to the common global system.

**[Number of science papers in Scopus, by type of collaboration, world]**

The number and proportion of papers co-authored in more than one institution in the same country has risen sharply, and papers co-authored in more than one country have risen even faster. Internationally co-authored papers have jumped from less than 2 per cent of all papers in 1970 to 23 per cent fifty years later. Science has gone global.

**[Internationally mobile/ foreign[\*] doctoral students as % of all doctoral students]**

Mobile doctoral students have played a large part in the globalisation of science, though the international proportion varies by country. In Canada in 2020 29 per cent of male doctoral; students and 43 per cent of female students had crossed the border for their trianing.

**[Why researchers collaborate]**

Why do researchers collaborate internationally? There are several answers in the research literature on science. Funding and programme structures often incentivise cooperation. In Europe the conditions of research funding often require cross-country teams. But the intrinsic motives of researchers are probably most influential. There may be career gains in going global. Partnerships between established researchers in the global North and emerging researchers in the global South are common, often through doctoral education. Interviews with scientists suggest that the motivations related to knowledge are often strong. The drive to discover, to create new work. Shared problems, interests and curiosity. Respect for other scientists good at what they do, trust that working together can take the work to the cutting edge. Willingness to work with scientists from anywhere to do this.

**[The science network is not a level playing field]**

So that’s the global science system. Open, fast growing, spreading, shaped to some degree by agreements between governments, and between universities, but primarily shaped from bottom up and sustained by collegial norms within the different fields of research. Bottom up, but not egalitarian. Resources, capacity and influence in science are not equivalent across the world, and still less are they equal. This is not a level playing field.

[**2. National and global science]**

So the bottom-up faculty to faculty dynamic might be more potent in shaping *global* science than the policies and actions of national governments. And in epistemic terms the work in global science tends to overshadow nation-bound and local science. Let’s look more closely at the relations between global science and national science.

**[“Sciences develop internationally, but funding is mainly national”]**

National governments and research agencies are essential to science in the material sense. They provide the infrastructure of institutions that house most basic science, universities and government laboratories, part fund the institutions and largely fund the projects. They should provide a stable policy, legal and regulatory framework for science. You might conclude that cross-border science, the global science system, is simply an outgrowth of national science. Many in government see it that way. But this misses the fact of global networking, collaboration and creativity, where most discoveries are made. In global science, knowledge and its organisation are grounded not in universities or in countries but in the disciplines and cross-disciplinary groups, in freely connecting research networks. The global science system is much more than the sum of the different national parts.

**[Science is *multi-scalar*: Global science and national science constitute distinct and overlapping systems]**

Science is multi-scalar in the geographic sense. It operates at different levels – it is individual, it is locally collaborative, it is national, often regional, and global now in a very visible way, all at the same time. These levels of science differ from each other in fundamental ways. National science is firmly centred by the nation-state, by governments. Global science has no normative centre. It is bottom-up. It is regulated not by rules and funding allocations but by voluntary cooperation, shared understanding, and the protocols that govern scientific work. It is influenced by national governments but is partly outside them. Of course there is a large area where national and global science, Canadian science and the global network, overlap. Scientists who lead their global discipline often also lead at institutional and national level. Knowledge generated originally for national government purposes can finds its way into the global conversation. Globally sourced knowledge enters into national agendas.

**[Global science is science driven – national research funding does not necessarily link to national innovation]**

The point is though that global science, and national government and policy, are different beasts. If nations treated science as a common human endeavour, focused on shared global problems such as climate change or epidemic diseases, the relationship is more seamless. However, nations often treat science as a tool of ‘technological nationalism’, hoping to mobilise science to pursue competitive nation-bound agendas. Then global science and national science find themselves pulling different ways. The nation-bound outlook can be a problem. It leads to confusion about the nature of science and its relation with the national economy. Governments hope that by investing in science within national universities and other agencies, they will fosters economic innovation. But the reality is that the ‘knowledge economy’ is a myth. On the balance of probability, national science that enters the global pool is much more likely to be used by foreign not local capital. Innovations by national industry are mostly sourced in foreign science. in any case, the majority of research is ‘altruistic’, not focused on economic development or national security at all.

**[3. Hegemony and exclusion]**

So that’s the relation between global science and national science. Nations have resource power and legal power. The global system has knowledge power. They often work together, but are sometimes pulling apart. Now let’s unpack that statement from before: ‘science is not a level playing field’. Science is a beautiful thing, but not *everyone’s* beautiful thing. There are walls around it. Let’s look at ‘hegemony’ as Gramsci called it, dominance via consent, and also at which knowledge and which agents are included. And excluded.

**[Leading research universities in global science]**

This table lists the world’s 16 leading research universities on the basis of production of highly cited science papers. Citations measure recognition, not the quality of research, but an order based on recognition shows us where authoritative science is concentrated. This list favours large institutions with big groups of productive scientists. It includes 8 universities from US, 3 from UK, 1 from Canada (UfT), and 4 from China. The last is a change. Four years earlier there were 12 from the US and none from China. But the Anglophone countries are still dominant, led by Harvard which produces twice as much high citation science as number two, Stanford, primarily because of the Harvard medical school.

**[Global science is real *but* also constructed]**

That list told us a lot about global science. It is led from familiar universities that concentrate resources and talents. So, you might think. Scientific merit determines all. And it so happens that scientific merit is dominated by Western and especially English speaking universities. Even the rising stars in China excel by being good at Western science. So the West is the best and the rest are nowhere? It’s not that simple. The same universities that dominate the comparison house the leading scientists who shape the comparison. They determine what is legitimate as global science, interacting with the publishing companies that circulate global science, in journals edited by the same discipline leaders, and the two large bibliometric companies which are the repository for global science. Through these processes, knowledge becomes rank ordered in terms of value and prestige. First, some knowledge is selected as legitimate and other knowledge is excluded. Second, there is a hierarchy within global knowledge, based on journal ranking and citation impact. Global science is real knowledge but that knowledge, and the prestige attached to it, are also socially constructed.

**[‘Global science’ is knowledge published by five firms, legitimated and value-ordered by bibliometrics]**

Let’s look more closely at how global science is defined, circulated and valued. Global science publishing is largely monopolised by five huge companies. Like science they operate freely across national borders. Science is a public good but the publishing companies turn it into something owned by them. Open access publishing has become another way of monetarising science, via author processing charges. The networked scientific world is a godsend to publishers. They actively encourage the publish or perish growth of science, regardless of content or originality, because this expands their market share and profitability.

Is science subsumed into capitalist production? Are scientists reduced to wage labour for publishers? There’s a tendency to this at the margin, but largely, no. Publishers do not create knowledge. They are parasitic on knowledge, a public good that is produced in non-profit universities and research institutes. But they also help to create the rhythms of production of that public good and closely affect its use as a tool of institutional, national, economic and cultural power. Public goods are often captured and deployed by powerful social groups.

The output of journals are fed into the two main bibliometric collections, Web of Science and Scopus, owned by companies specialising in scientific information and publishing. Books play only a minor role in bibliometrics. Peer reviewed journals are more amenable to rank ordering based on journal selectivity and citation impact. Bibliometrics have enabled the creation of a quasi-economy of science in which all outputs are assigned shadow values. These metrics then regulate the value of individuals, academic units, institutions, countries.

**[Bibliometrics in global rankings stratify worldwide higher education]**

This machinery has acquired its own momentum. Yet it still rests on decisions about inclusion and legitimacy made by faculty leaders and peer reviewers in the disciplines.

A crucial part of the machinery is global university rankings. The main component of the rankings is bibliometric data. Research metrics directly determine most of the Shanghai and Times Higher ranking and the prestige effects of research metrics indirectly determine the surveys used by Times Higher and QS. Rankings turn bibliometrics into the recognised hierarchy of universities, in which the Anglophone universities are dominant, and privileged social groups reproduce their inherited place in the world. Here we have moved a long way from the shared joys of grass-roots scientific collaboration. The collegial decisions of peer reviewers are not only monetarised by publishers, they are used to fix university hierarchies.

**[Hegemony: what constitutes global science]**

This what global science has become. It remains a system of open collaborative knowledge creation. It is also annexed to institutional and geo-political power. It is reproduced in circular fashion by the combination of national science infrastructures, leading universities, leading scientists, publishing companies, bibliometric companies, and university rankings. It is neo-imperial. It reproduces a global cultural hierarchy, inherited from the colonial era, which nurtures notions that some cultures, some languages, countries, people, are more highly valued, more creative and scientific, more objective, than others. There is universal science. The rest is just local. What falls outside the charmed circle? Everything else.

**[Exclusion: *not* global science]**

Which knowledge is not part of global science? (I am not here talking about fake data, fake news, raw ideology and propaganda, I am talking about truth-oriented material). There is the large body of research-based ‘grey literature’ in government and commerce. Research for local or national use, including most of the social sciences and humanities. And nearly all knowledge in languages other than English, including all indigenous knowledge. English is only the third largest first language after Chinese and Spanish. It is the first or second language of less than a fifth of people. Yet 97 per cent of the contents of global bibliometrics are in English. It is telling, isn’t it, that the divide between knowledge that is inside global science, and outside global science, is the old colonial divide between the dominant powers and the rest. The languages of the colonised are all excluded. Yet Anglophone and Western countries do not monopolise all wisdom. For example, Western capitalist economies are destroying the earth. There’s a lot at stake in this question of broadening the charmed circle.

[**4. Signs of change]**

Fortunately, everything changes and no system of power is fixed in stone. In the last thirty years science and knowledge have changed remarkably. In this lies the possibility of a more inclusive and diverse science conversation. There is also the possibility that science will close down, becoming more closely annexed to national interests, fracturing the global system.

**[Pushback in Latin America]**

The paradox of global science is this. Open networking has fostered all round capacity development, but global hegemony, and the associated social, economic and institutional processes, have imposed hierarchy and closure on the network. Gatekeeping has not stopped scientific development but it has imposed a hierarchy of value, and forced new science players to conform to the content requirements of the leading players. These content requirements reproduce patterns of dominance. Nevertheless, across the world there is significant pushback against the Anglophone control of science. We see this in Latin America and Africa, and in the Chinese emphasis on higher education and research with ‘Chinese characteristics’. Latin American scholars who focus on epistemic injustice point out that when science is defined as work in English, Latin America seems impoverished. But that is totally incorrect. When work in Spanish and Portuguese is included the picture is different.

**[In the last two decades science capacity has developed rapidly in middle income and some lower income countries]**

I think that in the long run all-round capacity development must foster a more inclusive and more diverse world of knowledge. Science output in China now exceeds the US. India has passed Germany, UK and Japan to become third largest producer of papers. Brazil, Iran, Turkey, South Korea, all outside the West, have large-scale science infrastructure and output.

**[Established and slow growing science systems in the period 2000-2020]**

Let me show you two charts that make the point, two contrasting groups of national science systems. The charts indicate national science output (the size of the ball), the rate of annual growth in papers between 2000 and 2020, the vertical axis, and national income per head which is the horizontal axis. The dotted line is world average income per head. The first chart shows science systems that after 2000 grew *more slowly* than the world average rate of 5.15 per cent per annum. These systems were already established at the beginning of the period. They are mainly Western countries with incomes well above the world average.

**[Emerging and fast growing Science systems in the period 2000-2020]**

The second chart is a different story. The systems where science output is increasing *faster* than the word average rate. Mostly new science powers. Some are showing spectacular growth – almost 20 per cent per year in Iran, almost 25 per cent in Indonesia. And look at the diversification in terms of economic indicators. Half of these countries have incomes per head below the world average. Like mass higher education, global science has spread to many middle income countries and some low income countries as well. This is very good.

**[Top universities in STEM research, Leiden ranking]**

There is also pluralisation at the top levels of science. Let’s look at the universities leading high citation research – top 5 per cent papers – in STEM. Two discipline groups, physical sciences and engineering on the left, mathematics and computing on the right. These tables are absolutely dominated by China. The two Singapore universities also figure. The tables represent a dramatic change. Five years ago, 11 of the top universities in physical sciences and engineering were from the US and one from China. Now ten are from China and two from the US. It is not that American science has declined, it is just that Chinese science, fed by state investment, has developed quickly and moved past the US. China is even more dominant in maths. These numbers have put the fear of God into the Trump and Biden administrations. It seems that it was fine for China’s science to develop when it was expected China would become Westernised and stay weaker than the US. It is another matter now that China has remained independent and gone past the US in key areas. The US has now moved to decouple US/China research collaboration. China’s rise has partly rested on collaboration with US and research but I don’t think weakening US-China ties is now going to ‘contain’ the rise of China. China’s science capacity is now well established.

**[Top universities in other science fields]**

Just to keep matters in perspective, it is a different story in other science fields. In biomedicine and health Anglophone universities are still dominant. UfT is number two after Harvard. The first non-Anglophone university is Copenhagen at 22 and the highest Chinese university Shanghai Jiao Tong at 66. Earth and life sciences are more geographically plural.

**[Growing impact of geo-politics]**

In the last five years governments have become more nation-bound and competitive about science. This can discourage collaborative projects and joint authorship, reduce university autonomy, and overbear academic freedom. For the first time since the Internet began, geo-politics are cutting into the global system. Truth is the first casualty in war whether a hot war as in Ukraine, which has generated an extraordinary level of Russian government-instigated disinformation, or a cold war as with the US and China.

The US China Initiative is associated with racial profiling of Chinese heritage American citizens, investigations shading into persecutions, discouragement of joint appointments and projects, visa blockages affecting Chinese students. Jenny Lee shows that a large minority of American scientists are reluctant to work with Chinese scientists. Sino-American tensions have spilled over into securitisation of research policy in UK, Australia and Western Europe. You know the situation in Canada. Meanwhile Brexit has taken the UK out of the EU and the UK is yet to negotiate re-entry to the brilliant Horizon research programme. These geo-political developments are a threat to the open global science system on which all depend.

[**5. Where to from here?]**

So, where to in university science from here?

**[Global science: upsides and downsides]**

Global science has great potential but has both upsides and downsides. Scientific knowledge is collective, collaborative and accumulative, a common good that crosses over the separated self-interests of individuals, institutions, companies and nations. At best it looks beyond a nation-bound perspective and thinks at the level of the world as a whole. Global science has been open and has facilitated the emergence of diverse national nodes and scientific voices. Science can talk truth to power; cutting across all the rubbish in the political space and social media, the fake news and manipulative populism. The reflexivity of science, the mode of judging science, is the test of truth. This is tremendously valuable to us.

But global science is culturally fixed, almost exclusively Western, neo-colonial in form and in the assumptions and relations and worldviews that it fosters. It is steeply hierarchical inside the global system and it excludes the vast majority of human knowledge, including almost everything in languages other than English. All indigenous knowledge. Think of the knowledge of land, nature and ecology. We lose so much by excluding this diversity.

**[Autonomous global science HAS been hegemonic and exclusive – now geo-politics threatens to lock it into national silos defend the autonomy of science, while opening it not closing it]**

Autonomous global science has been hegemonic and exclusive. Autonomous scientists have been the excluders, though aided and abetted by the publishing and bibliometric world. Now geo-politics threatens to subtract the autonomy of science, lock it into national silos, weaken or fragment the global system. So where do we go from here? We defend the autonomy of global science as best we can – from technological nationalism and from commercial publishers. We push for the further opening of science, not closure. We maintain open cooperation between scientists all over the world. No cold war in science.

**[Yes, “listen to the science” But whose and which science?]**

The ways forward to more democratic relations of power in science are genuine open access publishing, and a global conversation based on multiple languages. Using the emerging software to translate knowledge in languages other than English into English, and knowledge in English into other languages. That would change things. ‘Listen to the science, yes’. But what science? In face of global problems, global knowledge and cooperation are all we have. That makes it all the more important to bring all of the voices, all the different ways of seeing, all the insights, all the ideas, into the common conversation.