

Digital Research Reports

Japanese Collaboration in the Global Research Landscape

An analysis of international collaboration patterns in Japan

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Introduction

Japan has a long history of education, research and innovation. The establishment of the University of Tokyo in the Meiji period in 1877 was the beginning of Japan's modern-day engagement with research. The archetype for the Imperial Universities that would start to be created 20 years later, the University of Tokyo, had its roots in the Astronomy Agency which dated back to 1684.

Today, Japan has a rich and diverse academic environment with more than 3400 research organisations and companies (<http://grid.ac>) that contribute to a research environment that has produced more than 1.8m publications since the turn of millennium. Of this wide classification of institutions that have recently contributed to research in Japan, around 1345 identify as universities (either public or private). Many of these institutions found their footing in the 1970s and 1980s when Japan invested heavily in its research base, quickly establishing it as one of the world's principle research economies. Indeed, in the early 1990s more Japanese were involved in the research enterprise than the major European research economies (UK, France and Germany) combined. This focus on research translated to enviable scientific and engineering with more than 40% of global patents being logged by Japan for several years in the mid-1980s.

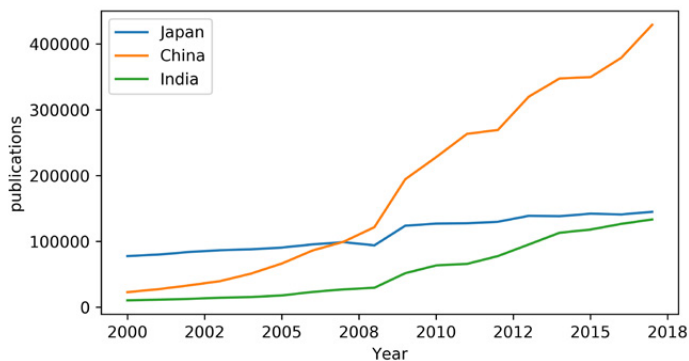
Since the financial crisis in 2008, Japan has had to be more measured in its investment into research and hence the Japanese research economy has slowed but remains one of the largest and most productive in the world. Many countries have felt the economic effects of the downturn and some have used this as a reason to invest in the research economy as it is recognised that research economies can be significant engines to speed and aid recovery. Other countries have been more restrained in their investment in research yet have found routes to significantly improve their reach through collaboration. Despite Japan's clear interest and prowess in research, it remains, perhaps due to cultural heritage magnified by geographical location, one of the more isolated research economies.

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Quality Over Quantity?

Research output from Japan has grown solidly over the last 10 years (Figure 1). But, with the rise of China and other developing research economies such as India, much like the rise of Japan itself in the 1980s, the percentage of world output contributed by Japan has decreased.

Growth in Number of Publications (from Dimensions)
per Year for Japan, China and India since 2009



Percentage of Global Output from Japan Since 2000

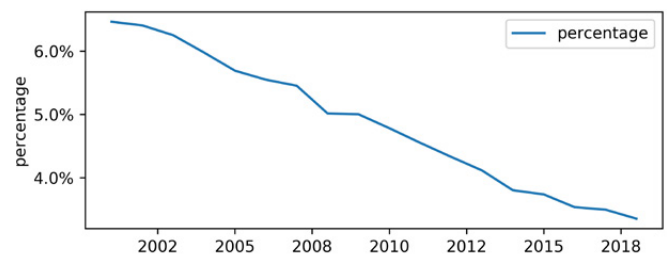


Figure 1: (Left Pane) Growth in number of publications (from Dimensions) per year for Japan, China and India since 2009. (Right Pane) Percentage of global output from Japan since 2000.

Even though Japan's overall contribution in volume has declined in percentage terms, their contribution to the best research, as defined by the journals included in the Nature Index, remains more stable (Figure 2). This is surely the mark of a more developed research economy that has had sustained investment over the long-term.

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Japanese Research as a Percentage of Global Research

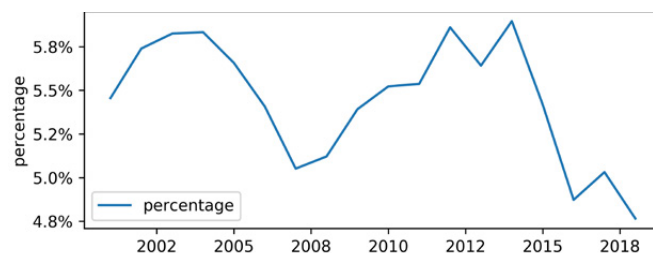


Figure 2: Japanese research as a percentage of global research in the Nature Index journals.

Risks and Opportunities

With continued development of the BRICS economies and the rise of Africa, it is clear that the more established research landscapes such as the US, UK, France, Germany and Japan will contribute less to the global research enterprise in their own right going forward. However, over the last 10 years we have seen significant movement by some of these countries towards a more collaborative research agenda. Engaging with the younger research economies brings fresh ideas, new perspectives and different ways of thinking. This is not only necessary but healthy for the research environment. Of course, the drivers behind greater collaboration are not purely academically motivated – due to the increasing prevalence of technology and very different cost profiles to do research in emerging economies, cross-border collaboration is becoming a highly efficient way to increase output for all participants and for younger economies is a good way to develop faster, gain experience, publish in higher quality venues and attract international researchers.

In this respect, Japan's large and diverse set of research organisations is not necessarily being used as an advantage. While most of the developed research economies have seen a transition from most of their publication output being domestic (only institutions within the country participating on the paper) to international (at least one institutional affiliation on the paper associated outside the country), Japan has not moved as quickly. The Australian, British, Canadian, Dutch, French, German and New Zealand output all crossed from domestic-dominated to international-dominated between 2010 and 2015. Italy and Spain will clearly join this group in the next 3-5 years. In the fast-growing research economies, such as Brazil, India and China, we see domestic publication rates outpacing and diverging from international collaboration. This makes sense due to the level of internal investment and the ability of any research economy to be sufficiently porous to research collaborations. Only the US and Japan amongst the world economies continue to see sustained dominance of domestic publication (Figure 3).

“Engaging with the younger research economies brings fresh ideas, new perspectives and different ways of thinking”

Domestic vs International Publication Levels from Dimensions

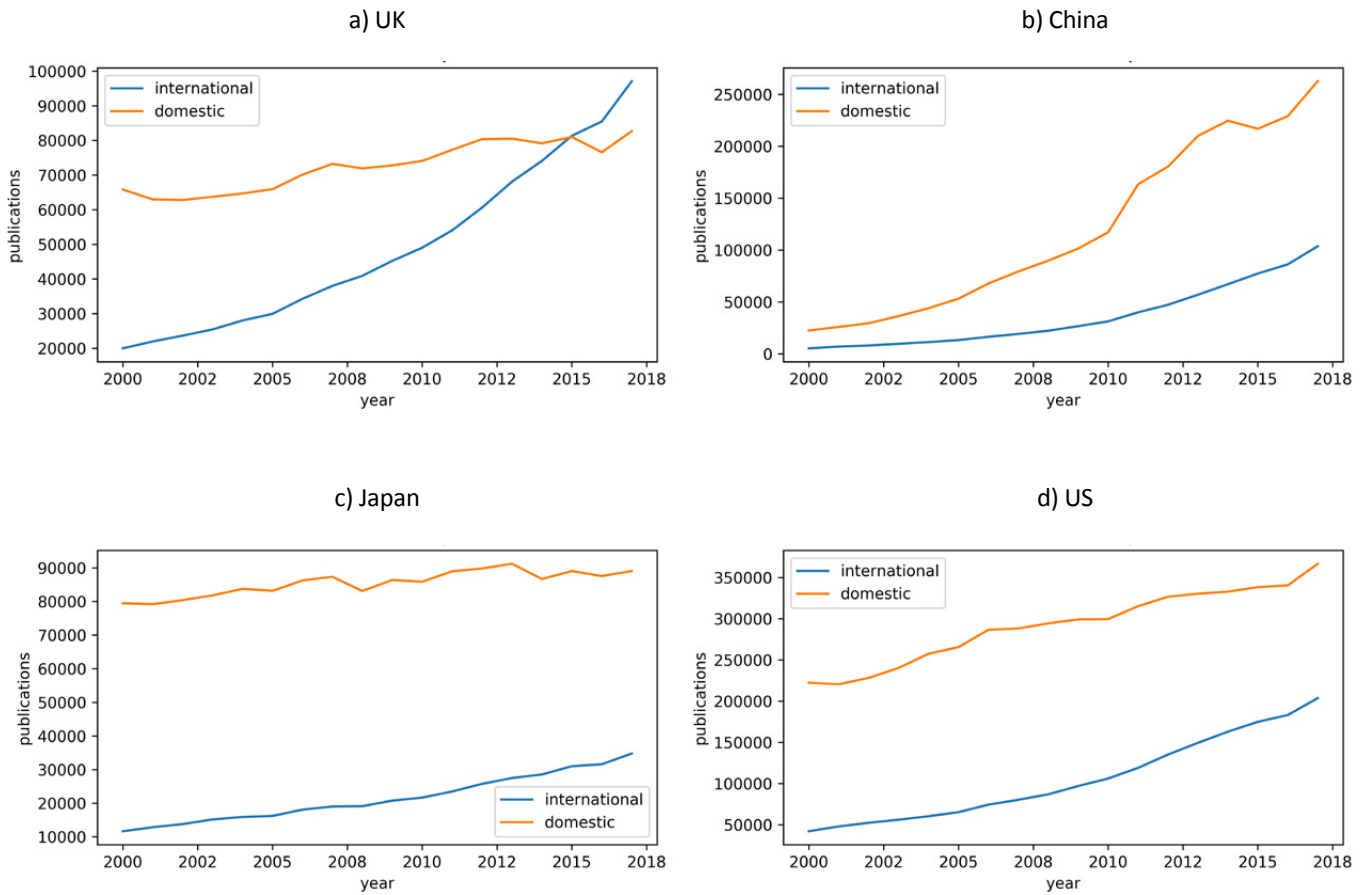
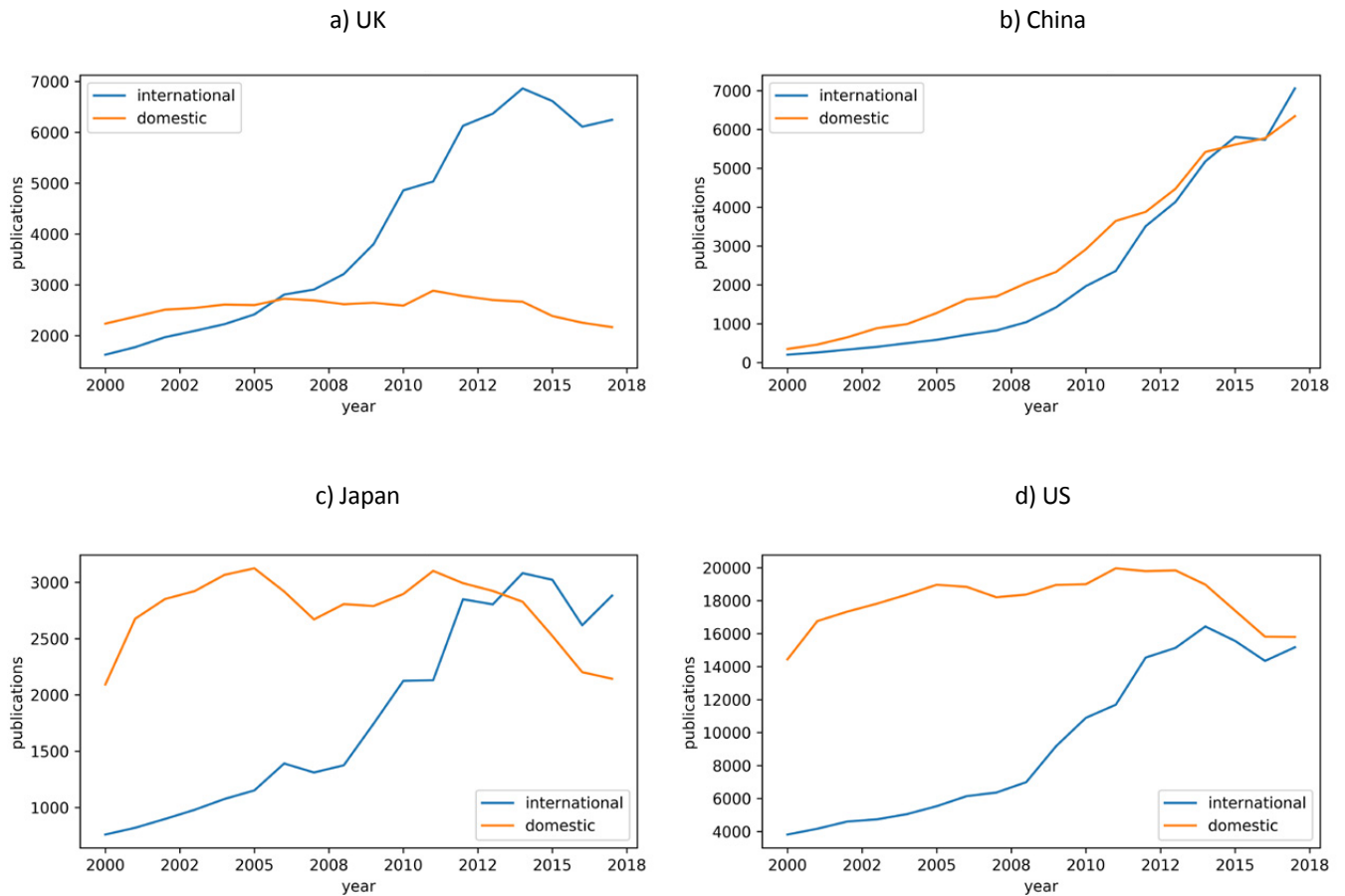


Figure 3: Domestic versus international publication levels for all publications (from Dimensions.ai) for: a) UK; b) China, c) Japan; d) US.

As noted in our previous report on Australasian Research <https://doi.org/10.6084/m9.figshare.7094381>, we tend to see rates of international collaboration in the Nature Index journals cross in advance of the trend for all research output for the country. It is not clear in which direction the causal relationship runs: Highly internationally collaborative researchers are able to access higher impact journals; or, high-profile researchers with the ability to access high-impact journals attract international collaborators. In either case, Nature Index can serve as a crystal ball at both a national and institutional level to understand the speed and direction of international collaboration. As can be seen in Figure 4, Japan has already seen a marked and significant cross-over in the level of its highest impact publications.

Domestic vs International Publication Levels in Nature Index Journals

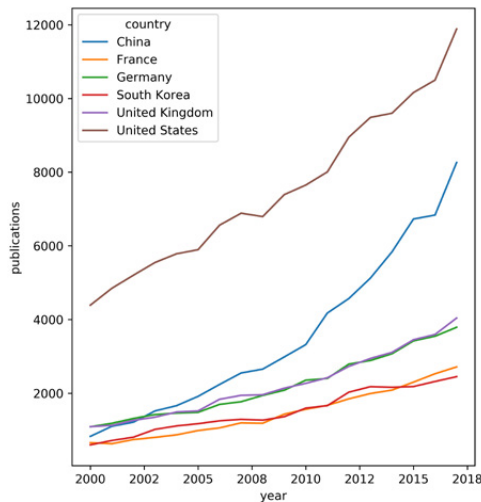


Overall, the structure of the diversity of Japan's international mix remains strong (Figure 4) both at the level of all its output and its output in the Nature Index journals. It is interesting to note that in both cases, collaboration with China is on the rise for Japan, but that South Korea is a more emergent research partnership that may become a core feature of the Japanese research landscape in years to come, as can be seen from its appearance in the left pane of Figure 5.

Figure 4: Domestic versus international publications in the Nature Index journals for: a) UK; b) China; c) Japan; d) US.

“Collaboration with China is on the rise for Japan, but South Korea is a more emergent research partnership that may become a core feature of the Japanese research landscape in years to come”

Collaboration by Country using Dimensions



Collaboration by Country using the Nature Index

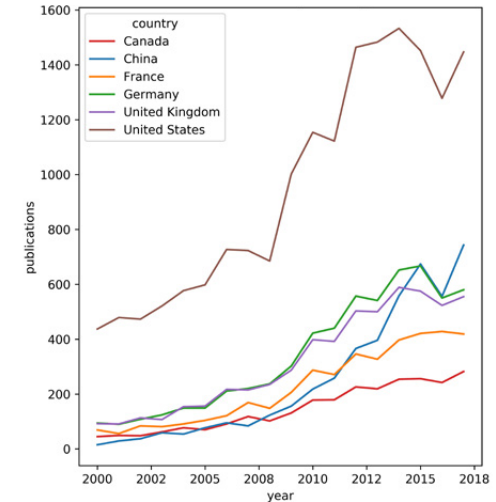


Figure 5: Collaboration by Country. (Left pane) Using Dimensions.ai global set of data; (Right pane) using the Nature Index list of journals.

If we extract the strongest research relationships that Japan has fostered over the last decade and examine how strongly Japan's research collaborators work with each other, an interesting plot emerges (Figure 6). Note that while Japan is one of the most significant producers of papers (only US, Germany, UK and China are larger producers) Japan is more tenuously related to the network than not only the more productive research producers but also than several of the less productive countries. As China increases its research output further and becomes an even more desirable research partner then without programs and initiatives to support internationalised approaches to research, Japan may suffer as network effects are difficult to develop and can have long-term positive benefits to both research production and collaboration.

Japan's Research Network for Nature Index Journals

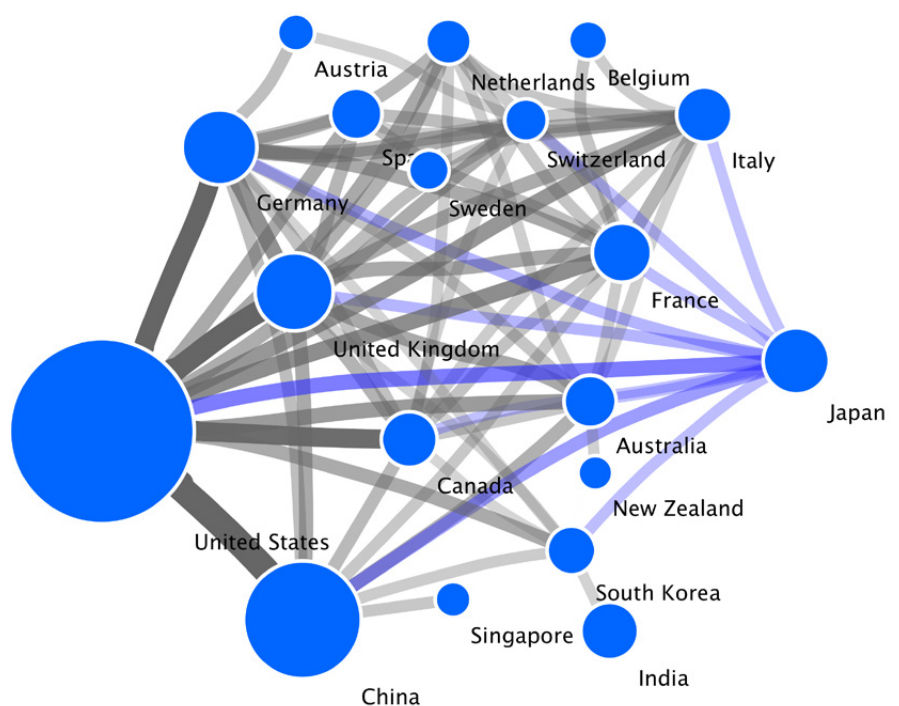


Figure 6: Japan's research network for Nature Index journals. Size of node is proportional to number of papers produced between 2009 and present day. The width of edges represent summed co-authorships on papers over the period. There is no information contained in the layout or distances between two nodes. The top ten research relationships for each of Japan's top ten collaborating countries are represented here. **Blue edges are direct relationships with Japan while, grey edges represent relationships between Japan's nearest collaborators.**

Of course, only looking at the picture of collaboration at a conglomerated national level gives limited insight. Examining at an institutional level we can gain a clearer picture of the trend in Japan. Table 1 shows the progression in proportion of international research published by the top 12 internationally collaborative (by volume) academic institutions in Japan between 2009 and 2017 in journals listed in Dimensions.

It's easy to see that Japanese institutions are becoming more collaborative and at a good rate. However, the international landscape is moving quickly. The increase in Japanese research volume for these institutions between 2009 and 2017 runs at 1.7% per year, a total of 17% increase, while their increase in internationally collaborative papers runs at 6% per year, a total of 69.3% increase. This significant increase for Japan should be seen in the context of a modest increase in overall production compared to the average in the developed academic economies.

“Japanese institutions are becoming more collaborative and at a good rate. However, the international landscape is moving quickly”

| Institution | Proportion of Publications with an International Author | |
|--|---|-------|
| | 2009 | 2017 |
| University of Tokyo | 21.1% | 28.5% |
| Kyoto University | 19.8% | 28.9% |
| Tohoku University | 19.0% | 28.1% |
| Osaka University | 17.0% | 25.4% |
| Nagoya University | 19.0% | 24.4% |
| Hokkaido University | 17.7% | 28.5% |
| Kyushu University | 16.0% | 28.1% |
| Tokyo Institute of Technology | 19.5% | 29.7% |
| National Institute of Advanced Industrial Science and Technology | 16.7% | 23.6% |
| Keio University | 16.6% | 18.9% |
| University of Tsukuba | 16.4% | 27.0% |
| Hiroshima University | 18.3% | 24.6% |

Table 1: Progression in proportion of academic collaboration between 2009 and 2017 for top internationally collaborative Japanese institutions by volume in Dimensions-tracked journals.

Closing Thoughts

“The indicators show a positive future for Japan if the leadership of top researchers can cascade down to the broader research population and make Japan much more outward bound in its research collaboration landscape”

It is clear that Japan remains one of the world’s great research ecosystems yet it has been held back by the effects of the financial crisis and its geographical location in recent years. Japan moved quickly to establish itself in the 1980s as a global leader in research and the legacy of that investment continues to pay dividends. Japan’s unique and varied multitude of universities and research organisations make the internal “market” for collaboration rich and interesting for researchers based in Japan. However, to profit from the global evolution in collaboration, Japanese researchers need to look beyond their shores. The best researchers in Japan are already doing this, and with significant success, and the best research organisations are turning more to international partnership.

Japan finds itself in a difficult position regarding ongoing funding for research in turbulent financial times but is starting to be much more active on the world stage. The indicators show a positive future for Japan if the leadership of top researchers can cascade down to the broader research population and make Japan much more outward bound in its research collaboration landscape. If this is supported by funders with innovative approaches to funding and incentivising Japan’s increased engagement and visibility on the world research stage then Japan looks forward to a prosperous and important place in the global knowledge economy.

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