

International Education East Asia

Assessing East Asia's Research Landscape

October 2021

Key takeaways

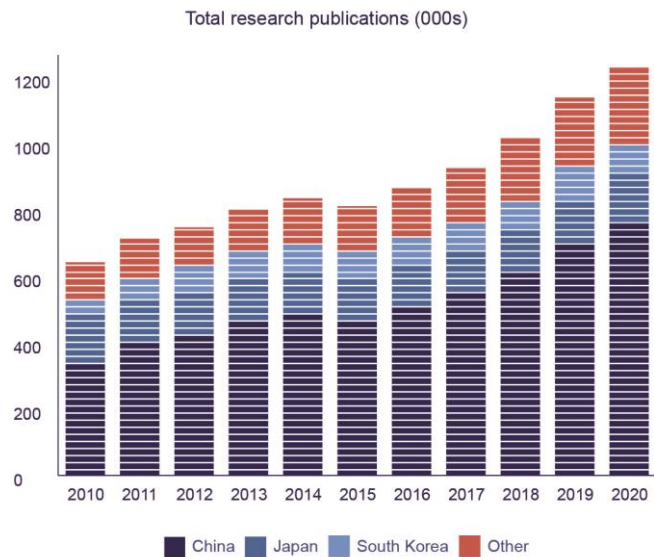
- East Asia covers a diverse research landscape, comprising both mature and developing markets—ranging from very large to very small in size—with wide variations in their levels of international cooperation.
- East Asia is also an exceedingly important research market, accounting for more than a third of all global research output and more than half of all growth worldwide in research capacity over the last five years.
- Every market in East Asia saw research output increase in 2020, despite the difficulties posed by Covid-19.
- **China** continues to publish more than 60 per cent of all research in East Asia, but four ASEAN markets have seen their number of research publications grow at an even faster clip since 2015.
- **Indonesia** and **Vietnam** in particular have increased research output sixfold and fourfold respectively since 2015.
- STEM subjects dominate the research landscape in East Asia, led by Engineering, Medicine, Materials Science, Computer Science and Physics & Astronomy
- Medicine and Computer Science are also among the fastest growing major subject areas, along with Environmental Science, Energy and Social Sciences.
- International collaboration levels vary widely across East Asia, with markets such as **Hong Kong, Singapore** and **Vietnam** producing two-thirds of their research with international co-authors, while **Indonesia, China, South Korea** and **Japan** produce 30 per cent or less of their research with international partners.
- The UK remains one of the top five international partners in 11 out of the 12 markets in East Asia, led by **Malaysia** where it ranks first.
- As a percentage of all internationally co-authored publications, **China** and **Singapore** collaborate most frequently with UK partners.
- The top five markets that most exceed “expected” levels of research collaboration with the UK are all ASEAN countries, led by **Singapore, Thailand** and the **Philippines**.
- On the other hand, UK collaboration with **Vietnam** is relatively weak, ranking 8th among all of Vietnam’s international partners.
- For UK institutions looking to collaborate more in East Asia, the 12 different markets offer distinct trade-offs based on size, growth, saturation, quality, internationalisation and existing cooperation with the UK.
- No country in East Asia offers everything, but every country offers something.

Research output continues to grow across East Asia

When viewed holistically, East Asia is both a global research behemoth and the engine of growth in scholarly output for the entire world. The region accounts for more than a third of all research publications¹ across the globe—up from a quarter only a few years ago. Over the last decade, more than 54 per cent of all growth in new scholarly publications came from East Asia too. While China gets most of the attention—accounting for 60 per cent of all research output from East Asia—smaller ASEAN countries are rapidly expanding their research capabilities as well. Four different markets in Southeast Asia saw growth in research output outpace China over the last five years (2015-20), led by Indonesia and Vietnam, where the number of scholarly publications has increased sixfold and fourfold respectively since 2015.

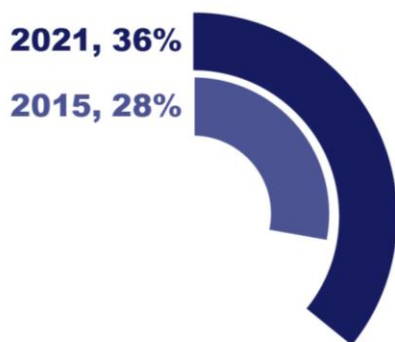
What’s more, research output continues to grow across all of East Asia², even in mature markets such as Hong Kong, Japan, Singapore, South Korea and Taiwan, which saw their number of research publications expand over the last five years. Even a global pandemic could not disrupt this positive momentum—all 12 markets in East Asia published more research in 2020 than 2019—despite the considerable dislocations Covid-19 caused to traditional research and collaboration methods.

RESEARCH OUTPUT ACROSS EAST ASIA MARKETS OVER TIME



East Asia’s growing research clout is reflected in its share of total global publications, which expanded from 27.7% in 2015 to 34.8% in 2020. So far in 2021, East Asia’s slice of the pie has expanded even further, with 36% of all global scholarly activity emanating from the region through the first three-quarters of the year³.

EAST ASIA’S SHARE OF GLOBAL RESEARCH OUTPUT



More remarkable still is that the quality of research output from East Asia has not suffered even as the rate of production has increased. In fact, the average “field-weighted

¹ Based on Elsevier dataset via SciVal portal.

² East Asia region contains 12 markets: China, Hong Kong, Indonesia, Japan, Malaysia, Myanmar, Philippines, Singapore, South Korea, Taiwan, Thailand and Vietnam.

³ Through September 2021.

citation impact”—a measure of the quality of research—of all publications improved in seven out of 12 markets in East Asia from 2016 to 2020. Only three countries in the region—Indonesia, the Philippines and especially Myanmar—saw the quality of their overall research output decline markedly over this period. Coincidentally, those three countries are also three of the four fastest growing research markets in the region. On the bright side, however, Vietnam managed to buck this trend, quadrupling its research output from 2015 to 2020 while improving the overall field-weight citation impact of its publications.

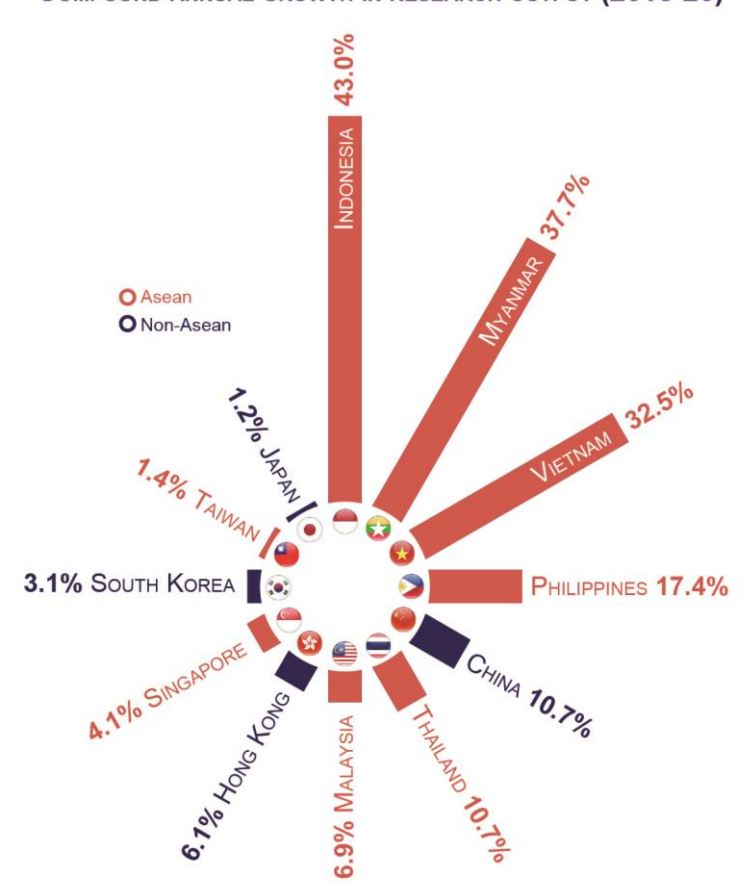
ASEAN markets are closing the research output gap

While China produces more than 60 per cent of all research in East Asia, followed by the developed economies of Japan and South Korea, ASEAN countries make up six of the seven fastest growing research markets in the region, led by Indonesia, Myanmar (prior to the coup), Vietnam, and the Philippines. In some ways this is to be expected, as ASEAN is also home to the five markets in East Asia with the lowest number of research publications per capita, indicating that these markets have the most ground to make up with other countries in the region. Preliminary data also suggests that these high-growth ASEAN markets may have lost some momentum in 2021, with this year’s share of research output so far lagging further behind last year’s production than any other countries in East Asia.

A closer examination of each one of these high-growth markets from 2015-2020 reveals the factors that may be driving growth but also the challenges that are holding them back.

Indonesia stands out as both the fourth largest research market in East Asia and its fastest growing, although this is partly explained by its large population and its relatively weak research footprint previously. On a per-capita basis, Indonesia’s research output trails nine other markets in East Asia, and its recent breakneck growth has not come without a cost; as might be expected of a country expanding its research capacity as rapidly as Indonesia, the overall quality of its output ranked last in East Asia in 2020 based on the average field-weighted citation of its publications. Indonesia also cooperates less frequently with

COMPOUND ANNUAL GROWTH IN RESEARCH OUTPUT (2015-20) **INDONESIA 43.0%**



international partners on its research than any country in the region; when it does, the UK ranks fifth among its most frequent partners.

Vietnam resembles Indonesia in some ways, as a populous country that is playing catchup in terms of its overall research. Its number of publications grew 3rd fastest in East Asia over the last five years (2015-20) but the country still ranks ninth on a per-capita research output basis. At the same time, Vietnam also differs from Indonesia in two key respects. First, its research output is of higher quality, ranking third overall in 2020 in terms of field-weighted citations—ahead of China and Taiwan. Second, Vietnam cooperates more than three times as often with international partners than Indonesia on a per-publication basis. However, despite Vietnam's high rate of international cooperation, the UK has been losing out to other countries, ranking 8th among Vietnam's most frequent international partners, trailing countries like France and India. Notably, the UK ranks no lower than 5th with any other country in East Asia. This suggests the UK has some ways to go in order to close the research gap with Vietnam.

In Myanmar, total research output grew nearly five times from 2015 to 2020, but it still ranked last among all countries in the region on a per-capita basis. The quality of these publications was also quite low, ranking 11th in the region (ahead of only Indonesia). What's more, Myanmar is very reliant on international partners to produce its research. More than three-quarters of all of Myanmar's research output in 2020 was published with international co-authors, suggesting that a large share of this research was both funded with international assistance and likely relied heavily on the capabilities of its international partners. Lastly, the military coup that took place in February 2021 seems to have had a negative impact on Myanmar's research environment, which could persist for years to come. So far in 2021, Myanmar's research output as a share of its total publications in 2020 has trailed every country in the region besides Indonesia.

Lastly, while the Philippines recorded impressive growth in research output over the last five years—more than doubling its scholarly publications from 2015 to 2020—it still has a long way to go. In fact, despite the recent surge in output, the Philippines still ranks ninth or below among the 12 markets in East Asia in terms of total publications, per-capita publications, the average quality of its publications, and the UK's share of its internationally co-authored publications. In other words, while the direction of travel is positive, and the country remains relatively open to international collaboration, the Philippines will need to record many more years of significant growth in research output in order to close the gap with its regional peers.

STEM subjects dominate East Asia's research landscape

STEM subjects make up the vast majority of research output from East Asia, accounting for 14 of the top 15 subject areas by total publication across the region in 2020. A few STEM subjects in particular account for the bulk of all research output, with more than half of all publications last year related to one of only five subjects: Engineering, Medicine, Materials Science, Computer Science and Physics & Astronomy.

Medicine and Computer Science are also among the fastest growing subject areas in East Asia since 2015, along with Environmental Science, Energy, Social Science and Earth & Planetary Science. This suggests a shift in research priorities in East Asia away from traditional engineering subjects to those focused more on technology and climate-related issues. The combination of rapidly aging societies, rising incomes and the global pandemic have also increased demand for medical research, which is one of the top subjects for UK collaboration with countries in East Asia.



In fact, over the last five years, two-thirds of markets in East Asia have collaborated most frequently with the UK on Medicine-related subjects, followed by Engineering and Physics & Astronomy. Among ASEAN countries, the demand for collaboration with the UK on medical research appears to be even stronger, leading the way in six out of seven countries and making up more than 21% of all UK collaboration with Myanmar, the Philippines, Thailand and Singapore.

Leading subjects for East Asia collaboration with UK partners (2016-21⁴)

Market	Subject	Total publications	% of all collaboration with UK
China	Engineering	31,093	17.0%
Hong Kong	Medicine	3,270	18.6%
Indonesia	Medicine	858	13.6%
Japan	Medicine	7,868	16.8%
Malaysia	Engineering	2,589	12.9%
Myanmar	Medicine	182	32.9%
Philippines	Medicine	726	27.1%
Singapore	Medicine	4,835	21.6%
South Korea	Physics/Astronomy	3,584	15.8%
Taiwan	Physics/Astronomy	2,484	19.0%

⁴ Through September 2021, source: SciVal
www.britishcouncil.org

Thailand	Medicine	2,829	24.5%
Vietnam	Medicine	1,037	18.2%

International collaboration varies widely across East Asia

The rate of international collaboration varies widely across East Asia, with few discernible patterns to explain the wide range of outcomes. On the upper end, markets as diverse as Myanmar, Hong Kong, Singapore and Vietnam produce more than 60 per cent of their scholarly output with international co-authors. On the other extreme, the four largest research producers in the region—Indonesia, China, South Korea and Japan—publish 30 per cent or less of their research with international partners.

It is not obvious what factors—or combination of factors—drive greater levels of international cooperation in some countries in the region over others. Language may be a hindrance to communication with partners in some markets, such as Indonesia, Japan or South Korea. Yet in other East Asian countries where English capability is far greater, such as Malaysia and the Philippines, international collaboration rates are equivalent to those in Thailand and lag well behind Vietnam.

A country's overall size reveals very little. While the two most populous countries in the region, China and Indonesia, cooperate infrequently with international partners on a per-publication basis, other regional countries with sizeable populations such as the Philippines and Vietnam partner two or three times as often with international co-authors. The smallest markets in terms of population—Hong Kong and Singapore—likely have no choice but to cooperate frequently with researchers from outside of their respective territories. Yet relatively small and isolated Taiwan produces a relatively small share of its research with international partners.

Development levels also give conflicting signals. The two richest markets on a per-capita basis, Hong Kong and Singapore, publish roughly two-thirds of their research with international partners, but so do Myanmar and Vietnam, two of the poorest countries in the region. On the other end of the spectrum, the two OECD countries in East Asia—Japan and South Korea—cooperate relatively sparingly with international co-authors, while Indonesia has average income levels roughly one-tenth the size of those countries yet produces an even greater share of research domestically.

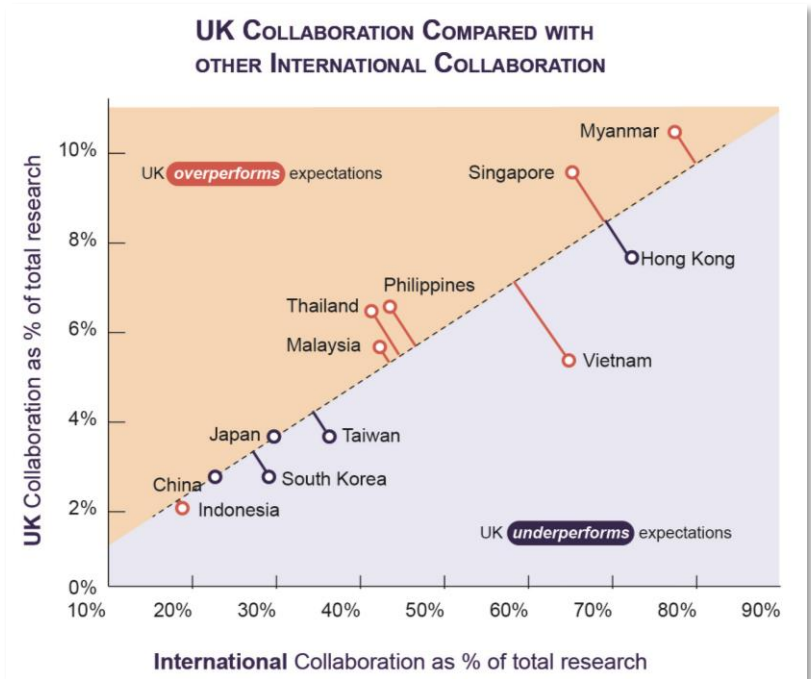
Overall research volume appears to explain part of the discrepancy. Countries with the largest research base such as China and Japan may have more capacity to produce research by relying only on domestic resources, while smaller or less sufficient markets may need to rely more on foreign partners to produce research. Yet the overall correlation remains weak, suggesting that a combination of the above factors—and perhaps others—may better explain variations in appetite for international collaboration. This could have important ramifications as the UK assesses its relative performance in collaborating with markets in East Asia to date, and especially as it seeks to boost its performance.

UK collaboration stronger with some East Asia markets

In the aggregate, the UK collaborates most often in East Asia with the countries that produce the most research. This is to be expected. Since 2016, fully 70 per cent of all UK research collaboration in East Asia has been produced with three countries—China, Japan and South Korea—which also happen to be the three largest producers of research in the region. China alone accounted for nearly half of all UK collaboration. In contrast, seven ASEAN countries combined to make up only 20 per cent of UK research collaboration over this period.

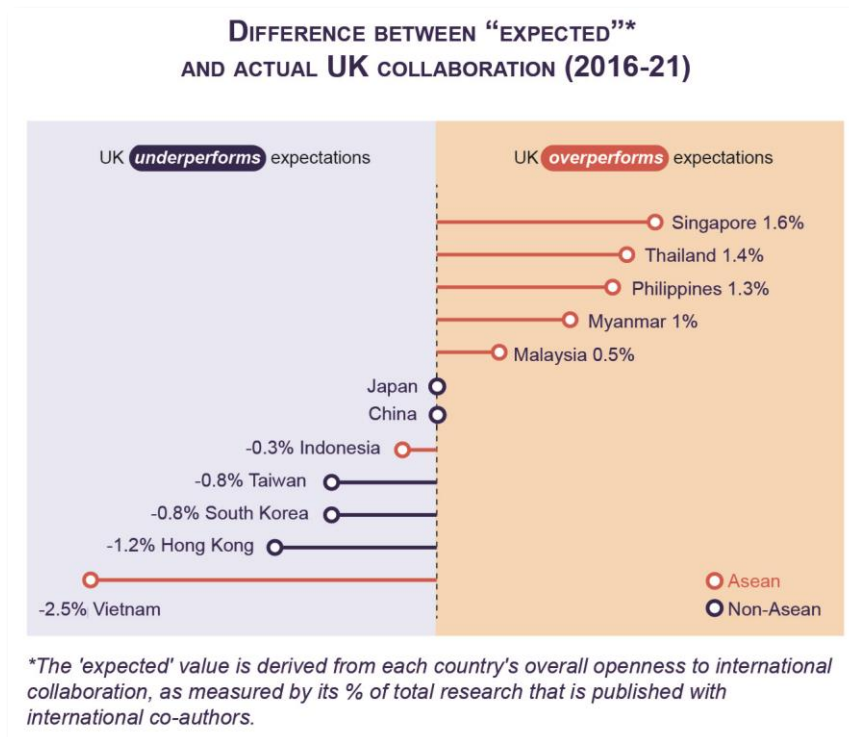
However, as a proportion of their total research output, ASEAN countries collaborate far more frequently with the UK, with Indonesia as the notable exception.

Indeed, more than five per cent of all research produced by six ASEAN countries since 2016 has had a UK co-author. Outside of ASEAN, only Hong Kong cooperates with the UK at a similar rate.



Still another way of looking at this is by examining the proportion of all international

collaboration that a country engages in that is conducted with UK partners. Across East Asia, a robust relationship exists between a country's overall willingness to cooperate internationally and the rate at which it collaborates with the UK. Unsurprisingly, the more frequently that a country collaborates internationally, the more often it also cooperates with co-authors in the UK. However, given this underlying relationship, some countries still overperform their "expected" levels of cooperation with the UK, while others underperform.

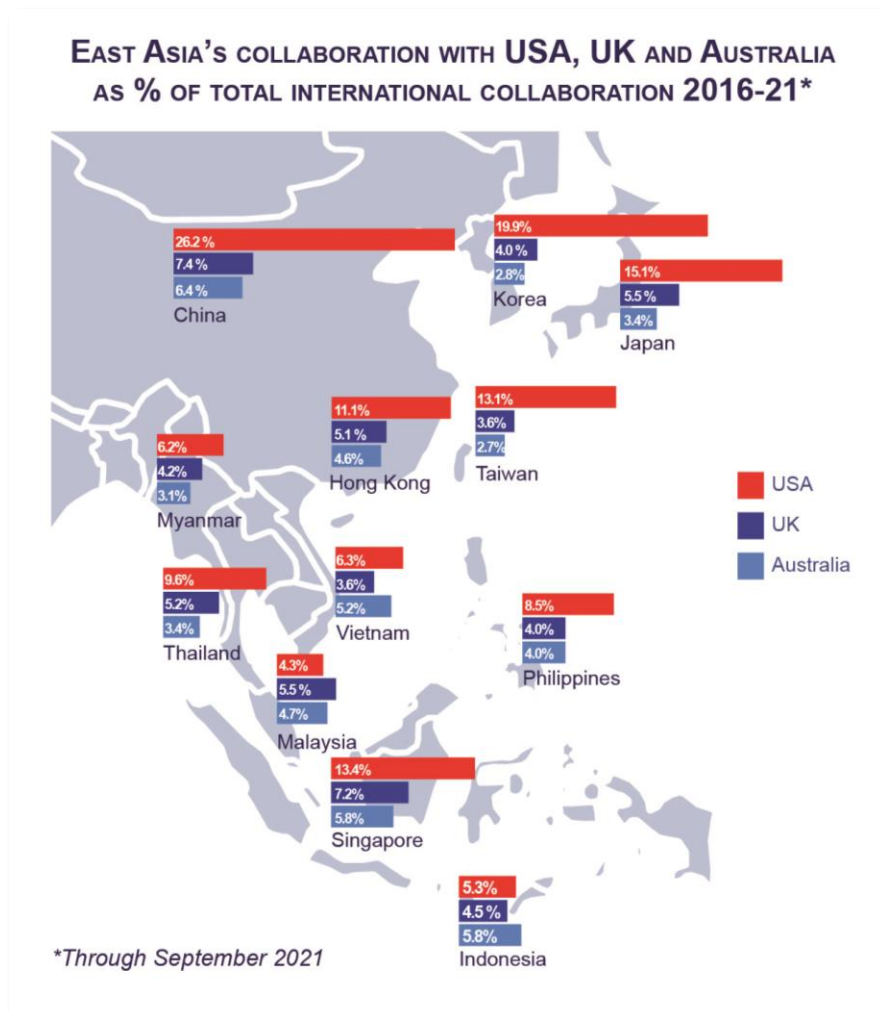


In fact, in five out of the 12 markets in East Asia, the UK punches above its weight, exceeding the “expected” level of joint research based on the country’s overall appetite for international collaboration. All five of these countries happen to be located in the ASEAN region, and three of them are former British colonies—suggesting that the UK’s general perception may be greater in Southeast Asia, particularly in countries with historical ties to the UK. It is worth noting, however, that much of the UK’s research collaboration with poorer countries in the region—notably Myanmar and the Philippines—is likely supported with UK aid funding, which may also explain the UK’s relative overperformance in these markets.

On the flip side, the UK collaborates less frequently with five markets in East Asia than would otherwise be expected based on their overall levels of cooperation with other countries. This is particularly pronounced in the case of Vietnam, which is one of East Asia’s most enthusiastic international collaborators—producing two-thirds of its output with international co-authors—but partners less often with the UK than its overall openness to collaboration would suggest.

This pattern also appears when comparing the UK’s performance against the other major Anglophone research partners in the region, namely the United States and Australia. In general, the UK trails the U.S. in terms of overall collaboration with East Asian countries and outperforms Australia. In eight out of the 12 markets in East Asia, this pattern holds, with the UK ranking second behind the U.S., while it ranks third in three countries in the region and first in Malaysia.

While the UK’s rank is one important gauge of its connectivity with the region, the gap between the UK and the top-ranked collaborating country can also be quite revealing. For example, in the largest and most developed research markets in East Asia – China, Hong Kong, Japan, South Korea and Taiwan – the share of research conducted with the UK is less than half of the comparable U.S. figure. In the ASEAN region, however, the gap between the UK and the U.S. is noticeably smaller and even inverted in the case of Malaysia.



The gap among the Anglophone countries does not tell the whole story though. Wide differences also exist in the willingness of East Asian markets to collaborate with any of the UK, U.S. or Australia. Notably, 40 per cent of all of China's international collaboration from 2016-21 was published with at least one co-author from these three Anglophone markets. That figure though is more than double the rate at which any ASEAN country besides Singapore has collaborated with the UK, U.S. or Australia over the same period. In fact, Myanmar, Malaysia, Vietnam and Indonesia all published less than 16 per cent of their international research with co-authors from the three major Anglophone countries over the last five years. This disparity suggests that ASEAN markets are not so much choosing one Anglophone country over another as they are choosing to collaborate more often with the rest of the world—particularly other countries within the East Asia region.

Where should UK institutions focus their research efforts?

As the UK seeks to benchmark its performance in collaborating on research in East Asia and boost its partnerships with strategic countries, it is important to disaggregate individual countries from the wider region. Indeed, East Asia is in some ways a misnomer, as the region is defined as much by its diversity as by its commonalities. The region includes some of the richest and poorest countries in the world; some of the most mature and most rapidly developing markets; and some of the most internationally connected research ecosystems and some of the most isolated.

For the UK, it can be difficult to allocate finite research resources across such a diverse landscape, and the best approach will inevitably involve trade-offs among competing goals. Just a sample of the most important strategic considerations for the UK will include the following:

- Should the UK focus its energies on the fastest growing research markets or the largest ones?
- Should the UK prioritise markets that produce the highest quality research or the ones which need the most help?
- Should the UK focus its energies on markets that collaborate internationally most frequently or the ones that remain more closed off to the outside world?
- Should the UK invest more resources in places where it already enjoys high market share or focus on improving links where it suffers from low market share?

The answer to these questions will likely vary from institution to institution, but the East Asia region offers something to pique almost any institution's interest. One way of thinking about the trade-offs involved in choosing among the markets in East Asia may be to break them down across seven categories:

Market consideration	KPI	Top performing markets
Size	Total publications	China, Japan, South Korea, Indonesia
Speed	Annual growth rate in publications	Indonesia, Myanmar, Vietnam, Philippines
Saturation	Publications per 1 million people	Singapore, Hong Kong, South Korea, Taiwan
Spend	R&D expenditure as % of GDP	South Korea, Taiwan, Japan, China
Quality	Average field-weighted citations of all publications	Hong Kong, Singapore, Vietnam, Taiwan
Internationalisation	% of total publications with international co-author	Myanmar, Hong Kong, Singapore, Vietnam
UK market share	% of all international collaboration with UK co-author	China, Singapore, Malaysia, Japan

What is perhaps most notable about these considerations is that 11 out of the 12 markets in East Asia feature among the top four performers in at least one of the seven categories above. Meanwhile, the only exception—Thailand—oddly performs no better than fifth across any of these considerations, but no lower than ninth, suggesting that it may actually be one of East Asia’s true goldilocks markets. In other words, despite the vast diversity across the 12 markets in East Asia, there is no country that does not offer one or more compelling reasons to deepen UK cooperation.

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Appendix: East Asia research benchmarks

Country / territory	Research output (2020)	CAGR ⁵ (2015-20)	Output per 1 million (2020)	R&D as % of GDP ⁶	Field-weighted citations (2020)	Top int'l partners (2020)	UK share of all int'l collaboration (2020)
China (rank)	770,944	10.7%	550	2.19%	1.14	USA, UK , Australia, Hong Kong, Canada	7.4%
	#1	#5	#7	#4	#5		#1
Hong Kong (rank)	26,425	6.1%	3,532	0.86%	2.25	China, USA, UK , Australia, Canada	5.1%
	#7	#8	#2	#8	#1		#6
Indonesia (rank)	50,877	43.0%	186	0.23%	0.74	Malaysia, Japan, Australia, USA, UK	4.5%
	#4	#1	#10	#10	#12		#7
Japan (rank)	138,294	1.2%	1,099	3.26%	0.91	USA, China, Germany, UK , France	5.5%
	#2	#12	#6	#3	#10		#4
Malaysia (rank)	39,357	6.9%	1,216	1.44%	1.03	UK , Australia, Indonesia, India, USA	5.5%
	#6	#7	#5	#6	#7		#3
Myanmar (rank)	1,001	37.7%	18	0.03%	0.85	Japan, China, USA, Thailand, UK	4.2%
	#12	#2	#12	#12	#11		#8
Philippines (rank)	6,195	17.4%	57	0.16%	0.95	USA, Japan, China, Australia, UK	4.0%
	#11	#4	#11	#11	#9		#10
Singapore (rank)	25,487	4.1%	4,483	1.94%	2	China, USA, UK , Australia, Germany	7.2%
	#8	#9	#1	#5	#2		#2
South Korea (rank)	95,920	3.1%	1,852	4.81%	1.05	USA, China, Japan, India, UK	4.0%
	#3	#10	#3	#1	#6		#9
Taiwan (rank)	41,778	1.4%	1,773	3.49%	1.16	USA, China, Japan, UK , India	3.6%
	#5	#11	#4	#2	#4		#11
Thailand (rank)	21,967	10.7%	315	1.00%	0.98	USA, Japan, UK , China, Australia	5.2%
	#9	#6	#8	#7	#8		#5
Vietnam (rank)	18,309	32.5%	188	0.53%	1.64	USA, South Korea, Japan, China, Australia	3.6%
	#10	#3	#9	#9	#3		#12

⁵ Compound annual growth rate

⁶ Source: World Bank; note: All data from 2018, except Malaysia (2016), Myanmar (2017), Philippines (2015), Singapore (2017), Taiwan (2019), Thailand (2017) and Vietnam (2017). Taiwan data from OECD.