

Current Status and Enhancement of Collaborative Research in the World: A Case Study of Osaka University

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Abstract

Purpose: The purpose of this research is to provide evidence for decision-makers to realize the potentials of collaborations between countries/regions via the scientometric analysis of co-authoring in academic publications.

Design/methodology/approach: The approach is that Osaka University, which has set a strategy to become a global campus, is positioned to have a leading role to enhance such collaborations. This research measures co-authoring relations between Osaka University and other countries/regions to identify networks for fostering strong research collaborations.

Findings: Five countries are identified as candidates for the future global campuses of Osaka University based on three factors, co-authoring relations, GDP growth, and population growth.

Research limitations: The main limitation of this study is not being able to use the relations by the former positions of authors in Osaka University, because the data retrieved is limited by the query of the organization name at the first step.

Practical implications: The significance of this work is to provide evidence for the university strategy to expand abroad based on the quantity and visualization of trends.

Originality/value: With wider practical implementations, the approach of this research is useful in making a strategic roadmap for scientific organizations that intend to collaborate internationally.

Keywords Co-authoring; University management; Overseas strategy; Global campus; Evidence-based policy-making

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1 Introduction

Japan had an extremely low birth rate and is in the super-aging society (Park & Takenaka, 2019). In addition to the shortage of the labor force, super-aging society makes successions in science and technology more difficult. Japanese universities cannot get adequate students from Japan only (Deguchi, 2018), hence, science and technology will be stagnant. In order to leave technologies for future generations, the only solution for Japan is to delegate them overseas. Meanwhile, new and emerging economies in the world are growing rapidly, and they are seeking cutting-edge technologies to further economic development. According to Melin and Persson (1996), Japanese universities get benefit in terms of enhanced technologies through collaboration with universities overseas, because international collaborations simultaneously enhance the quality of research and the attraction of citations (Glänzel, 2001; Jonkers & Cruz-Castro, 2013; Wagner & Leydesdorff, 2005). As such, international collaborations through a “global campus” (generally speaking, satellite campus (Healey, 2016)) will give a similar impact. Additionally, “research networks are a tool of international diplomacy” (Adams, 2012). Therefore, this research will enable people to find successors of Japanese science and technology.

1.1 The Medium-term Plan of Osaka University

Osaka University (OU) has enacted a Medium-term Plan (Osaka University, 2018a) every six years, and the third Medium-term Plan (April 2016 – March 2022) is being enforced as of 2020. OU has set the following numerical targets in order to promote globalization of its research.

- To run International Joint Research Promotion Program (Osaka University, 2018b), and to build approximately 80 International Joint Labs until March 2022. [ID: 6-2]
- To open global campuses, and to conclude at least 120 academic exchange contracts with foreign universities until March 2021. [ID: 10-2]
- To adopt approximately 400 foreign faculties until March 2022. [ID: 10-3]

OU has already opened ASEAN (Association of Southeast Asian Nations) campuses in Brunei, Thailand, Vietnam, and Indonesia. In our previous research (Iwami et al., 2019), the analysis was performed to check the validity of the already-opened ASEAN campuses and other ASEAN campus candidates were found. The next step is developing the campuses globally, and this research will provide the clues of the global campuses.

1.2 Research purpose

The purpose of this research is to provide an overview of the current status of collaborative research between OU and other countries/regions and as a way to



promote new collaborative research activities. In order to promote International Joint Research by the university's strategic headquarters, this work proposes a methodology of identifying: (1) strong academic collaborative countries/regions for building global campuses, and (2) researchers performing international joint research to request actions as a main player in university strategy. The merit to use co-authoring relations as an indicator is to perform matching on the scientific fields at the same time when researchers are found.

2 Methodology

This research was performed in the following steps:

- (1) The bibliographic data related to OU in 2001–2018 were retrieved.
- (2) Co-authoring relations between OU and other countries/regions were counted, and transitions were visualized.

Through these visualizations, the increase and decrease of collaborations among overseas partners across periods were overviewed at a glance.

2.1 Retrieved data

The bibliographic data of 108,948 academic papers were retrieved from the Web of Science; the data were provided by Clarivate Analytics (as of December 24, 2019). The data were retrieved with the query, OG=("Osaka University"), from publication year 2001 to 2018.

2.2 How to count co-authoring relations

Integer counting (Leydesdorff, 1989; Park, Yoon, & Leydesdorff, 2016) was used. However, academic papers with more than 1,000 authors were excluded. For example, in large-scale projects such as large-scale accelerators where many authors are usually involved. In light of the purpose of this research, these co-authorships of "kilo-paper" do not fit on the extraction of deep collaborations.

OU makes strategy every six years: 2004–2009, 2010–2015, and 2016–2021. Thus, co-authoring relations were counted every half of strategy period in addition to the previous three years (2001–2003).

2.3 Factors to select countries/regions

The co-authoring relation is defined as the most important factor. Additionally, GDP (gross domestic product) growth (World Bank Group, 2019a) as capitals and population growth (World Bank Group, 2019b) as young receivers are added to select countries/regions. The refinement of countries/regions is performed in the order of co-authoring, GDP growth, and population growth.



3 Results and discussion

3.1 Transition of research collaborations with the other countries/regions and organizations

To overview the research collaborations, Figure 1 illustrates contries/regions’ number of co-authoring papers with OU, and Table 4 in the Appendix tabulates the corresponding numbers. The co-authorships of “kilo-paper” are removed from the results.

In this research, the top countries are the USA (the United States of America), China, Germany, and England, that are also the top four countries in the total number of academic papers in 2018. The characteristic countries/regions are South Korea and Chinese Taiwan, which are geographically close to OU. Similar to a previous research (Iwami et al., 2019), Thailand, Singapore, and Vietnam are ranked within the top 25.

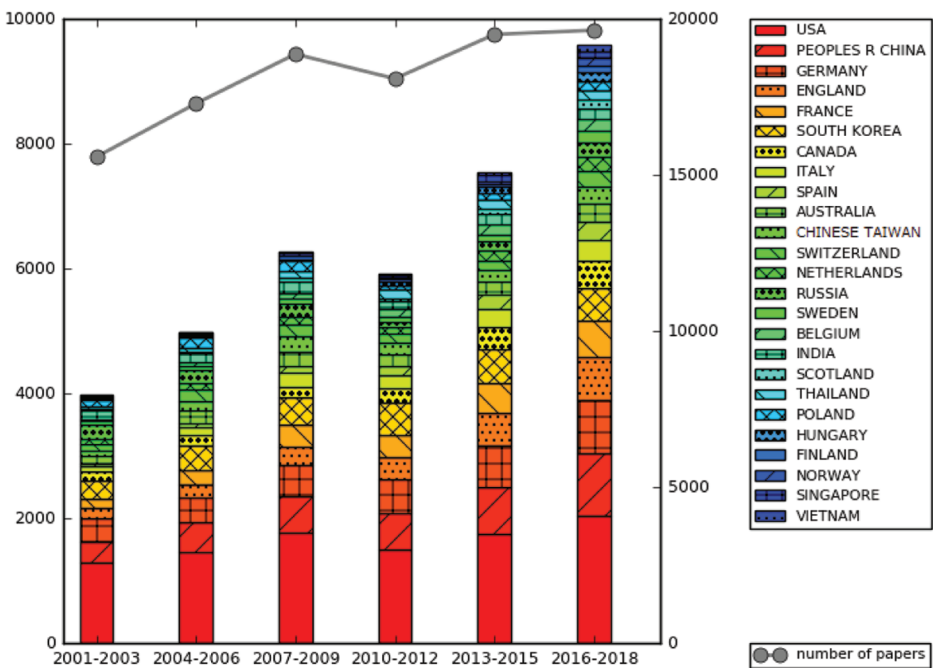


Figure 1. Transition of co-authoring relations between OU and the other countries/regions.

After the top 50 countries/regions were selected on the basis of the number of the co-authoring relations in 2016–2018 as shown in Table 4 in the Appendix, the top 15 countries/regions were selected on the basis of GDP growth or population growth. Capital, labor force and technological capability contribute to the economic



growth of a country (Solow, 1956; Swan, 1956). This Solow-Swan model won the Nobel Prize in economics in 1987 (Nobel Media AB, 2020). Considering that the number of co-authoring is an indicator of technological capability, GDP growth and population growth were carefully selected as indicators related to capital and labor force. Surely, taxation, infrastructure, education and the others could be considered as additional indicators, and the analysis could be even more extensive. However, since the existing ASEAN campuses were selected based on researchers' connections, the indicators in addition to research collaboration must require the strong grounds that are related to the Nobel Prize in economics.

Table 1 shows the selected countries from Table 4 in the Appendix on the basis of 2018 GDP growth provided by the World Bank (World Bank Group, 2019a). Based only on Table 1, Ireland, Middle Europe around Hungary, Egypt, China, India-Bangladesh region, Philippines, Malaysia, and Chile are candidates for the future global campuses. Based only on Table 2, Middle East around Egypt, South Africa, Sweden, New Zealand, Australia, Philippines, Malaysia, and Chile are candidates. The bold countries (Egypt, Bangladesh, Indonesia, Philippines, Malaysia, and Chile) were also selected as common candidates in the Table 1 and Table 2.

In the previous research (Iwami et al., 2019) about the relations with ASEAN, Thailand, Singapore and Vietnam had the largest share for OU in the latest period 2016–2018, and Malaysia was at the third rank in the previous period 2013–2015. Considering the growth rate of co-authoring relations, Indonesia will be an important partner with OU. Before this analysis, OU had decided ASEAN campuses in Thailand, Vietnam, Indonesia, and Brunei (Osaka University, 2017), and the former three countries' selection matches these results.

Table 1. 2016–2018 Co-authoring countries selected on the basis of GDP growth (≥ 4.0).

GDP Growth	EMEA (Europe, Middle East, Africa)	APAC (Asia, Pacific)	AMER (Americas)
Top 5	Ireland	China, India, Vietnam, Bangladesh	
10	Poland, Hungary, Egypt	Indonesia, Philippines	
15	Romania, Slovakia, Slovenia	Thailand, Malaysia	Chile

Table 2 shows the selected countries from Table 4 in the Appendix on the basis of 2018 population growth provided by the World Bank (World Bank Group, 2019b). Considering common countries both in Table 1 and Table 2, Egypt, Bangladesh, Philippines, Malaysia, and Chile are candidates for the future global campuses. The effectiveness of the OU's past strategy may have led to this result that ASEAN countries increase the number of their co-authoring relations with OU. However, Malaysia, Philippines, and Indonesia don't have ASEAN campuses yet, so it is considered that these three ASEAN countries are strong candidates.



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Table 2. 2016–2018 Co-authoring countries selected on the basis of population growth (≥ 1.1).

Population Growth	EMEA (Europe, Middle East, Africa)	APAC (Asia, Pacific)	AMER (Americas)
Top 5	Egypt , Israel, Saudi Arabia	New Zealand, Australia	
10	Turkey, South Africa, Iran	Malaysia, Philippines	Canada, Chile
15	Sweden	Indonesia, Bangladesh	Mexico

Figure 2 illustrates organizations’ number of co-authoring papers with OU, and contries/regions are displayed with alpha-3 code of ISO 3166-1. Chinese Academy of Sciences and Seoul National University have decreased the number of co-authoring with OU, while other contries/regions have increased it. Meanwhile, the world’s top universities such as Harvard University and Oxford University have increased it. However, the United States has kept stagnant about it. There is a trend that European universities such as Paris-Saclay University, University of York, and University Oslo have been developed as new co-authoring since 2010. In Figure 1, Germany is ranked at the third, but German organizations are not included within the top 25 in Figure 2. The reasons are that a large number of German organizations (500 German organizations / 5318 in 2016–2018) have a small number of co-authoring with OU, and MAX PLANCK was registered separately by departments.

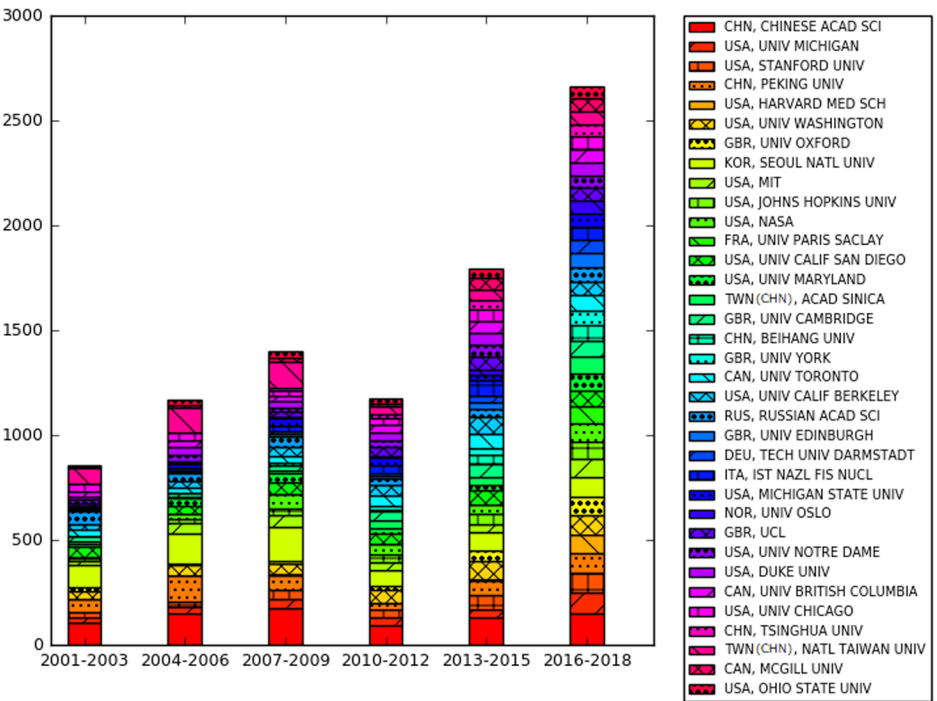


Figure 2. Transition of co-authoring relations between OU and the other world organizations.

3.2 Top collaborative researchers in Osaka University—case of Philippines

After deciding the countries/regions, researchers having strong relations are identified. Here, assuming that a global campus will be opened in Philippines, Figure 3 shows a part of the breakdowns of world co-authoring countries/regions with the top researchers in OU. The reason is that the two authors are related to Philippines, and there is no problem to reveal the names for scientific productivity. The thickness of the ring becomes wider as the number of papers in that period increases. The same color is used for one organization in one researcher lane beyond the periods. The labels are represented using the initial letters of the university, and the labels and shares are rendered if the share is 10% or more. The number in square brackets written on the left of researcher's name in Figure 3 is the number of the author's papers. The number in square brackets written on the left of an organization is the number of the co-authors. The specialized field, written on the right of researcher's name in Figure 3, is extracted automatically based on the maximum field in the latest period 2016–2018.

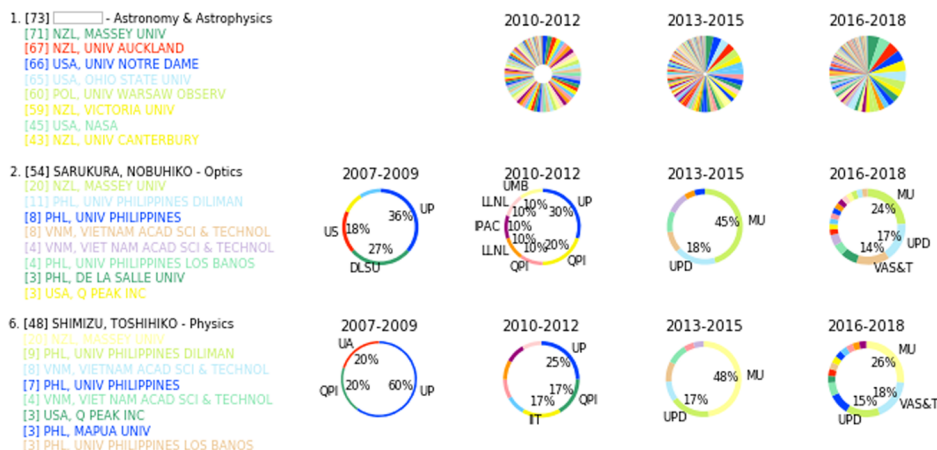


Figure 3. Share of Co-authoring Organizations of Researchers in Osaka University.

The 1st researcher has too many co-authoring organizations, so Philippines is not especially important for him. According to Figure 3, the 2nd researcher is a suitable person to ask for opening a global campus in Philippines. The University of Philippines has several campuses, so “Univ Philippines *” belong to the same university system. The 6th researcher belongs to the same lab with 2nd researcher, so he will also join the 2nd researcher's action.

To find strong relations, the OU researchers are ordered by the maximum number of co-authoring with each organization. As a result, researchers of astronomy are



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ranked up due to papers having a large number of co-author. It does not match the purpose, because such co-authoring means weak relations. Thus, the number of co-authoring internationally was adopted.

Table 3 shows the dependence rate for Philippines in 2001–2018, and the high dependence rate will indicate the high potential of the collaboration about the strategy towards the world. The dependence rate of each author is simply defined as below:

$$\text{Dependence rate} = \frac{[\text{number of co-authoring papers with target countries}]}{[\text{number of all papers}]}$$

Table 3. Dependence Rate of ASEAN-related Top 10 Researchers in Osaka University.

	Field	Dependence Rate
1 (blind)	Astronomy & Astrophysics	0.7%
2 SARUKURA, NOBUHIKO	Optics	22.9%
6 SHIMIZU, TOSHIHIKO	Physics	23.3%

3.3 Limitations

How to select data is always an issue. Since available data amount of analysis depends on computer resources, bigger data is not always good. However, in this research, as a result of narrowing the initial data set to the scope of OU, it became impossible to trace if the researchers belonging to OU have a relationship with world organizations under the name other than OU.

There are issues that cannot be solved even if data cleaning was performed – for examples, variations of person's name or organization name, people with the same name, indefinite pairs between affiliation and a person. The analysis result should be interpreted as a trend, but it is necessary to pay attention that bias will occur if the amount of data is small.

4 Conclusion

This research is performed on the purpose of providing evidences for Osaka University's strategy of internationalization from the view of evidence-based decision-making. Co-authoring implies relations to take an action and plays a role to match scientific fields with partners' interests. In order to decide partners for OU's global campuses, the findings are:

- From the view of the strength on co-authoring, GDP growth and population growth, the following countries are identified as candidates for the future global campuses: Egypt, Bangladesh, Philippines, Malaysia, and Chile.



- The existing ASEAN campuses in Thailand, Vietnam, and Indonesia matches factors of co-authoring and GDP growth.
- An approach to identify researchers who has strong relations with target countries/regions is evaluated.

The originalities of this research are time-series visualization of shares and the analysis from the view of partners. In future works, the analysis from the view of on-site requirements and existing competitors should be added as described in PEST (politics, economy, society, technology) analysis and 3C analysis (customer, competitor, and company). The economic analysis will give a foresight about the compatibility of OU's global campus.

Author contributions

Shino Iwami (iwami.research@outlook.com) and Toshihiko Shimizu (shimizu-t@ile.osaka-u.ac.jp) carried out the analysis. Shino Iwami and Jacque Lynn F. Gabayno (gabayno@ile.osaka-u.ac.jp) wrote the manuscript. Shino Iwami, Toshihiko Shimizu, Melvin John F. Empizo (mjfempizo@ile.osaka-u.ac.jp), Jacque Lynn F. Gabayno, Nobuhiko Sarukura (sarukura-n@ile.osaka-u.ac.jp), Shota Fujii (fujii@iai.osaka-u.ac.jp), and Yoshinari Sumimura (sumimura@cgin.osaka-u.ac.jp) planned the analysis and discussed the results.

References

- Adams, J. (2012). The rise of research networks. *Nature*, 490(7420), 335–336.
- Deguchi, H. (2018). The direction of education in Japan. *The Japan Times*. Retrieved from <https://www.japantimes.co.jp/opinion/2018/09/30/commentary/japan-commentary/direction-education-japan/>
- Glänzel, W. (2001). National characteristics in international scientific co-authorship relations. *Scientometrics*, 51(1), 69–115.
- Healey, N.M. (2016). The challenges of leading an international branch campus. *Journal of Studies in International Education*, 20(1), 61–78. <https://doi.org/10.1177/1028315315602928>
- Iwami, S., Shimizu, T., Empizo, M.J.F., Gabayno, J.L.F., Sarukura, N., Fujii, S., & Sumimura, Y. (2019). Current status and enhancement of collaborative research with ASEAN countries: A case study of Osaka University. In *Proceedings of the 17th International Society for Informetrics and Scientometrics (ISSI 2019)* (pp. 2532–2533). Rome. <http://issi-society.org/publications/issi-conference-proceedings/proceedings-of-issi-2019/>
- Jonkers, K., & Cruz-Castro, L. (2013). Research upon return: The effect of international mobility on scientific ties, production and impact. *Research Policy*, 42(8), 1366–1377. Retrieved from <https://linkinghub.elsevier.com/retrieve/pii/S0048733313000905>
- Melin, G., & Persson, O. (1996). Studying research collaboration using co-authorships. *Scientometrics*, 36(3), 363–377. Retrieved from <http://link.springer.com/10.1007/BF02129600>
- Nobel Media, A.B. (2020). The Sveriges Riksbank Prize in Economic Sciences in memory of Alfred Nobel 1987. Retrieved from <https://www.nobelprize.org/prizes/economic-sciences/1987/summary/>



Research Paper

- Osaka University. (2017). ASEAN Campus by Osaka University (In Japanese). Retrieved from <https://www.osaka-u.ac.jp/ja/international/asean>
- Osaka University. (2018a). Medium-term Plan (in Japanese). Retrieved from <http://www.osaka-u.ac.jp/ja/guide/information/joho/keikaku.html>
- Osaka University. (2018b). International Joint Research Promotion Program. Retrieved from http://www.osaka-u.ac.jp/en/research/researcher_sp/international_joint
- Park, C.-Y., & Takenaka, A.K. (2019). How technology can turn Asia's aging workforce into an advantage. Asia Regional Integration Center. <https://aric.adb.org/blog/how-technology-can-turn-asias-aging-workforce-into-an-advantage>.
- Park, H.W., Yoon, J., & Leydesdorff, L. (2016). The normalization of co-authorship networks in the bibliometric evaluation: The government stimulation programs of China and Korea. *Scientometrics*, 109, 1017–1036. Retrieved from <http://arxiv.org/abs/1605.03593>
- Solow, R.M. (1956). A contribution to the theory of economic growth. *The Quarterly Journal of Economics*, 70(1), 65. <https://doi.org/10.2307/1884513>
- Swan, T.W. (1956). Economic growth and capital accumulation. *Economic Record*, 32(2), 334–361. <https://doi.org/10.1111/j.1475-4932.1956.tb00434.x>
- The World Bank Group. (2019a). GDP growth (annual %). <https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG>
- The World Bank Group. (2019b). Population growth (annual %). <https://data.worldbank.org/indicator/SP.POP.GROW>
- Wagner, C.S., & Leydesdorff, L. (2005). Network structure, self-organization, and the growth of international collaboration in science. *Research Policy*, 34(10), 1608–1618. Retrieved from <https://linkinghub.elsevier.com/retrieve/pii/S0048733305001745>



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Appendix

Table 4 shows the top 50 countries/regions on the basis of the number of the co-authoring relations in 2016–2018, and GDP growth and population growth are investigated from the data provided by the World Bank (World Bank Group, 2019a; World Bank Group, 2019b).

Table 4. GDP Growth, Population Growth, and Number of Co-authoring Relations.

Country	GDP Growth	Pop. Growth	2010–2012	2013–2015	2016–2018	Country	GDP Growth	Pop. Growth	2010–2012	2013–2015	2016–2018
1 USA	2.7	0.6	1493	1740	2044	26 BRAZIL	1.1	0.8	39	69	98
2 CHINA	6.6	0.5	597	768	995	27 DENMARK	2.4	0.6	29	61	97
3 GERMANY	1.5	0.3	534	667	854	28 CZECH REPUBLIC	3.0	0.3	60	77	97
4 ENGLAND	1.4	0.6	362	517	684	29 NEW ZEALAND	2.8	1.9	28	70	92
5 FRANCE	1.7	0.2	357	465	580	30 AUSTRIA	2.4	0.6	84	97	91
6 SOUTH KOREA	2.7	0.3	509	549	537	31 TURKEY	2.8	1.5	39	57	81
7 CANADA	1.9	1.4	238	353	421	32 MALAYSIA	4.7	1.4	35	82	80
8 ITALY	0.8	-0.2	200	305	337	33 EGYPT	5.3	2.0	51	74	77
9 SPAIN	2.4	0.3	152	211	301	34 INDONESIA	5.2	1.1	32	46	68
10 AUSTRALIA	2.9	1.6	184	207	289	35 ISRAEL	3.5	1.9	28	56	66
11 CHINESE TAIWAN	-	-	189	189	272	36 IRELAND	8.2	1.0	28	21	64
12 SWITZERLAND	2.8	0.8	136	157	253	37 SAUDI ARABIA	2.4	1.8	8	28	64
13 NETHERLANDS	2.6	0.6	106	165	234	38 PHILIPPINES	6.2	1.4	29	33	53
14 RUSSIA	2.3	0.0	93	138	220	39 SOUTH AFRICA	0.8	1.4	46	51	49
15 SWEDEN	2.2	1.2	76	101	195	40 PORTUGAL	2.4	-0.2	20	26	46
16 BELGIUM	1.5	0.4	120	183	190	41 CHILE	4.0	1.4	19	39	43
17 INDIA	6.8	1.0	124	152	165	42 IRAN	3.8	1.4	26	34	38
18 SCOTLAND	-	-	58	98	146	43 ROMANIA	4.0	-0.6	10	36	37
19 THAILAND	4.1	0.3	129	134	145	44 MEXICO	2.1	1.1	28	38	36
20 POLAND	5.1	0.0	69	105	144	45 SLOVAKIA	4.0	0.1	21	26	36
21 HUNGARY	5.1	-0.2	63	100	130	46 GREECE	1.9	-0.3	24	27	30
22 FINLAND	1.7	0.2	38	51	119	47 UKRAINE	3.3	-0.5	7	16	29
23 NORWAY	1.3	0.7	23	50	118	48 WALES	-	-	20	19	28
24 SINGAPORE	3.1	0.5	36	87	112	49 BANGLADESH	7.9	1.1	14	23	27
25 VIETNAM	7.1	1.0	30	58	106	50 SLOVENIA	4.1	0.0	14	11	23

The data of GDP Growth and Pop (population) Growth in 2018 is provided by the World Bank Group. The red underlined bold indicates top 5, the green bold indicates top 10, and the blue italic indicates top 15.

