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Gaining soft power by fostering science, technology, and innovation: dilemmas in international relations

Abstract

This chapter investigates the relation between Science, Technology, and Innovation (STI) and Soft Power at the country level. To develop this discussion, first, we review the literature on the concept of Soft Power through Joseph Nye's theoretical analysis and its recent interpretation by.[1] Both argue that Soft Power is a diffuse tool of power through cultural and symbolic aspects. The role of STI in enhancing Soft Power and its influence in the international arena is updated through available recent literature. Data analysis is based on figures collected from the Global Innovation Index (GII) and its Special Chapter of Science and Technology Clusters and Soft Power 30. It was oriented to investigate the influence of STI in obtaining Soft Power, broadening the debate on recent literature. The research shows that although gaining Soft Power also requires culture/education, international policies, and universalistic values, STI plays an essential role in Soft Power.

Keywords: soft power, innovation, science, technology, clusters

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Introduction

Recently, the role of Science, Technology, and Innovation (STI) in international relations has gained more interest in academic literature and practice.[2] argues that "new technological capabilities transform war, diplomacy, commerce, intelligence, and investment." Denmark has gone so far as employing a tech ambassador, engaging in collaboration and focusing on impacting society.[3] In addition, it gets more and more common for countries to train their diplomats on the intersection of science (and technology and innovation) and diplomacy.

The concept of Soft Power was introduced in 1990 by Joseph Nye,[4] explaining that there are more ways to exercise power between nations than military and economic coercion. With the end of the cold war and world polarization, several researchers began to think about how international relations would occur. Nye was one of those authors who acquired international prominence and coined a vital term in academia, Soft Power. As ratified in his most recent article, Soft Power is how governments use symbolic aspects to achieve their agendas at the international level. In other words, culture, political values, and the way of relating in the international arena start to have a relevant value.[5] For this chapter and according to Nye's interpretation, economic development and achievements in STI are also elements of extending Soft Power.

Soft Power is a qualitative and fluid concept[6,7] and for this reason, we parameterized it by the Soft Power 30 ranking, which is insipiently used as a reference in some researches.[8] This same aspect occurs with STI since its measurement generally comprises various inputs, processes, activities, products, results, and external influences and structural conditions (OECD, 2018; SCIMAGO, 2021). Therefore, we use the Global Innovation Index to parameterize STI, an index frequently used for measuring and driving innovation.[9] In this chapter, we propose investigating the intersection between these two dimensions of international relations, STI and Soft Power, to understand the relationships between these categories in different nations.

The chapter structure is as follows. We start with a literature review on the concepts of Soft Power and its relationship with STI. Then we present the research methodology, where the data is collected from the Global Innovation Index (GII) and its Special Chapter of Science and Technology Clusters and Soft Power 30. Next, we present the findings. Finally, we discuss the results, debating whether countries can obtain Soft Power by fostering STI, broadening the debate on recent literature. Finally, we present the limitations of this work and suggestions for future research.

Soft power

Joseph Nye broadened discussions on relations between countries when he brought the term "Soft Power" to the debate in 1990. Military and economic coercion open space for symbolic, cultural, political, and evaluative constraints, expanding the realistic vision of Power that so far was focused on "hard power." He described Soft Power as "the ability to affect others to get desired results through attraction rather than military or economic coercion".[4] The idea, which seems simple today, but was revolutionary at the end of the 20th century, is that other countries and global actors will follow its international agenda due to cultural and political values. Soft Power demonstrates culture, political values, and forms of integration and interrelationship in international politics. We can exemplify the influence of Soft Power between nations with art (mainly cinema) and literature. These are features that influence international public opinion about a country and its visibility in the international arena.[10]

An important note is that Soft Power cannot be easily controlled. Nye himself observes, "most of a country's soft power comes from its civil society rather than from its government".[6] The government still has influence, first through the formation of civil society and, second, through public diplomacy, but these actions alone do not convince the international debate. Nevertheless, the consistency of these actions over time does.

Nye[9] argued that public diplomacy could positively influence a nation's Soft Power, using three dimensions (i) daily communication, (ii) strategic communication, and (iii) building lasting relationships. Blechman[11] states that civil society has more influence than the government, particularly with the advent of the internet. The author considers Soft Power "more an existential factor in the political environment than something that policymakers can use to their

advantage".[11] That is, Soft Power can be measured a posteriori, never a priori. The author points out that Soft Power is never fundamentally shaped by governments and cannot be "tapped" for specific situations.

On the other hand, the recent interpretation of Soft Power by[1] and the rereading of [5] himself argue that Soft Power is a diffuse tool of Power, through cultural, symbolic, and evaluative aspects, much more a thermometer of the contemporary world than an action of cause and effect in the daily actions of foreign policy between countries.

Science, technology, and innovation and soft power

Literature on the roles of STI as sources of Soft Power has gained increasing attention in recent years. The primary dimension of this discussion is based on science diplomacy, which comprehends international cooperation through the scientific and technological exchange. The idea is that this kind of cooperation builds trust and transparency outside the realms of politics and can contribute when diplomatic relations are threatened.[12–14]

In a similar vein[15,16] argue about the importance of international research institutions (such as the European Organization for Nuclear Research, CERN, or the Australian Centre for International Agricultural Research, ACIAR, just to bring two examples of the authors) in strengthening scientific ties and providing know-how (and occasionally associated policies). Quevedo[15]claims that these organizations must adapt to the geopolitical and developmental realities and learn to operate in a politically neutral management model, having a crucial role in uniting countries and cultures.

Nevertheless, science diplomacy and its influence on gaining Soft Power go beyond scientific cooperation itself. *[17]*brings the complementary concept of engineering diplomacy, which comprehends partnerships among countries to implement engineering and technology-related projects, bridging the gaps between countries.

[2]identified six patterns by which advances in science and technology influence international relations. The author considers science as knowledge based on experiments and theories and the communication and working processes of the scientific community. In turn, technology is defined as applying technical knowledge for a practical purpose, encompassing both simple and advanced technologies. The author states that a given technological or scientific advance can impact and influence international relations in different ways or even fit into a pattern at a given time and evolve into other patterns. According to the author, the standards by which science and technology influence international relations are:

When the advance of science and technology is so fast and powerful, impacting economic, political and lifestyle sectors, reformulating previously established concepts that surpass the management capacity of the international community that continues to try to update and deal with its consequences.

When advances in science and technology change the international game, they create new capabilities that affect war, diplomacy, commerce, communication, finance, and other dimensions. Examples include the possession of nuclear weapons and missiles, information technology, the possibility of cyber warfare, the defense of infrastructure that includes energy, water, sanitation, connectivity, and information security. These technological advances benefit those who manage them well and redistribute power among international actors and civil society.

When science and technology are sources of information for themes, problems, and risks, which need to be discussed and managed by the international community, generally, the first awareness of these issues is followed by a period of social learning, in which governments and society understand the fact and its consequences in the domestic and global spheres. However, there are cases where, although there is scientific consensus, an international agreement cannot be reached, either genuinely due to technical disagreements or purely political opposition.

When science and technology are crucial to understanding international issues, acting in concert with the economic, political, legal, and cultural forces brought to the international community's attention due to the knowledge and understanding developed and provided by the scientific community. Scientific counseling plays a vital role in international diplomacy, dealing with issues that may involve political, social, and ethical conflicts. *In this direction,[18]* investigate the contribution of Chinese Think Tanks in public diplomacy and Soft Power through policy research.

When science and technology are an instrument of foreign policy or a provider of technical information on an international issue. Examples include post-cold-war cooperation in space technology between the US and Russia; in 2009, the USA launched a scientific and technological cooperation program to better relations with Muslim countries.

The cooperative science and technology project requires international negotiation for debate on cost, infrastructure, intellectual property, management. In this governance, there may be a conflict between national and international interests.[2]

Adding another layer to the debate, Lynskey[19] brings the idea that big technologies companies are also a source of Soft Power of nations, as they influence public discourse and political discussions through the Power to form public opinion, market power, and finally, data power, derived from the control of data flows.

This influence of technology and innovation in Soft Power is also explored by Abels et al.[20] In discussing how to increase Europe's Soft Power, the authors propose eight measures, including promoting new technologies through targeted investment and "smart" clustering. This means fostering competitive technology companies, with high market potential, through a collective strategy that can guarantee sufficient scale and scope. Another related proposal by the authors to gain Soft Power in the region considers a modernized competition policy that includes strategic merges to create globally competitive champions, mainly in emerging technology fields. Complementarily, Montalto et al.,[21] highlight the role of cultural and creative innovations in the UK's Soft Power in a Brexit context enabling strategic mergers to create competitive global companies allowing strategic mergers to create a globally competitive champion.

Another critical dimension of this discussion regards the influence of prestigious higher education institutions of countries in Soft Power, notably by the attraction and recruitment of students. Some shreds of evidence of this positive influence were presented by Tella[22] when analysing the South African case, by[23] considering a particular Russian university, by Cooke & Kumar[24] through the study of a scholarship grant from US philanthropic foundations on management education and finally by Wu & Zha[25] *in their broad analysis of* higher education internationalization. While student mobility does not necessarily mean cross-country scientific and technological cooperation or innovation per se, it is clear that it does contribute to skills training and capacity building for STI efforts.

While considered sources of Soft Power, STI can also affect a nation's Soft Power negatively. Ainslie et al.,[26] analyse the recent

rejection of Korean cultural products by consumers from the more developed Southeast Asian nations of Thailand, Malaysia, and the Philippines, mainly "attributed to the general inability of Hallyu's static, stable, and conservative products to keep up with the changes in this region" that negatively affect "naked ambitions of 'soft power' for Korean overseas" (p. 84). One of the cases described by Sonnevend[27] also relates to adverse effects. The author reveals the use of the diplomatic technique of 'charm offensive' by Iran during negotiations of the nuclear deal with the United States to shift their international image and avoid losing soft Power.

Data collection and analysis

The previous section brought some fruitful insights about the evolution of the Soft Power concept and its relation to STI derived from the literature review. To broaden the debate, we propose to evaluate this relationship using the Global Innovation Index - GII, its Special Chapter of Science and Technology clusters, and The Soft Power 30. It was used the latest report available, GII 2020 and Soft Power Report 2019. The focus of the analysis is debating the implications between the indexes and their correlation.

The data analyzed are the following:

Global Innovation Index (GII): The ranking is based on a conceptual framework where seven aspects are taken into consideration when analyzing a country's innovativeness: institutions, human capital and research, infrastructure, market sophistication, business sophistication, knowledge and technology outputs, and creative outputs.[28]

Science and Technology Cluster Rankings:[28] Clusters identification is based on the locations of inventors listed in international patent applications and authors appearing in scientific journal articles. On Global Innovation Index 2020, this Special Section presents, for the first time, the ranks according to the sum of the country's patent and scientific publication shares divided by population.

Soft Power 30: This ranking is based on a conceptual framework where objective data accounts for 70% of the results and subjective data (pooling) counts for 30%. Regarding the objective data (70%), it is structured into six categories: Government (20,8%), Culture (12,7%), Global Engagement (17,9%), Education (16,6%), Digital (14,0%) and Enterprise (18,0%) (The Soft Power 30, 2019, p. 32-33). Regarding the subjective data (30%), Soft Power 30 conducts polling across 25 countries to gather the data, where the following dimension are analyzed: global culture (6,6%), luxury goods (7,2%), technology products (8,3%), cuisine (11,1%), liveability (20,0%), friendliness (20,9%), foreign policy (15,9%) (The Soft Power 30, 2019, p. 33-36).

First, we analyzed the top innovative countries according to the Global Innovation Index 2020. The top 20 innovative countries are high-income, according to World Bank Income Group Classification (July 2019), considered on GII, except China, classified as upper-middle-income.

Then, we analyzed the special chapter on Science and Technology clusters. The 100 top clusters are in 26 economies, from which 70% are high-income economies; only 5 of them (Brazil, China, Iran, Turkey, and the Russian Federation) are upper-middle-income, and 1 (India) is lower-middle-income.

Extracting only the top 20 most significant Science and Technology Clusters, we find that they are in the following countries: Japan, China, Korea, Unites States, France, Great Britain, The Netherlands, Germany. All these countries are also listed in the top 20 innovative countries.

In the next step, we compare these results with those of the Soft Power 30 ranking. Although the ten most innovative countries are mentioned among the twenty countries with the most significant Soft Power, which supports the relationship between STI and Soft Power, there are also contrasting examples. To name a few, the country with the most significant Soft Power, France, is only the twelfth most innovative country. Canada is ranked seventeenth in innovation and ranked seventh in Soft Power.

Having the data collection completed, we created a comparison (Table 1) combining the Soft Power according to Soft Power 30 Index, the innovativeness according to the Global Innovation Index, and science and technology performance based on the Special Chapter on Clusters.

Table 1 comparison created by the researchers based on the data collected from the rankings

	Global Innovation Index 2020				**Soft Power 30**	
	Global Innovation Index 2020		**Special Cluster Index**		**2019 Index**	
Country	**Rank**	**Score**	**Cluster Name**	**Rank**	**Rank**	**Score**
Switzerland	1	66,08	Zürich	49	6	77,04
Sweden	2	62,47	Stockholm	33	4	77,41
			Lund-Malmö	96		
United States of America	3	60,56	San Jose-San Francisco, CA	5	5	77,4
			Boston-Cambridge, MA	7		
			New York City, NY	8		
			San Diego, CA	11		
			Washington, DC-Baltimore, MD	13		
			Los Angeles, CA	14		
			Houston, TX	16		
			Seattle, WA	17		
			Chicago, IL	20		
			Minneapolis, MN	30		
			Philadelphia, PA	31		
			Raleigh, NC	36		
			Portland, OR	42		
			Atlanta, GA	55		
			Cincinnati, OH	59		

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	Global Innovation Index 2020				Soft Power 30	
	Global Innovation Index 2020		Special Cluster Index		2019 Index	
Country	**Rank**	**Score**	**Cluster Name**	**Rank**	**Rank**	**Score**
			Dallas, TX	62		
			Pittsburgh, PA	64		
			Ann Arbor, MI	65		
			Cleveland, OH	73		
			Phoenix, AZ	78		
			Bridgeport-New Haven, CT	84		
			Austin, TX	86		
			St.Louis, MO	94		
			Columbus, OH	97		
United Kingdom	4	59,78	London	15	2	79,47
			Cambridge	57		
			Oxford	71		
			Manchester	93		
Netherlands	5	58,76	Amsterdam-Rotterdam	18	10	77,4
Denmark	6	57,53	Copenhagen	54	14	68,86
Finland	7	57,02	Helsinki	68	15	68,35
Singapore	8	56,61	Singapore	28	21	61,51
Germany	9	56,55	Cologne	19	3	78,62
			Munich	23		
			Stuttgart	26		
			Frankfurt Am Main	38		
			Berlin	44		
			Heidelberg-Mannheim	53		
			Nuremberg-Erlangen	63		
			Hamburg	90		
Korea	10	56,11	Seoul	3	19	63
			Daejeon	22		
			Busan	75		
Hong Kong, China	11	54,24	Shenzhen-Hong Kong-Guangzhou	2	not on Soft Power 30 List	
France	12	53,66	Paris	10	1	80,28
Israel	13	53,55	Tel Aviv-Jerusalem	24	not on Soft Power 30 List	
China	14	53,28	Beijing	4	27	51,25
			Shanghai	9		
			Nanjing	21		
			Hangzhou	25		
			Wuhan	29		
			Xi'an	40		
			Chengdu	47		
			Tianjin	56		
			Changsha	66		
			Qingdao	69		
			Suzhou	72		
			Chongqing	77		
			Hefei	79		
			Harbin	80		
			Jinan	82		
			Changchun	87		
Ireland	15	53,05	not on Special Cluster Index list	-	20	62,91
Japan	16	52,7	Tokyo-Yokohama	1	8	75,71
			Osaka-Kobe-Kyoto	6		
			Nagoya	12		
			Hamamatsu	85		
			Kanazawa	91		
Canada	17	52,26	Toronto	39	7	75,89
Luxembourg	18	50,84	not on Special Cluster Index list	-	not on Soft Power 30 List	
Austria	19	50,13	Vienna	70	16	67,98
Norway	20	49,29	not on Special Cluster Index list	-	12	71,07
Belgium	22	49,13	Brussels	41	18	67,17

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Table Continued...

	Global Innovation Index 2020				Soft Power 30	
	Global Innovation Index 2020		Special Cluster Index		2019 Index	
Country	**Rank**	**Score**	**Cluster Name**	**Rank**	**Rank**	**Score**
Australia	23	48,35	Melbourne	35	9	73,16
			Sydney	37		
			Brisbane	83		
New Zealand	26	47,01	not on Special Cluster Index list	-	17	67,45
Italy	28	45,75	Milan	48	11	71,58
			Rome	58		
Spain	30	45,6	Madrid	45	13	71,05
			Barcelona	46		
Russian Federation	47	35,63	Moscow	32	30	48,64
Turkey	51	34,9	Istanbul	51	29	49,7
Hungary	35	41,53	not on Special Cluster Index list	-	28	50,9
Greece	43	36,79	not on Special Cluster Index list	-	25	53,74
Czech Republic	24	48,34	not on Special Cluster Index list	-	24	54,35
Poland	38	49,09	not on Special Cluster Index list	-	23	55,16
Portugal	31	43,51	not on Special Cluster Index list	-	22	59,28
Brazil	62	31,94	São Paulo	61	26	51,34

Using SPSS statistical analysis software, the correlation between the score obtained by the country in the GII and Soft Power 30 indexes was calculated. The sample size was 33 countries, meeting the minimum sample size criteria.[29] They were selected as follows: first, the 20 countries with the highest score in the GII were identified (among which 17 of them were also assessed in the Soft Power 30). Then, the remaining 13 countries were added until the entire list of the 30 countries evaluated with the highest Soft Power in the world was completed, according to the Soft Power 30 index. We specified an acceptable statistical error level alpha=0.05, considered moderate. Missing data was ignored because the number of cases was less than 10%, and the number of data disregarding missing was enough to perform the technique chosen (correlation).

The data normality test was performed so that we could identify the appropriate correlation to be conducted. Two tests were performed, Shapiro-Wilk and Kolmogorov-Smirnov, recommended for this sample size.

However, it is essential to consider that the Power at 5% significance level for these tests is less than 40% (RAZALI; WAH, 2011). According to the Shapiro-Wilk test, Soft Power 30 is not normal (p-value 0,016), while GII is normal (p-value 0,482). On the other hand, the Kolmogorov-Smirnov test indicates the normality of the data for both indexes (Soft Power 30 p-value is 0.170 and GII p-value is 0.200).

Then, the correlation, which is the measurement of strength and direction of the association between the variables, was calculated using Pearson's coefficient, which requires data normality, and Spearman's coefficient, non-parametric, which does not depend on data normality. Both results show a positive and strong correlation between the GII and Soft Power innovation rankings, Pearson's 72.5% (p-value < 0,001) and Spearman´s 69,1% (p-value < 0,001).

Discussion

Returning to the question in this chapter, which is whether there is a relationship between innovative countries recognized for their scientific and technological production, measured by GII and its special chapter in Science and Technology Clusters, with Soft Power, measured by Soft Power 30, the answer is that there is a strong correlation. STI can help gain Soft Power by combining different dimensions valued in the globalized world such as science and technology diplomacy and cooperation in their multiple patterns, the internationalization of culture through an innovation diffusion process, and student's exchanges to prestigious higher education institutions.

A second aspect to be considered is that, although the data indicate that there is a positive and strong correlation between the indices of innovation and Soft Power at the country level, Soft Power, as[7] put it, is a still underdeveloped concept and still need new parameters to guide a quantitative analysis on the tangible and intangible elements that contributes to its formation. Thus, there is an essential debate about using an index to measure Soft Power and its ability to assess such a fluid concept. In addition, the chosen index, Soft Power 30, compared to the GII, which is relatively consolidated, is still little explored in the literature.

Considering the previous arguments, we can identify a convergence between the literature on Soft Power and STI and the data found. Innovation and Soft Power are interrelated, but there is still a need to address other aspects beyond those already addressed by the selected rankings, contributing to this connection. Soft Power is a concept that depends on the country's history in its public diplomacy and investment in the internationalization of culture and political values. In its turn, investments in STI and their outputs and impacts are pretty complex in their internal relations and their relations to the historical political, economic and social context of a country.

Analyzing and comparing the collected data, the countries grouped and listed below represent the complexity of the STI and Soft Power relationship.

(a) The following countries are innovative but have low Soft Power: Hong Kong, Israel; Luxembourg; China.

(b) The following countries are innovative but not as strong in their science and technology clusters; still, they have Soft Power: Switzerland; Sweden; Denmark; Finland; Ireland; Canada; Austria; Norway; Belgium; New Zealand.

(c) Countries with strong Soft Power, which do not have the same innovation strength or science and technology clusters: Australia, Italy, and Spain.

(d) The following countries are powerful in everything. They are highly innovative, have strong science and technology clusters, and have strong Soft Power: United States of America; United Kingdom; Netherlands; Germany; Korea; France; Japan.

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Considering the great importance of science and technology in the development of countries and their innovation strength in strategic areas, we can consider that these elements will be increasingly important in the analysis of Soft Power. Therefore, even in an embryonic way, we can affirm that Soft Power is, among other factors, also anchored in the scientific, technological, and innovation influence that each nation has in its arena of action and the relevance of these features in international politics.

Limitations and suggestions for further studies

Recovering what was briefly presented previously, it is essential to highlight that the authors of this work are aware of the circumscriptions of the used indexes and associated rankings and the difficulty of using them in comparative analyses. Furthermore, the Soft Power index used in the analysis shows only the 30 countries with the highest scores, a small sample from a statistical point of view, and a breadth of discussions.

We suggest for the subsequent studies employing empirical analysis to identify relations of Soft Power with the area of science, technology, and innovation, to collect data from the State Department, Ministry of Foreign Affairs, and International Agencies from countries, discussing how these political actors use science, technology, and innovation to gain a strategic advantage in international power relations. Other possibilities for future studies would be the expansion of the indicators or indices considered in our study (for instance, foreign patent's ownership/assignability or international paper's co-authorship), or the expansion of the time frame considered, evaluating the behavior of STI and Soft Power indexes in a country level in a time series.

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Conflicts of interest

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