International Collaboration in Research: Contrasting Motivations of Scientists and Funding Agencies

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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Introduction

In March of 2025, scientists and engineers from around the world gathered in Anaheim, California at the American Physical Society (APS) Global Physics Summit. Over 14,000 members attended to share their work and find potential research partners. These parties included students and professionals from national laboratories, universities, and industry, as well as parties interested in utilizing such research. They traveled from different regions of the United States, as well as across oceans and country borders. For those traveling long distances, APS and funding agencies offered travel awards and grants. Hundreds of similar conferences take place annually around the world.

Why do individuals travel such long distances to present their research? And why do organizations spend considerable resources to host conferences and sponsor both national and international scientists? International collaboration in research paves the way to technological innovations such as particle accelerators and the COVID-19 vaccine that lead to the betterment of society. International research has also expanded disciplines across science and technology including particle physics, global health, and climate science.

Broadly speaking, international collaboration refers to the cooperation among scientists from different countries working on a shared research project. Parties work together in one's home country, virtually, or at an institution in an entirely different country. To quantify the successes of international collaboration in this discussion, we define international collaboration as the involvement in projects and publications where the authors are affiliated with institutions in more than one country.

This paper seeks to investigate the importance of international collaboration in research from the perspective of the individual scientists and the funding agencies or governments that

support them. Using a social constructivist framework, we highlight the contrasts between the parties' incentives and desired outcomes to prove that the facilitation of international research and thus the direction of science is biased towards government interests.

Survey data about the types of barriers that scientists face when working on international projects show economic factors to be the most prominent. External funding is necessary for researchers to conduct their projects, and is provided by professional organizations and governments. We examine the objectives of funding agencies and governments that support international research. Using a social constructivist framework, we argue that the execution of international research and its technological outputs are directed by the interests of governments and funding agencies. For example, the birth of high-energy physics was primarily a result of cross-border cooperation driven by government interests in gaining national intelligence. Since international projects are difficult to execute without the help of funding agencies, successful research projects take a specific turn in favor of the organization funding them.

Using a Cold War-era case study on international collaboration between high-energy physicists from the United States and the Soviet Union, we compare the motivations of the involved scientists and the funding agencies supporting them. Despite extreme tensions between the two states during the Cold War, both governments encouraged scientific collaboration with their adversaries. While the physicists collaborated with each other for the sole purpose of sharing work and accelerating worldly knowledge, the states encouraged international research in the interest of national intelligence and gaining an edge in the nuclear race.

The social constructivist framework is built on the theory that knowledge is developed by social and cultural interaction between individuals. This framework is used to examine how scientific knowledge is influenced by individual scientists and institutions from around the

world. Science is often biased and research projects are directed by the economic and political goals of the governments and funding agencies that make international collaboration achievable.

Methods

The method of research involves the retrieval of peer-reviewed publications from Virgo, the University of Virginia's online library catalog, and other academic databases such as ScienceDirect. Qualitative data extracted from these sources, such as free-response surveys, are used to gauge the perspectives of individual scientists and governments. Quantitative data are used to identify trends in international research growth, scholarly production, and funding patterns. The official websites of funding agencies are examined for mission statements and to obtain statistical data on funding allocations.

The Societal Value of International Collaboration

To highlight the importance of international collaboration in a larger context, we cite the emergence of new fields and technologies that impact large segments of the world's population. Examples of technological developments influenced by international collaboration are the Large Hadron Collider (LHC) at the European Organization for Nuclear Research (CERN), the International Space Station (ISS), and the Human Genome Project (HGP). Governments around the world invest substantial resources into the development and maintenance of these technologies. These large-scale projects demonstrate the significant impact that international research has on global economies and societies. To further illustrate the societal benefits of international collaboration, we reference the HGP, climate research, and development of the COVID-19 vaccine.

Motivations of Scientists

To understand the benefits of international collaboration to scientists, we investigate survey studies on the factors motivating individual scientists to participate in international research. Matthews et al. (2020) conducted a study on the growth of international research collaborations over the past decade. They surveyed a total of 9,422 biologists and physicists from eight different societies: the United States, the United Kingdom, India, Italy, Taiwan, Hong Kong, Turkey, and France. The scientists were asked about their reasons for conducting research with foreign partners.

Publication and citation metrics are valuable to scientists who wish to advance their academic and research careers. Statistics on publication and citation rates are used to identify trends between scholarly production and international collaborative research. Several sources support a positive correlation between the frequency of international projects and the success of publications across different scientific disciplines. In particular, Rodrigues et al. (2016) demonstrated how the expansion of international research led to a greater citation impact for different countries. Citation impact was measured using the h-index, an indicator developed by Hirsch (2005) that quantified scientific research output based on the number of journal citations.

The Role of Funding Agencies in International Collaboration

Several sources suggest that economic barriers pose the greatest challenge for scientists who wish to conduct research internationally (Luukkonen et al., 1992; Matthews et al., 2020). Scientists overcome these barriers with the help of funding agencies. Statistics on the success of international research with and without the help of funding agencies are studied to prove the need for government support in the development of such research (Feitosa et al., 2023). Deeper research by Tian et al. (2023) on funding patterns across 171 disciplines listed by the Science

Citation Index is used to analyze the influence of funding agencies on research outputs. A dataset of over 13 million articles published between 2011 and 2020 was taken from the Web of Science database and analyzed for patterns of successful scholarly production.

Motivations of Funding Agencies

To tie this case study to the modern world, we research why governments and funding agencies support international collaborative work. We review organizations that invest the most heavily into international research such as the U.S. National Science Foundation (NSF), U.K. Research and Innovation (UKRI), Department of Science and Technology (DST) of India, and Japan Society for the Promotion of Science. The websites of each organization are examined to understand their motivations, the type of research they promote, and the amount of funding they provide. We also analyze international partnerships for geographical and political patterns to further investigate how international competitiveness influences the motivations of these funding agencies (Jane & Ko, 2018; Pepe et al., 2024).

The Cold War as a Precedent

A Cold War case study is used to compare the historical motivations between the scientists engaging in international collaborative research and the governments and funding agencies supporting them. A chapter from Lalli and Navarro (2024) discusses the relationship between physicists and governments of the United States and the Soviet Union during the Cold War (Hof, 2024). A clear divergence existed between the objectives of each party. By explaining that the development of high-energy physics and research relationships were a social construction of scientists and governments, we demonstrate how the direction of science is shaped by social and political forces rather than being entirely objective.

Results

The Societal Value of International Collaboration

The expansion of scientific disciplines can be credited to international collaboration. For example, the rise of high-energy physics was a result of collaboration between scientists from the United States and Soviet Union during the Cold War. In the modern day, high-energy physics is still driven by international collaboration on large-scale projects such as the LHC at CERN. The LHC has cost about $4.75 billion for its development and maintenance. CERN comprises 20 European countries, 7 observer states and organizations, over 30 non-member states, and about 20 states that hold scientific contracts and contribute to projects conducted at the research facility (CERN, 2008). The number of current visiting scientists is about 10,000 from 608 universities and of 113 nationalities.

Advancements in space exploration, astronomy, and astrophysics can also be attributed to international facilities such as the ISS since November 2, 2000. The construction of the station itself cost over $100 billion, and about $3 billion is spent annually for operation (NASA, 2023). The ISS is primarily used by five space agencies operating across 21 countries including the National Aeronautics and Space Administration, Roscosmos, and the Japan Aerospace Exploration Agency.

Biomedical research has developed as a result of international collaboration. For example, the HGP was an internationally conducted project from 1990 to 2003. The goal of the project was to fully decipher the human genome. Scientists from across the United States, United Kingdom, France, Germany, Japan, and China were involved in the successes of the HGP (National Human Genome Institute, 2024). The HGP cost several billion dollars, but led to life-saving benefits such as more accurate disease diagnosis and gene therapy treatments.

Motivations of Scientists

To investigate the reasons why scientists participate in international collaboration, we refer to the survey study conducted by Matthews et al. (2020). The majority of participants highly valued international collaboration at rates ranging from 68% to 95% of scientists across the eight different societies. Matthews et al. (2020) identified five main motivations for scientists engaging in international research. These motivations were to: (1) increase visibility and build a professional reputation; (2) share the cost of project resources; (3) share access to expensive and highly specialized equipment; (4) achieve greater leverage by sharing data; and (5) to exchange ideas and perspectives that generate creative solutions.

Scientists who participate in international collaborations generally see higher publication rates compared to those who only conduct research domestically (Hinnant et al., 2012; Kwiek, 2020; Rodrigues et al., 2016). Rodrigues et al. (2016) discovered a correlation between citation impact and the expansion of international collaboration in the field of immunology and microbiology over the course of two decades. To quantify citation impact, the h-index was applied to countries with developing scientific infrastructures. The countries with the most expansion in international research produced the highest levels of citations. Additionally, Kwiek (2020) found correlation between the frequency of internationally co-authored publications and citation rates. The overall trend is that the results of international collaboration receive more citations per publication than the results of domestic collaboration (Kwiek, 2020; Persson et al., 2004; Shin et al., 2022; Tian et al., 2023).

The Role of Funding Agencies in International Collaboration

Within the survey distributed by Matthews et al. (2020), scientists were asked about the barriers they faced when engaging in international research. These barriers were sorted into

political, cultural, and logistical issues. Funding was the most prevalent across all eight societies, constituting 68% to 85% of political issues. From the open-response section of the survey, scientists stated that they struggled with lack of economic project support, out-of-pocket costs for international travel, and limitation of grants to certain countries.

To aid with the facilitation of international research projects, financial support is offered by federal, state, and local governments, higher education institutions, non-academic nonprofit organizations, and private businesses. In 2019, the U.S. and Chinese governments spent $656 billion and $526 billion, respectively, on global research expenditures (National Science Board, 2022). From 2010 to 2019, cost allocations towards and the growth of global research projects steadily increased.

Projects supported by funding agencies to overcome economic barriers tend to be more successful than those that do not receive financial support. Tian et al. (2023) found that projects funded by one or more sources were twice as likely to be in the top 10% of publications with high impact and citation rates when compared to unfunded articles, particularly in the fields of engineering and medicine. Moreover, a greater number of grants and financial support was associated with higher citation rates.

Motivations of Funding Agencies

Funding agencies provide mission statements on their role in fostering international research projects. The NSF Office of International Science and Engineering (OISE) is a major source of funding for international research. In 2024, the NSF allocated a total of $82 million in awards to the Global Centers Competition (NSF, 2024). The NSF states on their website that OISE “advances global collaboration to enhance the nation's scientific leadership and drive

innovation" and that they foster "partnerships that connect U.S. researchers and students with international colleagues, enabling the development of solutions to global challenges."

The UKRI is an agency that supports British scientists participating in international research. On their website, the UKRI claims that "international collaboration is integral to achieving our mission to make the UK a science and technology superpower" and attract researchers "vital to building on existing strengths and meeting future global challenges" (UKRI, 2025).

The DST supports international research conducted by Indian scientists. The DST website lists the countries they most closely collaborate with. Their goals for international research are to enlarge "India's pursuit of influence in global arena/platforms and mainstreaming Science Technology and Innovation (STI) into international diplomacy and foreign relations" and to leverage "foreign alliances and partnerships to accelerate key priorities and programs devoted to strengthening India's national science and technology" programs (DST, 2024).

International collaboration plays a role in a country's rank in regards to the global scientific competition. It serves as an aid to latecomer countries in science and technology (Jang & Ko, 2018). Latecomer countries are defined as those who entered the global academic landscape after the 1960s. Jang & Ko (2018) studied the scientific productivity of thirteen latecomer countries in the field of high-energy physics. Public research institutions from the latecomer country constituted about 41% of the global research productivity. Their findings suggest that countries with strong international research networks have a competitive advantage in scientific and technological innovation.

The Cold War as a Precedent

We review a case study of the relationship between scientists from the U.S. and the Soviet Union during the height of Cold War tensions. In a chapter from Lalli and Navarro (2024), the birth of high-energy physics was examined as a byproduct of international research across the Iron Curtain during the Cold War. International projects were driven by the initiative of individual scientists to collectively produce objective knowledge across national borders. These projects were also facilitated by U.S. and Soviet government motivations to monitor foreign developments and gather national intelligence. After World War II, physicists across the globe pushed to direct research away from weaponry towards nuclear and high-energy physics.

In 1950, the very first international high-energy nuclear physics conference was held by Robert Marshak at the University of Rochester located in New York. The objective was to depoliticize physics and explore the physical nature of the universe The Rochester Conference series was supported by several funding agencies such as the International Union of Pure and Applied Physics and the United Nations Educational, Scientific, and Cultural Organization. Physicists came from a number of countries including the United States, Italy, Mexico, Australia, and Japan. For broader international representation, Soviet scientists were also encouraged to attend. Initially, the State Department opposed the idea of Soviet scientists within U.S. borders, but American physicists argued that international collaboration hosted within national borders would help diffuse negative perceptions of the state. Eventually, Congress agreed and government officials even offered to accelerate administrative processes to ease the travel of Soviet physicists. While the scientific community had its objective of establishing “open science”, U.S. officials were driven by the opportunity to gain intelligence on Soviet

technological activities. The Soviet Union reciprocated the conferences, inviting U.S. scientists with a similar goal to conduct intelligence operations.

Discussion

The Societal Value of International Collaboration

International collaboration in research leads to the expansion of scientific fields such as high-energy physics, climate science, space exploration, and medicine. It also leads to technological breakthroughs including particle accelerators and gene therapies. Defining features of international collaboration are the promotion of objective, unbiased science and accessible, transparent research findings.

Governments spend billions of dollars in facilitating international research annually. These investments go towards building and maintaining international facilities such as the LHC and ISS, as well as individual scientists through grants. The rewards of scientific research justify the substantial amount of funding. International research allows countries to collaborate with each other to address global or regional challenges, such as the COVID-19 pandemic and global warming. International collaboration also leads to innovative technologies with wide societal benefits. For example, the HGP and development of the COVID-19 vaccine were international efforts that have transformed medicine and public health, saving many. Although costly, these collaborations pave the way for new frontiers in research from clean energy solutions to gene therapies.

Motivations of Scientists

Survey studies demonstrate that the majority of scientists from a number of countries believe international collaboration in research to be important. The study conducted by Matthew et al. (2020) only involved physicists and biologists, but their underlying motivations are

applicable across disciplines. These motivations include increased professional visibility, resource sharing, and the opportunity to create innovative ideas. Collaborative research conducted cross-borders results in higher citation impacts, contributing to scientists' professional career advancements and reputation growth (Kwiek, 2020; Persson et al., 2004; Shin et al., 2022; Tian et al., 2023). As shown by the Cold War case study, scientists also pursue international collaboration out of a genuine desire to explore the unknown. If they do not have a strong interest in their research, it is unlikely that they would invest such effort into such large, labor-intensive international projects.

The Role of Funding Agencies in International Collaboration

Research collaborations across countries rarely occur without sources of external funding. Economic limitations are cited as the most significant barrier to international collaboration (Matthews et al., 2020). It is difficult for scientists to conduct international research without financial assistance. Funding agencies play a pivotal role in international collaboration by covering travel costs, project equipment, and academic support.

There is evidence that funded projects consistently receive higher citation rates than unfunded projects (Tia et al., 2023). Given that international projects are more resource-intensive than domestic projects, the involvement of funding agencies is essential in facilitating international research. Thus, the support of funding agencies directly impacts a project's success and influence.

Motivations of Funding Agencies

While funding agencies often expressed support for global collaboration to address shared global challenges, their underlying motives are frequently tied to national interests. Mission statements from the official websites of funding agencies including the NSF, UKRI, and

DST emphasize the facilitation of international collaboration to enhance national scientific leadership and competitiveness.

The support of international collaborative research to accelerate global progress and address global challenges contradicts the desire to advance national competitiveness. Governments use international collaboration to serve diplomacy, economic growth, and technological supremacy. Since scientists rely on financial support from funding agencies and governments to conduct international research, the direction of projects and scientific expansions is heavily influenced by the motivations of these institutions.

The Cold War as a Precedent

The Cold War case study reveals how the scientific ideals of open exchange and pursuit of pure, unbiased knowledge do not alone drive scientific research. Applying the idea of social constructivism, science is driven by the social and political relationships among scientists and governments. Despite the geographical barriers and political rivalries, both the U.S. and Soviet Union encouraged scientific exchange with each other. Physics conferences such as the Rochester Series were promoted by the government with the underlying interest of gathering intelligence on the other country's technological capabilities. At the same time, individual scientists continued to prioritize "open science" and accessible knowledge. The birth of high-energy physics in this case study demonstrates that the motivations of both parties influence the path of scientific development and knowledge, leaning in favor of the governments that make international collaboration possible.

Conclusion

International collaboration is a building block of modern scientific progress. It leads to the production of knowledge that transcends borders, cultures, languages, and institutions.

International research leads to the expansion of fields, including high-energy physics and health science, and revolutionary technologies such as the LHC, ISS, and HPG. International research allows societies to address global challenges like the COVID-19 pandemic and global warming through a collective effort made by brilliant scientists and supporting governments from around the world.

For scientists, international collaboration offers a number of benefits such as access to specialized equipment, sharing of project costs, intellectual diversity, and higher professional visibility through co-authored publications. These benefits help scientists earn higher citation impacts that advance their academic and professional careers.

However, the success of international research heavily depends on the availability of external funding. High-cost, high-impact research projects such as the LHC or ISS are only feasible given substantial financial support by governments and funding agencies. As shown by Tian et al. (2023), funded projects are consistently more successful than unfunded projects in terms of citation impact. Yet, the decisions of funding agencies are shaped by national interest rather than scientific merit. The simultaneous contrasting motivations of governments to address global challenges with other countries and to act in the interest of national priorities for technological competitiveness is paradoxical. By recognizing the motivations of both the scientists participating in international research and the funding agencies supporting them, we can improve upon these research networks to truly benefit all of society.

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