

COOPERATING IN ASYMMETRIC CONTEXTS: AN INTERDISCIPLINARY APPROACH TO ST&I NEGOTIATIONS INVOLVING DEVELOPING COUNTRIES¹

Iara Leite²

What drives the implementation of international cooperation in science, technology and innovation (ST&I)? Why do negotiations in some areas evolve to concrete measures and others do not? What factors explain variations in implementation in initiatives with different countries? At which circumstances can implementation be effective from the point of view of developing countries? To answer those questions this paper proposes an interdisciplinary theoretical framework that draws on studies from international politics, political economy, foreign policy analysis, science and technology policy and history of science and technology. The paper departs from conceptual and theoretical elaborations on power and shows how they relate to ST&I and asymmetric negotiations involving developing countries and powerful counterparts. It concludes by an attempt to integrate key points raised by the revised literature, proposing four patterns on implementation and non-implementation and illustrating them with suggested cases for future research on Brazil-United States nuclear and aeronautic agreements and Brazil-China space and agriculture agreements.

Keywords: science, technology and innovation; international cooperation; power; foreign policy; developing countries.

COOPERANDO EM CONTEXTOS ASSIMÉTRICOS: UMA ABORDAGEM INTERDISCIPLINAR ÀS NEGOCIAÇÕES EM CT&I ENVOLVENDO PAÍSES EM DESENVOLVIMENTO

O que impulsiona a implementação da cooperação internacional em ciência, tecnologia e inovação (CT&I)? Por que negociações em algumas áreas evoluem para medidas concretas e outras não? Que fatores explicam as variações na implementação de iniciativas com diferentes países? Em que circunstâncias a implementação pode ser eficaz do ponto de vista dos países

1. This paper is an output of a research project that started in 2016, supported by Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq – Edital Universal 2016; Programa Institucional de Bolsas de Iniciação Científica – PIBIC) and Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (Capes; Pesquisador Visitante no Exterior – PVEX 2019). The research involved a couple of master students and several undergraduate students, who raised quantitative and qualitative information on Brazil's science, technology and innovation (ST&I) agreements with particular countries and the latter's ST&I diplomacy towards Brazil, resulting in monographs that are available at: <riicti.ufsc.br> and in a forthcoming book. Initially it was believed that statistical inferences could be drawn from a database built by Eliza Brites and Paula Werlang (PIBIC research assistants), co-supervised by this paper's author and by economist Gilson Geraldino Júnior, that systematized bilateral agreements containing ST&I elements available at the Brazilian Ministry of Foreign Affairs' Concórdia Platform. However, challenges related to building a comprehensive inventory of implementation instruments derived from specific bilateral umbrella ST&I agreements, which have also been faced by analysis beyond the case of Brazil (Fickers and Horvat, 2014), prevented big-N inferences that could lay the ground for the subsequent identification of cases to be explored by qualitative research. Therefore the research approach has been exploratory and focused on proposing frameworks and hypotheses for future research. Besides thanking the whole team involved in the project and its financing agencies, I would also like to thank Prof. John Krige for his uncountable and precious insights during and after the time I spent at Georgia Tech as a visiting researcher.

2. Associate professor at the Department of Economics and International Relations of Universidade Federal de Santa Catarina (UFSC); master in international relations at Pontifical Catholic University of Rio de Janeiro (PUC-Rio); PhD in political sciences at Instituto de Estudos Sociais e Políticos of Universidade do Estado do Rio de Janeiro (IESP/UERJ); and coordinator of CNPq research group International Relations and Science, Technology and Innovation (RICTI). Orcid: <0000-0001-6118-2459>. E-mail: <iaracleite@hotmail.com>.

em desenvolvimento? Para responder a essas questões, este artigo propõe um referencial teórico interdisciplinar que se baseia em estudos de política internacional, economia política, análise de política externa, política científica e tecnológica e história da ciência e tecnologia. O artigo parte de elaborações conceituais e teóricas sobre poder e mostra como elas se relacionam com CT&I e negociações assimétricas envolvendo países em desenvolvimento e contrapartes poderosas. Conclui em uma tentativa de integrar pontos-chave levantados pela literatura revisada, propondo quatro padrões de implementação e não implementação de negociações de CT&I e ilustrando-os com sugestão de casos para pesquisas futuras de acordos nos âmbitos nuclear e aeronáutico assinados entre Brasil e Estados Unidos e espaciais e agrícolas assinados entre Brasil e China.

Palavras-chave: ciência, tecnologia e inovação; cooperação internacional; poder; política externa; países em desenvolvimento.

COOPERANDO EN CONTEXTOS ASIMETRICOS: UN ABORDAJE INTERDISCIPLINARIO A LAS NEGOCIACIONES EN CTI INVOLUCRANDO PAÍSES EN DESAROLLO

¿Qué impulsa la implementación de la cooperación internacional en ciencia, tecnología e innovación (CT&I)? ¿Por qué las negociaciones en algunas áreas evolucionan hacia medidas concretas y otras no? ¿Qué factores explican las variaciones en la implementación de iniciativas con diferentes países? ¿En qué circunstancias puede ser efectiva la implementación desde el punto de vista de los países en desarrollo? Para responder a esas preguntas, este artículo propone un marco teórico interdisciplinario que se basa en estudios de política internacional, economía política, análisis de política exterior, política científica y tecnológica e historia de la ciencia y la tecnología. El artículo parte de elaboraciones conceptuales y teóricas sobre el poder y muestra cómo se relacionan con CT&I y negociaciones asimétricas que involucran a países en desarrollo y contrapartes poderosas. Concluye en una tentativa de integrar puntos-clave planteados por la literatura revisada proponiendo cuatro patrones sobre la implementación y no implementación de negociaciones de CT&I e ilustrándolos con sugerencias de casos para investigaciones futuras de acuerdos nucleares y aeronáuticos Brasil-Estados Unidos y acuerdos espaciales y agrícolas Brasil-China.

Palabras clave: ciencia, tecnología e innovación; cooperación internacional; poder; política exterior; países en desarrollo.

JEL: F5.

DOI: <http://dx.doi.org/10.38116/rtm28art4>

Data de envio do artigo: 18/2/2022. Data de aceite: 4/3/2022.

1 INTRODUCTION

At the onset of the covid-19 pandemic, a lot of attention has been given to international science and technology collaboration and competition (Dantas, Mascarello and Sant'Anna, 2020; Mascarello, 2020). Efforts to promote global knowledge sharing aimed at containing the pandemic have been accompanied secrecy and competition between teams working on specific vaccines, as well as by the increasing engagement of leading scientists in national response teams (Krige and Leonelli, 2021), preventing full implementation of international collaborative initiatives.

Drawing on studies from international politics, political economy, foreign policy analysis, science and technology policy and history of science and technology, this paper explores what drives the implementation of international cooperation in science, technology and innovation (ST&I). Why do negotiations in some areas evolve to concrete measures and others do not? What factors explain variations in implementation in initiatives with different countries? At which circumstances can implementation be effective from the point of view of developing countries?

Though discussions may seem highly abstract, the selection of topics has been grounded in a research on Brazil's bilateral ST&I cooperation with countries that occupy higher positions in ST&I. The article departs from conceptual and theoretical elaborations on power and shows how they relate to ST&I (section 1) and to asymmetric negotiations involving powerful countries and developing ones (section 2). Concluding remarks propose a framework to integrate key issues raised in the article by suggesting four patterns of implementation and non-implementation of ST&I agreements and illustrating them with cases of ST&I agreements signed by Brazil with the United States and China, to be further explored in future research.

2 POWER, ST&I, AND INTERNATIONAL COOPERATION

One of the main political science debates is on the faces of power: the first one refers to the ability to set agendas in a particular area; the second encompasses the ability to exclude issues from certain agendas; and the third, which can be connected to the definition of soft power, relates to the ability to change minds and preferences of counterparts, leading them to do something they would not otherwise do (Baldwin, 2013). Whereas those debates have influenced, to some extent, elaborations on power in international relations (IR), the most traditional realist assessments of power in IR are centered in the so-called "capabilities", that is, power resources accumulated by a country in different dimensions – military, economic, territorial etc.

Though, for instance, IR realists acknowledge the role of ST&I in adding up to economic and military capabilities (Morgenthau and Thompson, 2004; Waltz, 1979),³ in general ST&I is not a central topic to IR (Mayer, Carpes and Knoblich, 2014; Skolnikoff, 1993; Weiss, 2005), and few have offered encompassing analysis on ST&I as a source of power. According to Susan Strange (1994, p. 121), part of the puzzle of grasping the centrality of knowledge in international political economy dynamics relates to the fact that the structural power emanating from

3. According to Waltz (1979) ST&I can be a vehicle for autonomy, for instance by allowing the discovery of alternative energy resources, but if technological autonomy is chosen to the detriment of competitiveness a state can lose power.

it relies not only on the ability to provide knowledge, but also to deny it – either through material constraints, by restricting transmission channels, for instance; or through ideational ones (having the power to be acknowledged by others as possessing the “right”, desirable knowledge). This means that ST&I is not simply something a country possesses and a means to accumulate hard capabilities; it is also part of a performance that influences decisions made by others – such as to which universities a country should send its brightest students or where multinationals should allocate research and development (R&D) activities.⁴

What is commonsense in liberal-inspired IR scholarship is the acknowledgement of science and technology as causing increasing interconnectedness and leading states to abdicate to fully autonomous decision-making in order to face common challenges. According to Skolnikoff (1993), however, as science and technology operate in specific (and diverse) social, political and economic contexts they cannot be treated as pure independent variables. He also disagrees that technological revolutions have been undermining basilar principles of international relations. Sovereignty still matters, though autarchy should not be pursued as economic competitiveness demands taking part in global networks. In that context power is not only built on traditional geopolitical capabilities such as population size and natural resources, but also, and increasingly, on people’s skills and policy effectiveness (Skolnikoff, 1993).

Policy effectiveness can be connected to early discussions on capabilities related to the quality of government – or the ability to select achievable policy aims, design legitimate and representative policies and allocate the needed material and human resources to implement them (Morgenthau and Thompson, 2004) – and to the very definition of the state:

[a]n organization, composed of numerous agencies led and coordinated by the state’s leadership (executive authority) that has the ability or authority to make and implement the binding rules for all the people as well as the parameters of rule making for other social organizations in a given territory (Migdal, 1988, p. 19).

State-society relations are a key element of policy effectiveness and of power as both depend on a state’s ability to mobilize the tangible and intangible resources needed from societies to implement policies (Kugler and Domke, 1986; Mastanduno, Lake and Ikenberry, 1989; Migdal, 1988). State-society relations also influence power in international negotiations because the degree of governmental porosity to societal demands impacts the size a country’s win set:

4. It has become popular, among science diplomacy scholars and policy analysts or documents (Flink and Schreiterer, 2010; Ruffini, 2017; The Royal Society, 2010), to state that science is an instrument soft power, that is, “the ability to affect others through the co-optive means of framing the agenda, persuading, and eliciting positive attraction in order to obtain preferred outcomes” (Nye, 2011, p. 20-21). Many science diplomacy documents and analysis, however, tend to hold a positive normative stance towards science and its role in bringing cooperation and peace to relations among states (for a couple of very recent critical reviews of science diplomacy discourses and practices, see Adamson and Turchetti, 2020 and Ruffini, 2020).

the more porous, the more domestic preferences are imprinted, and therefore the less an international negotiator will be able to make concessions (Putnam, 1988). At the same time, implementing international agreements depends on societal actors, thus they need to be involved in negotiations if there is a real interest in effecting their results – otherwise a country's reputation in future negotiations can be compromised, though leaders can allege defection was caused not by their will, but because of domestic opposition (Putnam, 1988).

Nevertheless, as acknowledged by both economic and military-centered analysis (Haskel, 1980; Kugler and Domke, 1986), not only domestic dynamics matter in the search for policy effectiveness and power. Being able to raise foreign resources can be crucial for several reasons, including alleviating pressures on extraction from domestic societies (Mastanduno, Lake and Ikenberry, 1989); and obtaining political support from foreign counterparts that either strengthens the negotiator's position *vis-à-vis* its own domestic interest groups and institutions (in case powerful ones oppose such position) or raise the costs of non-agreement by the counterpart negotiator (by mobilizing the latter's constituents to support an agreement) (Putnam, 1988).

In international ST&I dynamics, foreign resources involve not only the pecuniary kind, but also access to research infrastructure, discoveries, evidences, datasets, and talents. How accessing them relates to power is clearly put by Skolnikoff (1993, p. 229) when he states that

a nation's performance in science and technology, vital to its competitive success, is now dependent not only on its indigenous scientific and technological capabilities, but also on its ability to stay abreast of progress in other advanced countries and to use that progress effectively in its own research and innovative activities.

However, it is important to bear in mind that ST&I collaboration is not necessarily about ST&I itself. In some situations, the need to strengthen an ally in the face of a challenger may favor critical knowledge sharing to support real development of a partner, even to the detriment of one's economic interests (Mastanduno, 1991). In other situations, the private sector can have a critical role in implementation by hindering it when knowledge sharing can compromise exports (Moravcsik, 1992). One might also wonder whether technological sharing could be promoted even in such cases, especially when the partner's ability to really learn from and use that knowledge is severely limited.

As also acknowledged by literature on science diplomacy, a rapidly diffusing policy field in the context of growing competition for access to emerging markets (Flink and Schreiterer, 2010), the promotion of science networks can be a vehicle for political purposes, such as using ties between scientists to improve the image of a country *vis-à-vis* the society of an unfriendly state; or a tool to advance

economic purposes, using collaboration to introduce a higher added value product still not exported to the partner country, to identify biodiversity with potential commercial applications, or to attract talents (Leite and Gayard, 2019).

Historians of science and technology have long studied connections between ST&I, state power and international relations. At least three features of their findings should be stressed. First, differently from most IR studies (Baldwin, 2013), power related to ST&I is not assumed to be exclusively an independent variable, as a country does not build its ST&I power on its own indigenous efforts and resources only. That is clear, for instance, when Krige (2014, p. 234), analyzing United States-United Kingdom nuclear scientific collaboration in the 1960s, stressing it was not symmetric, but still reciprocal, states that “American ‘self-sufficiency’ in weapons development is a myth; U.S. weapons are hybrid objects, not purely national products.” Nevertheless, establishing scientific and technological transnational networks is not enough for promoting one’s advancement in science and technology. Preparedness to receive and use scientific and technological resources from abroad has also been crucial since the emergence of modern science (Basalla, 1967; Mcleod, 2000), and it is not related to technical and institutional capacities only. Trust is also a crucial element, and whereas it was present among United States-United Kingdom nuclear scientists it lacked in many other relations throughout the centuries – for instance, between Russian and Transhimalayan communities in the 19th century, when the former tried many times, in vain, to use knowledge on the region that Russian geographers became acquainted with while interacting with their Victorian counterparts (Raj, 2002).

Second, differently from IR liberal scholarship inspired in game theory, historians of science and technology do not see cooperation and competitiveness as opposite dynamics (Leite and Gayard, 2019). Cooperation is not only about strengthening its participants’ competitiveness towards outsiders (Axelrod, 2006), but it can be promoted to enhance a state’s power vis-à-vis the very partners involved in collaborative initiatives. Again, this is visible in nuclear affairs, where

[t]echnological collaboration allows access to the programs of the other; denial closes down the dialogue. Collaboration may encourage proliferation, but it can also redirect or even retard it. Scientists and engineers who have access to the research sites and plans of their foreign colleagues can gain a pretty good idea of their level of competence, and can often infer from that and informal conversations what their future plans are (Krige, 2016, p. 164).

In scientific and technological nuclear collaboration involving the United States in the 1960s its power emanated from the ability to define the agenda, both in delimiting which technologies would be denied and which would be shared (Krige, 2016) and under which institutional structure collaboration would be implemented, mainly (though far from exclusively) with untrusted partners. By that time Gaullist France was already a nuclear power, and the United States not only sponsored its

vigilance by other European countries through support to the creation of the European Launcher Development Organization (Eldo), but also took part, through National Aeronautics and Space Administration (Nasa), at the development of its joint satellite launcher, making sure that propulsion technology sharing would rely on non-storable liquid propellants – therefore not adding up to France’s missiles program, which relied on solid fuels (Krige, 2014). In other cases, denial to strengthen other countries’ nuclear capacities was accompanied by incentives aimed at raising their symbolic status as technological powers in other areas, such as when Johnson sponsored United States collaboration in civil space with Germany (Krige, 2014) and in physical environmental sciences with India (Doel and Harper, 2006).

Third, a group of historians of science claims that the study of transnational dynamics – scientist-to-scientist collaboration – should not be isolated from traditional approaches on the role of states and their interests. Though scientists can be seen as agents in the sense that they connect to each other following endogenous scientific purposes – enhancing their research’s visibility and raising or sharing financial, physical and human resources (Wagner, 2006; Wagner, Park and Leydesdorff, 2015) –, there are also patronage mechanisms through which states shape scientific exchange agendas and environments (Turchetti and Roberts, 2014) or simply allow *laissez-faire* to operate in order to create an apparently neutral, horizontal and trustful atmosphere, and therefore a very proficuous one for intelligence gathering (Krige and Barth, 2006). Studies on the intersection between transnational networks and traditional international dynamics usually focus on scientific collaboration during the Cold War, but according to a volume on geosciences “the coexistence of scientific and intelligence ambitions should be regarded as ubiquitous rather than episodic” (Turchetti and Roberts, 2014, p. 4).

3 INTERNATIONAL ASYMMETRIES AND ST&I NEGOTIATIONS

Many science and technology policy scholars have indicated that after the Cold War there has been a growth in scientific transnational networks, that such growth has not been influenced by states and that the open character of such networks can favor less developed countries. For instance, Wagner, Park and Leydesdorff (2015, p. 12) found that

[t]he growth of the global network is an emerging organization added to (and possibly superseding) the national model. The organization may be open to new members, since greater density of the network and the lowered betweenness measures suggest that fewer of the communications pass through the leading nodes or countries. This may mean reduced influence for advanced countries, and shifting of power to some “peripheral” nodes. (...) This dynamic system, operating orthogonally to national systems, is increasingly difficult to influence and even less amenable to governance as it grows. This does not mean that nations must build

and international governance mechanism, but that they must learn to manage and benefit from a network.

However, though data suggest that emerging countries such as the BRICS have enhanced their participation in excellence research and in networks with traditional leading countries (Bornmann, Wagner and Leydesdorff, 2015), part of them and many other developing countries can still face structural challenges that hinder the effective management of scientific, and also technological, networks.

Literature on comparative foreign policy indicates that not all countries are equally able to mobilize domestic and foreign resources in order to achieve national interests. There is plenty of discussion on how states behave differently depending on the domestic structure of state-society relations. In contrast to authority centralization in strong states (Katzenstein, 1976) or hard states (Mastanduno, Lake and Ikenberry, 1989) – due to factors such as the historical precedence of bureaucratic institutions over representative ones (Katzenstein, 1976) or the need for the state to take a leading role in industrialization (Evangelista, 1997) –, in weak states or soft states authority is decentralized and policy processes are bottom up (Evangelista, 1997). Since the latter are more porous to societal demands, and more constrained by social resistance, they tend to develop international strategies in order to pursue state goals, whereas hard states can achieve the latter through domestically-extracted resources. If a soft state is also a powerful one it will be more successful in extracting resources from abroad, and have less incentives to rely on domestic mobilization. Less domestic mobilization tends, however, to negatively impact the competitiveness of soft and powerful states in the long run. This challenge can also characterize hard-powerful states, which, though being able to combine internal mobilization and external extraction, rely on state-led mobilization, and therefore on less effective wealth accumulation strategies (Mastanduno, Lake and Ikenberry, 1989).⁵

Mastanduno, Lake and Ikenberry (1989) also explicitly incorporate the case of developing countries and “late comers” to their model. Part of them can be grouped in a less-powerful-soft-state pattern. Finding a hard time to mobilize and extract resources domestically, and not possessing coercive capabilities to extract resources from abroad, states on that group can develop international validation strategies aimed at strengthening their legitimacy at home, such as obtaining

5. Domestic structures affect not only foreign policy decision-making, but also innovative capacities. Researching the case of weapons innovation during the Cold War, Evangelista (1997) claims that whereas the American program was grounded in independent entrepreneurs' initiatives – whose strength emerged historically due to the fact that the United States industrialization process was more gradual, less constrained by international pressures and led by the private sector –, in the case of the soviets weapons innovation processes relied in top down decisions, responding to the need to counter innovations made by the United States. Contrarily to the United States, Russia's industrialization pattern, just like China's, is a “late, late” one: “[u]nder extreme international pressure, communist elites in these countries undertook costly campaigns of forced-draft industrialization to catch up with their more advanced competitors. The political outcome of such ‘revolutions from above’ included highly centralized, strong states with weak, even atomized societies” (Evangelista, 1997, p. 209).

symbolic support from international organizations. However, those strategies neither contribute to accumulating international power nor to effective domestic mobilization, as extraction happens to the benefit rent-seeking coalitions. Less powerful but hard, centralized states, would be able to escape that trap as, though still unable to extract resources from abroad, they would succeed in internal mobilization and therefore in wealth accumulation.

Developing countries can be less powerful not only in the sense of not being able to extract resources from abroad, but also to control the access of outsiders to their domestic resources (Haskel, 1980). This weakness can be associated to a pattern Migdal (1988) calls “weak states, strong societies”, that is, domestic structures that are characterized by policy implementation ineffectiveness (even in cases where leaders do want social changes to take place and apparently possess the necessary means to effect them) and resistance from strong societal groups that can capture parts of the state or be supported by them. In such situations noncompliance is the rule, and the latter

is not simply personal deviance or criminality or corruption; rather, it is an indication of a more fundamental conflict over which organizations in society, the state or others, should make these rules. These struggles are not over precisely which laws the state should enact or how the state’s laws or constitution should be interpreted; these struggles, after all, are decided within *state* organs, legislatures and courts. Instead, these struggles are much more fundamental, reaching beyond marginal deviance and beyond the formal roles of any existing political institutions in the society. These struggles are over whether the state will be able to displace or harness other organizations – families, clans, multinational corporations, domestic enterprises, tribes, patron-client dyads – which make rules against the wishes and goals of state leaders (Migdal, 1988, p. 31).

The strength of societal groups in developing countries described by Migdal (1988) is historically imbricated with transnational connections built with the global market backed by powerful states which, in a context marked by the emergence of the Industrial Revolution in Europe and its technological and administrative impacts, have been able to access and manage societies in a global scale aiming at guaranteeing markets, supplies and commodities.⁶

6. The historical processes that pervade weak-states-strong-societies structures are complex but can be summarized as follows: starting in the middle of the 19th century and having fully integrated the whole globe by the beginning of the 20th century, a sudden and deep European-states-supported penetration of the world economy in developing regions weakened strong societal groups that had previously been isolated from the influence colonial empires and new independent governments. Western-inspired policies implemented by indigenous regimes (either to comply to Western powers or because they believed they were the formula to wealth and power) ended up strengthening societal groups that kept successfully resisting centralization. That was the case, for instance, of (not-coincidentally) similar shifts in land tenure in many disconnected parts of the developing world that resulted in increasing yields and export crops. Though many leaders expected to have more control over their respective territories, landlords hostile to centralization emerged and accumulated strength thanks to their increasing integration to the world market economy and to the support of local populations benefited by it (Migdal, 1988).

Domestic structures that are particular of the trajectory of developing countries can produce very specific effects on their foreign policy, suggesting limitations of foreign policy frameworks built on empirical evidence from developed countries. One of the most popular frameworks is the organizational process one (Allison, 1971), which focuses on how foreign policy decisions made by leaders are delimited by regularized patterns and priorities developed under bureaucratic organizations specialized in particular issues and whose permanent staff systematically filters a great volume of information collected by several input-contact points. In developing countries bureaucracies are not as complex and as differentiated, and therefore not as systematic in acting on information – a role that is usually performed by different people in different administrations and also relying on few input-contact points – and in channeling it to top decision makers. The latter's choices in foreign policy, therefore, are not circumscribed by bureaucracies in a consistent and systematic way. In that context leaders may find the information or people who transmit them unreliable and ignore previous decisions made by subordinates (Migdal, 1972).

A second popular foreign policy approach is the bargaining one, called “bureaucratic politics paradigm” by Allison (1971). It focuses on the interaction between leaders with different stakes, personalities and hierarchic positions that possess power and skills to either promote or oppose a certain agenda, depending on the strength of the organization they lead, its relations with constituencies and the salience of the issue they deal with in a certain context. That framework is equally insufficient to understanding developing countries' foreign policy since leaders cannot necessarily rely, for power and information, on the bureaucracies they head (as the latter are institutionally weaker) and cannot build strength on relations with the public, as societies are not differentiated enough to produced specific organized groups that can support leaders in advancing or vetoing agendas (Migdal, 1972).

Given such limitations, analysts studying developing countries should focus on leaders and the choices they make to realize goals such as using foreign policy as a tool to guarantee political stability and social cohesion at home. The range of pursued goals would be more restricted since leaders cannot ignore the preferences of more powerful countries; gather less resources to allocate to foreign policy as the available ones are absorbed by immediate domestic demands – in some extreme cases leading to no presence at all at the international arena; count on less systematized information on several foreign policy issues. In a context marked by deep domestic divisions ideology can end up playing a larger role in delimiting choices (Migdal, 1972).

Very recent findings made by a research on Brazilian bureaucracy conducted by the Institute for Applied Economic Research (Ipea) can also shed light on the source of bureaucratic weakness that can characterize many developing countries.

Relying on data analysis for the 1999-2017 period, Lopez and Silva (2020) found that Brazilian direction and advisory federal bureaucratic staff (the so-called DAS), which are crucial to the whole policy cycle, including planning and implementation, remained in office for an average of 25 months only. A lot of them, specially the high-ranked ones, were pointed by ministries, whose average time in charge was 21 months. The criteria for picking staff have been far from based on merit only, resulting, together with high staff turnover, in disincentives for permanent staff to accumulate more skills and expertise. According to the authors,

[g]rowing intersectoriality and complexity in the design and management of federal programs render ruling bureaucracy an indispensable source of expertise to manage them and give continuity to the administration's projects. Staff instability becomes a risk to management success. The problem is aggravated when turnover adds to the entrance of people that do not possess accumulated knowledge, without experience in public management in specific areas (Lopez and Silva, 2020, p. 29).

The propositions above pose crucial implications for the study of international cooperation and asymmetry in international negotiations. First, in assessing the effectiveness of international cooperation over time one cannot assume endurance necessarily results from both parties being satisfied. In a context marked by uneven political and social institutionalization, parties may not be equally able to assess gains and losses over time. As acknowledged by Axelrod (2006) as a limitation of his model, the players' ability of knowing what really happened in previous games to make choices on whether to cooperate or not in the current game (thus protecting their own gains and not ending up as a "suckers") cannot be taken for granted. Even not considering previous games the ability of top negotiators in developing countries to make decisions that produce overall domestic gains can be severely limited by internal divisions and by lack of consistent information on opportunities abroad and on the implications of decisions to domestic gains.

Second, one can expect, on the one hand, countries where political and social institutionalization is higher to have more restricted win sets, and therefore more power to imprint preferences, if not in written agreements themselves, in their implementation (or non implementation). On the other hand, where political and social institutionalization is lower one may find either broader win sets, as preferences are not restricted by specialized domestic groups and bureaucracies; or restricted ones resulting from higher levels of politicization one might expect in contexts at which ideology frames assessments more frequently and may hinder the conclusion of negotiations that would indeed be advantageous (or, on the contrary, ideology may lead a country to conclude negotiations that will not be advantageous at all or that will produce very limited gains if compared to the ones obtained by the powerful party).

Finally, countries with higher levels of social and political institutionalization can influence the results of international negotiations because they gather more qualified information coming from bureaucracies and from societal organizations. The role of information as an instrument of power is extensively studied by IR scholars. More informed groups can exert influence in positions adopted by their governments in international negotiations (Milner, 1997), but one can also expect more informed governments, receiving inputs from specialized official or societal organizations, to have more power in bilateral negotiations (including power to keep certain issues out of the agenda). In developing countries, even if governmental and societal institutions are invited to take part at defining positions in international negotiations, their limited differentiation and international experience can constrain their ability to provide qualified inputs to decision-makers. Besides, individuals and institutions with extensive transnational ties can have their preferences delimited by priorities that emerge from partners' communities and needs.

Propositions on power, domestic structures and foreign policy also have implications to ST&I dynamics and can explain Wagner's (2008) assertion on developing countries having a tendency to establish generic ST&I priorities that reflect global emerging scientific and technological agendas and to imitate developed countries' agendas and investments. Less differentiated bureaucracies and organized social groups and less power to control foreign access to domestic society and resources can mean that foreign policy decision-makers themselves have a hard time in directing information collection and other ST&I efforts to areas where they have exchange or absorption capacity and that connect to the solution of local problems (and to industrial policies).

On the one hand, in a context marked by few contact points to collect and process information on opportunities abroad, and by domestic divisions, the symbolic value of science and technology may have a larger weight in decisions than the economic one. The latter demands high levels of specialization and collaboration, whereas the former can be easier to accomplish, for instance by focusing resources in a big research infrastructure, visible to both foreign and domestic audiences (certainly the kind of validity strategy that will keep a country in a permanent white-elephant trap).

On the other hand, powerful foreign agents possess more material and institutional resources to direct agendas in weaker countries to their own priorities. But power disparities also include intangible, soft dimensions, as developed countries are usually seen as superior and more experienced in ST&I – a perception that is becoming common also for Southern countries, mainly China –, conferring authority to ST&I individuals and organizations acting towards developing countries, and therefore enhancing their influence over bilateral ST&I agendas.

Therefore, power disparities are not only related to the capacity to identify priorities in each part of the globe and gathering the material resources needed to propose or implement collaboration in some areas and not in others. It is also about, intentionally or not, making governmental and non-governmental partners feel that it is also their interest to pursue foreign agendas.

Of course one cannot assume those dynamics to endure across time and sectors, and in the case of ST&I negotiations one does find developing countries that became a reference in certain areas in a more equal bargaining position vis-à-vis developed ones. Though changing general public perceptions on the former's weaknesses can still be limited by material and ideological constraints – as sectors producing innovations do not necessarily possess language skills and other resources to access diffusion channels deemed as “legitimate” –, acknowledgement of the existence of ST&I capacities in developing regions is confirmed by increasing competition between European countries, through science diplomacy strategies, to access knowledge and other ST&I resources in emerging economies (Flink and Schreiterer, 2010).

Though imbalances may still endure, as capacities to screen global knowledge production and to extract resources from abroad are uneven, drawing on studies on economic complexity one can assume that the process of becoming a reference in certain exports is grounded in more specialization and collaboration in domestic sectors related to them (Hausmann et al., 2011). But one may expect that international collaboration has been a part of that trajectory, probably shifting from initial unequal partnerships to more equal ones as progress was made. The role of historical relations in fostering trust among the involved parties, to which cultural proximity may also be a key factor, is also important, as previously discussed. Finally, one expects that being grounded in collaborative domestic and international networks makes reference sectors in developing countries more likely to have capacities to raise information on opportunities abroad and feedback them to their own strategies and to top state decision-makers, though the latter's preferences and support may shift from time to time (and for the reasons already presented such shifts may be more frequent in developing countries).

4 CONCLUSION

The ability of a country to become reference in ST&I is not related to its indigenous efforts only. Being able to screen knowledge produced elsewhere, and supervise foreign access to one owns resources, is crucial for a country to be competitive in international relations. As knowledge flows are key to prosperity and security, collaboration between knowledge repository actors, such as scientists and enterprises, does not necessarily take place in a pure transnational domain. However, not all states are equally able to supervise transnational knowledge flows.

Powerful countries are able to set the agenda of ST&I collaboration, denying access to certain knowledge and promoting sharing in other areas. They also gather soft power, in the sense that other countries can incorporate their preferences as their own. This feature can be particularly salient when acting towards countries where societal organization around ST&I issues is weak and where bureaucracies that integrate specific sectorial innovation systems are not strong enough to provide a clear guidance on their own needs and on which countries and sectors fit them best.

This paper gathered contributions from several areas to shed light on what can drive the implementation and non-implementation of ST&I cooperation involving developing countries and powerful counterparts. A crucial variable is related to the latter's preferences. If an ally is needed in times of structural security salience assessments, knowledge sharing can be hindered in critical security issues, but promoted in other areas. To which extent access to foreign knowledge will be effective, however, depends on the preparedness of the partner country to receive and use that knowledge to promote national development. Such preparedness is higher in sectors at which the receiving country has already made innovative advances. Effective knowledge sharing can also be strongly influenced by previous bilateral collaborative initiatives which can forge trust and promote a shared cultural environment.

On the contrary, if security is not salient, and if economic competitiveness drives the powerful country, ST&I collaboration can be hindered in sectors at which it is a real or potential reference in terms of exports, unless the partner country is not prepared to absorb related knowledge (which can be exchanged, for instance, for political support or market access). This last strategy can be particularly effective if the partner country focuses on international validation strategies and on the symbolic dimension of ST&I, instead of on its real impact on development. Implementation can also be promoted in sectors at which the partner country has already made advances as a means to identify talents and other types of ST&I resources that can enhance the competitiveness of the powerful country.

In an attempt to integrate implementation and non-implementation in ST&I asymmetric cooperation in a coherent framework, and relying on illustrations drawn from cases of United States and China agreements with Brazil, four patterns can be proposed as a suggestion for future research avenues.

In *pattern 1* the powerful country, "A", is not interested in implementing collaboration with "B" in a certain area because doing so will risk the former's security. "A" either does not trust "B" or is cautious not to share knowledge because other untrusted players can later benefit from it. Collaboration may still be promoted, either directly or indirectly (through the promotion of arrangements involving allies), as a means to get information on "B's" advancements and intentions, but sensitive knowledge will not be shared by "A".

Non-implementation for security reasons is a pattern traditionally found in constraints to knowledge circulation imposed by United States non-proliferation strategies. Attempts to hinder Brazil's access to nuclear knowledge can be identified already in the 1940s, when the United States, aiming at monopolizing the global supply of fissile raw material (mainly uranium and thorium), negotiated a secret agreement with Brazil, which hosted the second richest then known deposits of monazite (from which thorium is usually extracted). Provisions on the July 6th, 1945 Memorandum of Agreement (Berle Junior, 1945) related to knowledge flows were highly vague, suggesting such demand came from Brazilian negotiators and that it was not in the interest of the United States to compromise on details, just as it had previously happened in negotiations with the Belgians (Helmreich, 1986). The attempt to deny Brazil's access to nuclear knowledge was very explicit in a March 1947 secret memorandum addressed to under secretary of State Acheson, when the United States government found out Admiral Alvaro Alberto was negotiating the sales of a small quantity of monazite to Canada. If that operation happened, the United States government would not oppose, assuming that "there would not be any exchange of scientists", demanded by the Brazilian government (United States, 1947).

Knowledge denial can be accompanied by the promotion of collaboration in other areas (*pattern 2*), making "B" believe it can become a technological power in areas that do not jeopardize "A". Depending on how much "B" is needed in "A's" strategy to balance a powerful enemy country, "A" can make efforts to really contribute to "B" ST&I capacities, and doing so demands focusing on the implementation of cooperation in areas at which "B" does have an absorptive capacity. This strategy can demand compensating domestic economic sectors at "A" that can be negatively affected by the support to a potential competitor in that area, and maybe implementing initiatives through indirect arrangements (for instance through international organizations), or simply allowing transnational knowledge flows to operate freely in sectors that can take advantage of them.

It is very likely that the United States' indirect support, via Inter-American Development Bank, to the creation and structuring of Empresa Brasileira de Pesquisa Agropecuária (Embrapa) (Cabral, 2005; Embrapa, 2006), and direct sponsoring of knowledge flows that would strengthen institutions crucial to the creation of Empresa Brasileira de Aeronáutica S/A (Embraer), illustrate *pattern 2*, therefore representing a positive disarmament strategy in a context marked by nuclear knowledge denial to Brazil. One the benefited institutions was the Brazilian Aeronautical Institute of Technology (Instituto Tecnológico de Aeronáutica – ITA), which earned support from the Point IV Program and later the Alliance for Progress (Forjaz, 2005). For instance, the United States Agency for International Development, by means of an agreement with the University of Michigan signed

in 1962 and implemented between 1964 and 1967, earmarked \$ 1.4 million that allowed 14 University of Michigan professors to create a mechanical engineering graduate program at ITA, equip its laboratories, and promote contacts between ITA and other institutions, including the industry (Mouzon, 1967).

It is important to bear in mind, however, that the preferences of the most powerful country are not an enough and sufficient condition to explain international ST&I agreements implementation and effectiveness. In the case of United States-Brazil aeronautic cooperation initiatives like the one mentioned above happened in a context marked by the existence of a collaborative trajectory that dated back to the Second World War, when United States military attack aircraft were assembled in Brazil and the United States Air Force trained Brazilian pilot and aeronautic engineers (Marques, 2011). ITA's creation itself had been supported by an agreement that sponsored a mission of professors from the Massachusetts Institute of Technology (Forjaz, 2005). Also, the aeronautic innovation sectorial system was already being built in Brazil (Marques, 2011), something that can have facilitated tacit knowledge accumulation and strengthened capacities to learn from external sources of information and knowledge, including international collaboration, directly or indirectly (involving other Brazilian aeronautic system actors).

That case can be contrasted with the space innovation system in Brazil, whose fragility can explain the limited effectiveness of the China-Brazil Earth Resources Satellite Program (CBERS) in terms of its impact on Brazilian high tech industry (Fernandes e Garcia, 2013). Even in the case of Embraer, Marques (2011) found a historical dependency pattern on foreign highly value added parts. But the point here is that a powerful country can promote knowledge flows to another potentially competing country exactly because it is aware that latter will not be able to absorb such knowledge and, to the contrary, not support knowledge flows in sectors at which the competing country possesses a stronger sectorial innovation system. The latter might configure as a possible explanation, for instance, to difficulties faced by Embrapa in implementing part of cooperation agreements signed with the Chinese Academy of Agricultural Sciences and other organizations that paved the activities of Embrapa's virtual lab (Labex) in China, initiated in 2012. According to a Brazilian diplomat, China's interests in Embrapa were not so great after the Asian country became a genomic power (Sly, 2017). But cultural and language barriers, as well as the relatively recent emergence of agriculture in the agenda of bilateral ST&I collaboration with China, are also mentioned by Embrapa's researchers as factors that challenged the adequate implementation of Labex's activities in Beijing (Sly, 2017).

Those cases can integrate future research agendas aimed at testing the last two patterns of implementation and non-implementation of ST&I agreements. In *pattern 3* country “A” does not face a salient security issue involving country “B”. Their relations are marked by economic competitiveness. Country “A” is not interested in sharing any knowledge that can be absorbed by its competitor, so areas at which “B” is already a reference will not be part of the agenda, or at least no efforts will be made to support their implementation. If implementation happens “A” will avoid sharing knowledge, but can support schemes at which key knowledge produced by country “B” can be identified.

On the other hand, “A” can promote implementation at areas at which “B” is not a real or potential reference (*pattern 4*). We can even expect “A” to issue discourses that makes “B” feel an important player in that area, and as “B” does not have enough information to know its real stakes, and the other country’s intentions, it can trust “A” and really believe it will be able to advance in that area. If country “A” oversees crucial ST&I transnational dynamics involving its innovation system’s actors (which could happen in either centralized states or at small ones, market by a strong cohesion between decision-making and implementing ST&I agreements), it may end up not allowing any balanced ST&I relation with “B” to develop. The ability of “B” to understand the iterated losses of collaborating with “A” will depend on the strength of its bureaucracies and government-societal articulations in certain areas.

The cases suggested above as avenues for future research to test the proposed framework are not to be confused with a valorization of Brazil’s ST&I collaboration with the United States in contrast to collaboration with China. In fact, both must be analyzed in specific historical periods (as security has not been a permanent salient issue in United States-Brazil relations, for instance). Also, the focus on the preferences of powerful countries should not obliterate other variables that can explain patterns of implementation or non-implementation of ST&I agreements, such as the presence or absence of a collaborative trajectory. And, finally, considering the preferences of a stronger party does not mean developing countries cannot be agents in ST&I agenda setting and implementation. Negotiation strategies in asymmetric contexts are abundant, and promoting dialogue between official negotiators and domestic innovation system actors with international experience and strongly linked to strategic local problem solving can help channel crucial information to decision-makers, restrict win-sets and guarantee that future implementing knowledge repository institutions will be involved in the design of agreements.

REFERENCES

- ADAMSON, M.; TURCHETTI, S. Friends in fission: US-Brazil relations and the global stresses of atomic energy, 1945-1955. **Centaurus**, p. 1-16, 2020. Retrieved from: <<https://bit.ly/3z7359G>>.
- ALLISON, G. T. **Essence of decision**: explaining the cuban missile crisis. Boston: Little, Brown and Company, 1971.
- AXELROD, R. **The evolution of cooperation**. New York: Basic Books, 2006.
- BALDWIN, D. A. Power and international relations. In: CARLSNAES, W.; RISSE, T.; SIMMONS, B. (Ed.). **Handbook of international relations**. 2nd ed. Los Angeles: Sage, 2013. p. 273-297.
- BASALLA, G. The spread of Western science: a three-stage model describes the introduction of modern science into any non-European nation. **Science**, n. 156, p. 611-622, 1967.
- BERLE JUNIOR, A. A. The ambassador in Brazil (Berle) to the secretary of State. In: UNITED STATES. United States Department of State. **Foreign relations of the United States**: diplomatic papers, 1945 (general: political and economic matters). Washington: U. S. Government Printing Office, July 10, 1945. v. 2. Retrieved Dec. 18, 2021, from: <<https://bit.ly/3ayieGU>>.
- BORNMANN, L.; WAGNER, C.; LEYDESDORFF, L. BRICS countries and scientific excellence: a bibliometric analysis of most frequently cited papers. **Journal of the Association for Information Science and Technology**, v. 66, n. 7, p. 1507-1513, 2015. Retrieved from: <<https://bit.ly/3zcW9rA>>.
- CABRAL, I. **Sol da manhã**: memória da Embrapa. Brasília: Unesco, 2005.
- DANTAS, A. C.; MASCARELLO, J.; SANT'ANNA, N. R. Brazil's international cooperation in science, technology and innovation in the context of the covid-19 pandemic. **Boletim de Economia e Política Internacional**, n. 27, p. 55-76, 2020. Retrieved from: <<https://bit.ly/3m5E9aJ>>.
- DOEL, R.; HARPER, K. Prometheus unleashed: science as a diplomatic weapon in the Lyndon B. Johnson administration. **Osiris**, v. 21, n. 1, p. 66-85, 2006.
- EMBRAPA – EMPRESA BRASILEIRA DE PESQUISA AGROPECUÁRIA. **Livro preto**: sugestões para a formulação de um sistema nacional de pesquisa agropecuária. Brasília: Embrapa Informação Tecnológica, 2006.
- EVANGELISTA, M. Domestic structure and international change. In: DOYLE, M. W.; IKENBERRY, G. J. (Ed.). **New thinking in international relations theory**. Boulder: Westview Press, 1997. p. 202-228.

FERNANDES, L.; GARCIA, A. **Cooperação científica e tecnológica para o desenvolvimento dos BRICS: o caso do programa CBERS**. Rio de Janeiro: BRICS Policy Center, 2013.

FIKKERS, D. J.; HORVAT, M. (Ed.). **Basic principles for effective international science, technology and innovation agreements**. Brussels: European Commission, 2014.

FLINK, T.; SCHREITERER, U. Science diplomacy at the intersection of S&T policies and foreign affairs: toward a typology of national approaches. **Science and Public Policy**, v. 37, n. 9, p. 665-677, 2010.

FORJAZ, M. C. S. As origens da Embraer. **Tempo Social**, v. 17, n. 1, p. 281-298, 2005. Retrieved from: <<https://bit.ly/3N5YI2U>>.

HASKEL, B. G. Access to society: a neglected dimension of power. **International Organization**, v. 34, n. 1, p. 89-120, 1980.

HAUSMANN, R. et al. **The atlas of economic complexity: mapping paths to prosperity**. Cambridge, Massachusetts: MIT Press, 2011.

HELMREICH, J. E. **Gathering rare ores: the diplomacy of uranium acquisition, 1943-1954**. Princeton: Princeton University Press, 1986.

KATZENSTEIN, P. J. International relations and domestic structures: foreign economic policies of advanced industrial states. **International Organization**, n. 30, p. 1-45, 1976.

KRIGE, J. Technological collaboration and nuclear proliferation: a transnational approach. In: MAYER, M.; CARPES, M.; KNOBLICH, R. (Ed.). **The global politics of science and technology: concepts from international relations and other disciplines**. London: Springer, 2014. v. 1, p. 227-241.

_____. **Sharing knowledge, shaping Europe: US technological collaboration and nonproliferation**. Cambridge, Massachusetts: MIT Press, 2016.

_____. Introduction: writing the transnational history of science and technology – how knowledge moves. In: KRIGE, J. (Ed.). **How knowledge moves: writing the transnational history of science and technology**. Chicago: The University of Chicago Press, 2019. p. 1-31.

KRIGE, J.; BARTH, K. Introduction: science, technology, and international affairs. **Osiris**, v. 21, n. 1, p. 1-21, 2006.

KRIGE, J.; LEONELLI, S. Mobilizing the transnational history of knowledge flows: covid-19 and the politics of research at the borders. **History and Technology**, v. 37, p. 125-146, 2021. Retrieved from: <<https://bit.ly/3z6eDKr>>.

KUGLER, J.; DOMKE, W. Comparing the strength of nations. **Comparative Political Studies**, v. 19, n. 1, p. 39-69, 1986.

LEITE, I. C.; GAYARD, N. A. Quatro abordagens sobre a interação entre cientistas e estados nas relações internacionais. **Relações Internacionais**, n. 62, p. 85-101, 2019.

LOPEZ, F.; SILVA, T. **O carrossel burocrático nos cargos de confiança**: análise de sobrevivência dos cargos de direção e assessoramento superior do Executivo federal brasileiro (1999-2017). Brasília: Ipea, 2020. (Texto para Discussão, n. 2597).

MACLEOD, R. Introduction. **Osiris**, v. 15, p. 1-13, 2000. (Nature and Empire: Science and the Colonial Enterprise). Retrieved from: <<https://bit.ly/3u1rdHq>>.

MARQUES, R. A. **O desenvolvimento da capacidade para inovação**: as pequenas e médias empresas do setor aeronáutico brasileiro. 2011. Tese (Doutorado) – Universidade Federal da Bahia, Salvador, 2011.

MASCARELLO, J. International cooperation in science, technology and innovation in the context of the global covid-19 pandemic. **Revista Mundorama**, Apr. 2020.

MASTANDUNO, M. Do relative gains matter? America's response to Japanese industrial policy. **International Security**, v. 16, n. 1, p. 73-113, 1991.

MASTANDUNO, M.; LAKE, D. A.; IKENBERRY, G. J. Toward a realist theory of state action. **International Studies Quarterly**, v. 33, n. 4, p. 457-474, 1989.

MAYER, M.; CARPES, M.; KNOBLICH, R. **The global politics of science and technology**: an introduction. London: Springer, 2014. p. 1-35.

MIGDAL, J. S. Internal structure and external behaviour: explaining foreign policies of third world States. **International Relations**, v. 4, n. 5, p. 510-526, 1972.

_____. **Strong societies and weak states**: state-society relations and state capabilities in the third world. Princeton: Princeton University Press, 1988.

MILNER, H. V. **Interests, institutions, and information**: domestic politics and international relations. Princeton: Princeton University Press, 1997.

MORAVCSIK, A. Armaments among allies: European weapons collaboration, 1975-1985. In: EVANS, P. B.; JACOBSON, H. K.; PUTNAM, R. D. (Ed.). **Double-edged diplomacy**: international bargaining and domestic politics. Berkeley: University of California Press, 1993. p. 128-167.

MORGENTHAU, H. J.; THOMPSON, K. W. **Politics among nations**: the struggle for power and peace. 6th ed. Beijing: Peking University Press, 2004.

MOUZON, J. C. **Final report**: the University of Michigan-AID Brazilian program at the Instituto Tecnológico de Aeronáutica – contract AID/LA-81 (Brazil). Ann Harbor: Bentley Historical Library; University of Michigan, 1967.

NYE, J. S. **The future of power**. New York: PublicAffairs, 2011.

PUTNAM, R. D. Diplomacy and domestic politics: the logic of two-level games. **International Organization**, v. 42, n. 3, p. 427-460, 1988.

RAJ, K. When human travelers become instruments: the Indo-British exploration of Central Asia in the nineteenth century. In: BOURGUET, M.; LICOPPE, C.; SIBUM, H. (Ed.). **Instruments, travel and science: itineraries of precision from the seventeenth to the twentieth century**. New York: Routledge, 2002.

RUFFINI, P. **Science and diplomacy: a new dimension of international relations**. Gewerbestrasse: Springer, 2017.

_____. Conceptualizing science diplomacy in the practitioner-driven literature: a critical review. **Humanities and Social Sciences Communications**, v. 7, n. 124, p. 1-9, 2020. Retrieved from: <<https://bit.ly/3x4pd3g>>.

SKOLNIKOFF, E. **The elusive transformation: science, technology, and the evolution of international politics**. Princeton: Princeton University Press, 1993.

SLY, M. J. H. **A cooperação científico-tecnológica sino-argentina e sino-brasileira: os casos do laboratório virtual (Labex) da Embrapa em Beijing e do Centro Binacional China-Argentina de Ciência e Tecnologia de Alimentos**. 2017. Dissertação (Mestrado) – Universidade Federal de Santa Catarina, Florianópolis, 2017.

STRANGE, S. **States and markets**. 2nd ed. London: Continuum, 1994.

THE ROYAL SOCIETY. **New frontiers in science diplomacy: navigating the changing balance of power**. London: The Royal Society, 2010. (Policy Document, n. 01/10).

TURCHETTI, S.; ROBERTS, P. **The surveillance imperative: geosciences during the Cold War and beyond**. Basingstoke: Palgrave MacMillan, 2014.

UNITED STATES. Department of State Atomic Energy Files. Memorandum by Mr. Edmund A. Gullion to the under secretary of State (Acheson). In: _____. United States Department of State. **Foreign relations of the United States**. Washington: U. S. Government Printing Office, March 3, 1947. v. 1.

WAGNER, C. International collaboration in science and technology: promises and pitfalls. In: BOX, L.; ENGELHARD, R. (Ed.). **Science and technology policy for development: dialogues at the interface**. London: Anthem Press, 2006. p.165-176.

_____. **The new invisible college**. Washington: Brookings Press, 2008.

WAGNER, C.; PARK, H. W.; LEYDESDORFF, L. The continuing growth of global cooperation networks in research: a conundrum for national governments. **PLoS ONE**, v. 10, n. 7, 2015. Retrieved from: <<https://bit.ly/3N0hHMa>>.

WALTZ, K. N. **Theory of international politics**. Boston: Addison-Wesley Publishing Company, 1979.

WEISS, C. Science, technology and international relations. **Technology in Society**, n. 27, p. 295-313, 2005.